Technical Memorandum

DATA SUMMARY
MCLAREN PIT, COMO BASIN,
AND
GLENGARRY AND GOLD DUST ADIT AREAS
NEW WORLD MINING DISTRICT

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1.0 INTRODUCTION

This document summarizes environmental information collected at the New World Mining District (District) located in southern Park County, Montana. A substantial amount of environmental data have been collected throughout District by numerous investigators including the Montana Department of Natural Resources and Conservation (DNRC), Montana Bureau of Mines and Geology (MBMG), USDA Forest Service, US Environmental Protection Agency (EPA), and Crown Butte Mining, Inc. (CBMI). This report was prepared to:

1) Summarize pertinent findings of previous investigators,

2) Develop conceptual models of contaminant source areas and migration pathways to aid in the evaluation of alternatives in annual Engineering Evaluation/Cost Analysis (EE/CAs),

3) Identify any data gaps that exist.

This data summary focuses on surface water, groundwater, and geochemical features of the McLaren Pit area, Daisy Creek, Como Basin, and Fisher Creek.

2.0 MCLAREN PIT AREA

The McLaren Pit is located on the southwest side of Fisher Mountain at the headwater of Daisy Creek (Figure 1). Approximately 335,000 tons of sulfide ore were mined from the McLaren deposit from 1934 to 1953 (URS 1998). The McLaren ore body was initially mined by driving five exploration tunnels a short distance into the deposit (Kirk 1999). Most of the underground workings were subsequently removed when open cut mining methods were employed. One collapsed, discharging adit daylights near the northern perimeter of the McLaren Pit area. Based on review of historical maps of the original underground workings, one or more short tunnel segments may still exist beneath the headwall east of the current pit area.

Ore was stripped from open cuts and waste rock was pushed back into the cuts as mining proceeded into the headwall. Ore from the McLaren mine was processed at the McLaren mill, located at the headwater of Soda Butte Creek in Cooke City. Mining at the McLaren Pit ceased when the mill shut down in 1953. Roads and waste rock piles left in the pit resulted in poor drainage, which promoted ponding and trapped run-on originating on Fisher Mountain to the east.

From 1973 to 1975, the MBMG, under contract to DNRC, conducted a hydrological study in the District to quantify sources of surface and groundwater degradation in the area (DNRC 1977). Based on results of this investigation, the DNRC recommended that the McLaren Pit area be recontoured and revegetated to eliminate ponding, promote run-off, and reduce infiltration. DNRC also recommended constructing a lined diversion channel around the pit area to prevent surface water from running on to the pit. Based on these recommendations, CBMI conducted surface restoration work in the McLaren Pit area from 1993 to 1996. Restoration work included recontouring the McLaren Pit to approximate pre-mining conditions, constructing diversion ditches to divert run on and minimize infiltration into the waste rock, and liming, fertilizing and seeding disturbed areas with native grass species. With the exception of periodic fertilizing and ditch maintenance, no reclamation work has been completed in the McLaren Pit area since 1996.

2.1 Geology

Geologic units in the McLaren Pit area include waste rock, the Fisher Mountain Intrusive Complex, Meagher Limestone, and Wolsey Shale. Tertiary-age Fisher Mountain Intrusive rock is present in lenses along Meagher Limestone and Wolsey Shale formation contacts. Ore-forming fluids, enriched in sulfur, iron, copper, gold, and other metals, accompanied emplacement of the intrusive rock (URS 1998). The reaction of the highly corrosive fluids with lime-rich units formed the skarn mineral deposits of Fisher and Henderson Mountains. The Meagher Limestone is the principal host rock for skarn deposits in the McLaren Pit area.

The McLaren ore deposit is a near-surface, massive sulfide replacement skarn located at the headwater of

Daisy Creek. Ore-grade mineralization occurs primarily within the Meagher formation where it is in contact with the Fisher Mountain Intrusive Complex. The deposit is bounded to the northwest by the Crown Butte fault. The ore body extends approximately 600 feet from its contact with the Fisher Mountain Intrusive Complex (northeast to southwest) and about 3,000 feet along the strike of the intrusive (northwest to southeast). Mineralization also occurs within the upper 20 feet of the Wolsey Shale and within some of the Tertiary-age dikes and sills that intrude the sedimentary deposits.

2.2 Surface Water

The McLaren Pit is located at the head of Daisy Creek, a perennial stream that collects water from the north side of Daisy Pass, the north flank of Crown Butte, and the west flank of Fisher Mountain (Figure 1). Daisy Creek flows northwesterly from its origin for approximately two miles where it joins the Stillwater River. The Stillwater River flows north-northeast through the Absaroka-Beartooth Wilderness Area and eventually empties to the Yellowstone River at Columbus, Montana, about 55 miles from the District.

2.2.1 Flow

Flow measurements and water samples have been collected on a periodic basis from as many as nine different locations on Daisy Creek by various investigators from 1974 to the present. The most frequent water quality and flow data were collected by the DNRC during 1974/1975 at station DNRC-109 and by Hydrometrics during 1995/1996 at station DC-2, located approximately 1,200 feet downstream from station DNRC-109 (Figure 2). During 1999, Maxim collected water samples at station DC-2. Base-flow conditions typically occur in Daisy Creek from November to about mid-May. Flows begin to increase during mid-May at the commencement of snowmelt, with peak flows typically occurring during early to mid-July.

Base flow in the upper reaches of Daisy Creek is typically less than 0.1 cubic feet per second (cfs) while peak flows range from 10 to 15 cfs at station DC-2. Due to various factors (e.g. measurement methods, time and temperature at time of sampling, precipitation, snowpack, etc.), it is difficult to compare peak flows measured during 1975 to those measured during the 1990's. However, it appears peak flows in Daisy Creek may have increased since reclamation work at the McLaren Pit was completed. Flow data also indicate annual discharge volumes in Daisy Creek may have increased since the McLaren Pit reclamation work was completed. Based on 12 measurements recorded by DNRC during 1974/1975, URS (1998) calculated that approximately 528 acre-feet passed station DNRC-109. Of this, 413 acre-feet, or 78% of the total annual discharge occurred during snowmelt runoff (May 15 through August 5). Based on 12 measurements recorded during the 1995/1996 water year, the total annual discharge at station DC-2 was 1,157 acre-feet, of which 1,079 acre-feet, or 93% occurred during spring run-off (URS 1998). It is unlikely that an increase of more than 100% of annual flow in Daisy Creek can be attributed solely to the reclamation work completed in McLaren Pit. Other factors, including snow pack, frequency of flow measurements, time of day, measurement location, as well as others, also contributed to the calculated increase in total annual flow.

2.2.2 Water Quality

Graphs of selected metals and flow for two stations on Daisy Creek (DC-2 and DC-5) and one station on the Stillwater River (SW-7) are graphically presented and tabulated in Appendix A. From review of the graphs, it is evident that an inverse relation between metals concentrations and flow occurs in Daisy Creek. The lower metals concentrations during runoff are attributable to dilution. However, dilution during high flow events is not as profound as would be expected because considerable metals are flushed into Daisy Creek during runoff events (URS 1998). From the graphs, it is difficult to ascertain whether metals concentrations in Daisy Creek have decreased since the reclamation work because the graphs contain data from both high and low flow events, which tend to mask obvious trends in the data.

Scatter plots relating selected metals concentrations to pH, specific conductance, and flow for certain surface water stations in the District are included in Appendix B. The scatter plots show that metals concentrations correlate relatively well to specific conductance, as compared to correlations between metals and pH or flow.

Figure 1

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Figure 2

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Data presented on the scatter plots were sorted by separating pre-1995 data from post 1995 data to help discern if metals concentrations in Daisy Creek decreased since reclamation work in the McLaren Pit was completed. With few exceptions, metals concentrations are lower for post-1995 as compared to pre-1995 data, indicating metals concentrations in Daisy Creek have decreased, to some degree, since the reclamation work was completed.

Selected flow, pH, and metals data collected at stations DC-2 and DC-5 are presented in Table 1. These data only represent fall data obtained on Daisy Creek during comparable low flow conditions. Review of Table 1 shows metals concentrations at both stations DC-2 and DC-5 dropped considerably during September 1999 as compared to previously collected data. The lower metals concentrations measured in Daisy Creek during September 1999 may be attributable to improved groundwater quality resulting from the McLaren Pit reclamation work. Crediting the lower metals concentrations measured in Daisy Creek during September 1999 to the 19931-1995 McLaren Pit reclamation work would suggest groundwater emanating from the McLaren Pit does not daylight to Daisy Creek for a period of approximately four years. Future low flow data collected on Daisy Creek will serve to support or refute this premise.

TABLE 1
SELECTED METALS DATA FOR DAISY CREEK
FALL LOW FLOW SAMPLE EVENTS

Date	Flow	pH	Aluminum	Copper	Iron	Manganese	Zinc
DC-2							
10/89	0.20	2.90	N.M.	7.89	28.26	3.37	1.03
9/94	N.M.	N.M.	25.00	7.44	23.6	3.59	1.20
9/95	0.19	3.30	22.00	6.33	16.2	2.99	0.89
9/96	0.18	3.10	20.20	6.22	15.6	2.72	0.89
9/99	0.46	3.8	12.4	3.98	13.6	1.93	0.6
DC-5							
10/89	0.37	5.20	N.M.	2.54	6.88	1.16	0.4
9/93	0.54	5.80	5.3	2.17	4.68	1.2	0.36
8/94	0.24	5.60	8.10	2.85	5.7	1.23	0.42
9/95	0.42	5.40	7.70	2.45	2.38	1.18	0.39
9/96	0.31	5.40	7.20	2.62	4.42	1.08	0.37
9/99	1.48	7.5	4.00	1.26	2.67	0.5	0.17

Notes: Flow in cubic feet per second.
Metals are total recoverable metals in mg/l.

URS (1998) calculated annual metals loading in Daisy Creek using data collected by the DNRC during 1974-1975 and Hydrometrics during 1995-1996. Annual metal loads calculated by URS are considered to be rough approximations because the total annual loads were calculated using flow and chemistry data that were collected only periodically (12 sample events). These data were extrapolated to represent loads transported throughout a continuous year. Based on URS' calculations, annual copper, iron, and aluminum loads in Daisy Creek during 1995-1996 appear to have decreased by 42, 75, and 39 percent, respectively from that calculated for the 1974-1975 water year.

Water quality data collected on Daisy Creek by Maxim during 1999 are presented on Table 2 along with applicable water quality standards. Aluminum, copper, and zinc exceeded acute and chronic aquatic standards at upstream stations DC-2 and DC-5 during both the May and July sampling events. Copper was the only metal to exceed acute aquatic standards at downstream station SW-7 during both events. Copper at upstream station DC-2 during May (low flow) was the only metal measured at a concentration above human health standards.

2.3 Groundwater

Groundwater occurs in two general hydrostratigraphic units in the McLaren Pit area: unconsolidated material and consolidated bedrock. Unconsolidated material in the area is thin relative to bedrock units and is primarily composed of mine waste rock, colluvium, alluvium, and glacial deposits. Waste rock in the McLaren Pit area ranges from 0 to 30 feet with an average thickness of approximately 15 feet (URS 1998). Three monitoring wells in the McLaren Pit area are screened in unconsolidated waste rock (EPA-3, EPA-4, and EPA-7, Figure 3). Groundwater flow through unconsolidated material is usually more predictable than groundwater flow through bedrock units. The permeability of waste rock in the area appears to be lower than that of underlying and adjacent bedrock units but the porosity and storage capacity of the waste rock is higher than that of bedrock. Aquifer tests have not been conducted in wells completed in waste rock at the McLaren Pit. Using water level data measured in monitoring wells during the falling limb of the hydrograph, URS (1998) estimated the hydraulic conductivity of waste rock to be on the order of 1×10^{-3} cm/sec. This value is consistent with hydraulic conductivities associated with poorly sorted, fine-grained, clayey material.
Bedrock monitoring wells in the McLaren Pit area are screened in Tertiary-aged Fisher Mountain Intrusive rocks (EPA-2, EPA-5, EPA-6, EPA-11, Tracer -2), Wolsey Shale (EPA-1, EPA-9, MW-2, MW-3), and Meagher Limestone (EPA-8, EPA-10). Primary porosity and permeability of bedrock in the area (Meagher Limestone, Wolsey Shale and Fisher Mountain Intrusive) are generally low, and as a result, groundwater flow in bedrock is controlled by secondary permeability developed along fractures and joints. Because the effective porosity of bedrock is low, the velocity of groundwater movement in bedrock is high, relative to unconsolidated material. Aquifer tests have not been conducted in bedrock wells completed in the McLaren Pit area. Based on water level fluctuations that occur in response to snowmelt and water level recovery rates measured after groundwater sampling, it appears the hydraulic conductivity of the Meagher Limestone is higher than that of the underlying Wolsey Shale. This is attributable, in part, to alteration zones within the Meagher Limestone where the limestone has been replaced by sulfide skarn. Overall, the hydraulic conductivity of Fisher Mountain Intrusive, Meagher Limestone, and Wolsey Shale rocks are low, probably in the range of 1×10^{-4} to 1×10^{-5} cm/sec.

2.3.1 <u>Groundwater Flow</u>

Previous investigators (URS 1998 and USFS, unpublished) have estimated that between 50 to 75 percent of rain and snow that falls on the McLaren Pit area infiltrates. Based on water levels measured during 1996-1997, wells completed in waste rock in the McLaren Pit go dry in late fall. As with all monitoring wells in the area, water levels are highest during July as a result of recharge from snowmelt. When saturated, groundwater within the waste rock flows to the southwest where it discharges via seeps in the headwater of Daisy Creek. To a lesser extent, some groundwater hosted within the McLaren Pit waste rock also migrates vertically into underlying bedrock units of Meagher Limestone, Fisher Mountain Intrusive, and Wolsey Shale. Groundwater that moves into the underlying bedrock units ultimately discharges to Daisy, Fisher, and Miller creeks.

Figure 3

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TABLE 2
COMPARISON OF SURFACE WATER RESULTS TO STANDARDS
DAISY CREEK DRAINAGE SAMPLING STATIONS
1999 MONITORING EVENTS

Parameter (mg/l)	Aquatic Life (acute)	Aquatic Life (chronic)	Human Health Standard	DC-2			DC-5				SW-7			
				May-99	Jul-99	Sep-99	Temporary Water Quality Standard	May-99	Jul-99	Sep-99	Temporary Water Quality Standard	May-99	Jul-99	Sep-99
Aluminum	0.75	0.087	NA	9.2	3.7	12.4	**9.510**	1.4	1.2	4.0	**0.670**	0.4	0.4	<0.1
Cadmium	0.002067(1)	0.001429(1)	0.005	0.0038	0.0012	0.0044	**0.004**	0.0006	0.0004	0.0012	**NA**	<0.0001	0.0001	<0.0001
Copper	0.0073(1)	0.00529(1)	1.3	1.94	1.07	3.98	**3.530**	0.33	0.31	1.26	**0.200**	0.008	0.064	<0.001
Iron	NA	1	NA	16	4.83	13.6	**6.830**	0.65	1.54	2.67	**1.320**	0.62	0.53	0.42
Lead	0.082(2)	0.0032(2)	15	0.006	0.002	0.002	**NA**	0.001	0.001	0.002	**0.013**	<0.001	<0.001	<0.001
Manganese	NA	NA	NA	1.61	0.37	1.93	**1.710**	0.25	0.124	0.50	**0.086**	0.036	0.027	0.023
Zinc	0.067(1)	0.067(1)	2.1	0.51	0.15	0.60	**0.540**	0.08	0.07	0.17	**0.049**	<0.01	0.02	0.03
pH (s.u.)	NA	NA	NA	4.5	5.2	3.8	**4.6**	7.6	7.7	7.5	**5.5**	7.1	7.9	7.5
Flow (cfs)	NA	NA	NA	0.028	9.46	0.46	NA	1.18	23.82	1.48	NA	6.48	111.83	2.49

NOTES:

Shading/coloring indicates exceedance of respectively shaded/colored regulatory standard

*	All metals are reported as Total Recoverable Metals
mg/l	Milligrams per liter
(s.u.)	Standard unit
(cfs)	Cubic feet per second
<	Indicates analyte not detected above laboratory Practical Quantitation Limit (PQL)
(1)	Based on 50 mg/l hardness
(2)	Based on 100 mg/l hardness

Comparison of water levels in wells completed in waste rock to water levels in wells completed in underlying bedrock formations indicates there is usually a downward hydraulic gradient from waste rock to the underlying Meagher Limestone (see Figure 4). The downward gradient from waste rock to underlying bedrock is greatest during snowmelt (May-June). Two measurements; however, obtained during late July 1997 and 1999, indicated there was an upward gradient from the Meagher Limestone (well EPA-10) to waste rock (well EPA-4). Upward flow from bedrock to waste rock was also confirmed during the Phase II tracer study completed during 1998 when dye injected into well Tracer-2, completed in Fisher Mountain Intrusives, was recovered in well EPA-4, completed in waste rock.

When groundwater levels are at or near seasonal lows, there is an upward gradient from the Wolsey Shale into the Meagher Limestone (URS 1998). This gradient appears to reverse during late May through July as a result of snowmelt recharge.

2.3.2 Groundwater Quality

Since 1996, five comprehensive groundwater sampling events have been completed in the McLaren Pit area:

- October 1996
- May 1997
- July 1997
- May 1999
- July 1999

Water samples were also collected from older, Crown Butte Mining monitoring wells (MW-series) periodically from 1989 through 1995. Groundwater quality data for wells in the McLaren Pit area are summarized in Table 3. Review of these data show that in general, groundwater quality in the McLaren Pit area improves with depth and groundwater quality is poorest when water levels are at seasonal highs. Groundwater intercepted by wells completed in waste rock is typically the most acidic, with average pH values ranging from 2.4 in well EPA-4 to 2.9 in well EPA-3. The average pH of water intercepted by wells screened in the Meagher Limestone ranged from 3.4 to 3.9, with the lowest pHs occurring during July (high groundwater). The pH of Wolsey Shale wells (EPA-1, EPA-9, and MW-2) ranged from 2.8 in well MW-2 to 6.8 in well EPA-9. Fisher Mountain Intrusive wells (EPA-5 and EPA-6) intercept water with pHs ranging from 3.4 to 5.5 with the highest pH values occurring during May (low groundwater conditions). As expected, dissolved metals concentrations correlate inversely with pH values.

With the exception of well EPA-2 (completed in Fisher Mountain Intrusive and Wolsey Shale formations), dissolved metals concentrations in all McLaren Pit area wells decrease with depth. The highest concentrations of dissolved aluminum, copper, and zinc occur in well EPA-4, which is completed in waste rock. The highest dissolved iron concentrations occur in well EPA-10, completed in the Meagher Limestone.

Well EPA-2 is completed at a total depth of 112 feet and is reportedly screened in Wolsey Shale and a lens of Fisher Mountain Intrusive. Metals concentrations in this well are typically higher than those in other wells completed in Wolsey Shale and Fisher Mountain Intrusive. Abnormally high concentrations of aluminum, copper, iron, and zinc were measured in samples collected from this well during May 1997 when the pH in the well was 2.9. The chemistry of well EPA-2 appears to be similar to the chemistry of wells completed in the Meagher Limestone.

By comparing surface water quality in Daisy Creek to groundwater quality in the McLaren Pit area, it appears the chemistry of Daisy Creek is similar to the chemistry of water hosted by rocks of the Fisher Mountain Intrusive. Most metals concentrations in wells completed in waste rock and the Meagher Limestone are significantly higher than metals concentrations in Daisy Creek.

Figure 4

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TABLE 3
McLaren Pit Area
1999 Groundwater Monitoring Comparison

Sample Location	Sample Date	Laboratory Parameters							
			Dissolved Metals						
		pH (S.U)	Aluminum (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Iron (mg/l)	Lead (mg/l)	Manganese (mg/l)	Zinc (mg/l)
Waste Rock									
EPA-3	07/28/99	2.7	31.00	0.0036	12.600	135.0	0.006	1.31	0.73
EPA-3	**MAX***	3.0	31.20	0.0084	13.600	140.0	0.015	2.50	1.26
EPA-3	**MIN***	2.7	0.52	0.0020	0.007	0.0	0.002	0.06	0.03
EPA-3	**MEAN***	2.9	20.91	0.0047	8.736	91.7	0.008	1.29	0.67
EPA-4	07/28/99	2.4	97	0.0220	41.000	383.0	< 0.001	10.00	4.14
EPA-4	**MAX***	2.4	111	0.0310	44.400	439.0	0.015	10.60	4.14
EPA-4	**MIN***	2.3	81.7	0.0220	34.500	197.0	0.001	9.31	3.41
EPA-4	**MEAN***	2.4	92.6	0.0252	38.600	329.6	0.005	9.86	3.78
EPA-7	07/09/97		20.3	< 0.0050	1.240	5.90	< 0.003	J 0.155	0.09
EPA-7	05/11/99	Dry							
EPA-7	07/27/99	Not Sampled							
Fisher Mountain Intrusive									
EPA-5	07/29/99	3.6	65.0	0.0010	10.200	71.8	0.003	0.48	0.23
EPA-5	**MAX***	3.6	72.8	0.0050	11.900	78.7	0.003	0.54	0.23
EPA-5	**MIN***	3.5	63.7	0.0010	2.750	70.7	0.002	0.48	0.18
EPA-5	**MEAN***	3.6	66.3	0.0023	6.973	75.0	0.003	0.52	0.20
EPA-6	05/11/99	3.8	49.9	0.0010	0.400	64.4	0.002	0.58	0.21
EPA-6X	05/11/99	3.8	51.9	0.0009	0.430	67.6	0.001	0.61	0.22
EPA-6	07/27/99	3.6	45.0	0.0008	0.800	57.6	0.001	0.48	0.22
EPA-6X	07/27/99	3.6	45.0	0.0008	0.780	57.5	0.002	0.48	0.20
EPA-6	**MAX***	5.5	64.0	0.0200	6.090	69.5	0.006	0.74	0.22
EPA-6	**MIN***	3.4	45.0	0.0001	0.001	0.0	0.001	0.01	0.01
EPA-6	**MEAN***	4.1	40.0	0.0031	1.824	46.9	0.002	0.43	0.16
Meagher Limestone									
EPA-8	05/10/99	4.1	26.1	0.0250	16.000	43.8	0.008	12.80	2.48
EPA-8	07/28/99	3.6	59.0	0.0380	33.500	72.4	0.003	11.30	3.02
EPA-8	**MAX***	4.2	69.4	0.0380	40.400	94.0	0.030	13.00	3.20
EPA-8	**MIN***	3.5	26.1	0.0225	16.000	43.8	0.003	11.30	2.48
EPA-8	**MEAN***	3.9	52.5	0.0264	29.967	72.8	0.011	12.25	2.90
EPA-10	05/12/99	3.7	25.7	0.0140	5.000	237.0	0.012	5.41	1.97
EPA-10	07/28/99	3.2	59.0	0.0180	25.800	357.0	0.009	8.43	3.28
EPA-10	**MAX***	3.7	72.9	0.0448	34.800	448.0	0.046	11.90	3.77
EPA-10	**MIN***	3	25.7	0.0140	5.000	237.0	0.009	5.41	1.97
EPA-10	**MEAN***	3.4	52.6	0.0242	22.317	356.3	0.026	8.61	3.08

TABLE 3 (Continued)
McLaren Pit Area
1999 Groundwater Monitoring Comparison

Sample Location	Sample Date	Laboratory Parameters							
			Dissolved Metals						
		pH (S.U)	Aluminum (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Iron (mg/l)	Lead (mg/l)	Manganese (mg/l)	Zinc (mg/l)
Wolsey Shale									
EPA-1	05/10/99	4.7	11.9	0.0080	0.180	163.0	0.050	5.13	
EPA-1	07/27/99	4.5	14	0.0094	0.740	239.0	0.044	6.92	2.26
EPA-1	**MAX***	4.7	18.5	0.0250	2.230	449.0	0.112	11.70	3.16
EPA-1	**MIN***	4.1	11.9	0.0080	0.180	163.0	0.044	5.13	1.78
EPA-1	**MEAN***	4.5	15.6	0.0126	0.786	236.8	0.076	6.74	2.35
EPA-2	07/28/99	3.8	38	0.0074	1.440	153.0	0.072	2.86	1.20
EPA-2	**MAX***	3.8	57.1	0.0223	23.500	292.0	0.204	5.36	3.71
EPA-2	**MIN***	2.8	19.7	0.0056	1.440	129.0	0.020	2.68	1.17
EPA-2	**MEAN***	3.2	34.38	0.0123	10.088	178.0	0.079	3.77	2.20
EPA-9	05/10/99	6.8	< 0.1	0.0004	< 0.001	41.5	< 0.001	1.31	0.17
EPA-9	07/28/99	6.6	< 0.1	< 0.0001	0.003	32.9	< 0.001	1.02	0.17
EPA-9	**MAX***	6.8	0.2	0.0050	0.010	48.0	0.003	1.49	0.19
EPA-9	**MIN***	6.3	0.0	0.0001	0.001	21.9	0.001	0.90	0.05
EPA-9	**MEAN***	6.6	0.1	0.0013	0.004	34.8	0.002	1.16	0.14
MW-2	05/12/99	3.9	34.4	0.0017	0.011	92.2	0.008	1.09	0.24
MW-2	07/27/99	3.7	36.0	0.0012	0.011	94.5	0.004	1.04	0.31
MW-2	**MAX***	4	51.0	0.0060	0.910	131.0	0.030	1.20	0.91
MW-2	**MIN***	2.8	34.4	0.0006	0.010	23.0	0.002	0.62	0.24
MW-2	**MEAN***	3.5	42.8	0.0026	0.348	100.8	0.013	0.99	0.48

Note:

* Max, Min, and Mean are calculated using entire hisorical data for each sample location presented

2.4 McLaren Pit Geochemistry

The source-pathway conceptual model shown in the Overall Work Plan (Maxim 1999) for the McLaren pit is based on ARD-producing interaction of oxygen-rich surface water from run-on and groundwater with sulfides in waste rock and the mineralized pit highwall and floor. ARD produced in this manner impacts Daisy Creek downgradient of the pit, and impacts groundwater during spring snowmelt. Regional groundwater flow from Fisher Mountain toward McLaren Pit does not appear to interact with waste piles, so metal loading in groundwater is primarily attributable to flushing of waste by snow melt and precipitation.
Skarn and replacement mineralization occurs in the Meagher Limestone along the contact with the Fisher Mountain intrusive. Less significant mineralization occurs in vein deposits in the upper Wolsey shale and in intrusive rocks. The hydrothermally altered and replaced portions of the Meagher Limestone contain massive sulfide and oxide mineralization, whereas contact metamorphism has produced biotite hornfels and micritic limestone beds in other areas adjacent to the intrusive.

2.4.1 Data Summary

The available ARD data for McLaren deposit wastes and pit are summarized in Table 4. Available metals data are contained in Appendix C. Sources of these data are summarized below:

ARD Geochemistry
Crown Butte Data Base
DEQ Database
1991 Bechtel samples 88-130, 88-298, 88-78, 88-426, 88-103, 89-298
MDSL AMR Inventory
Grass Land technical memo(Pre-McLaren reclamation surface pH, ABP, lime requirement data)

Metal/mobility

MDSL AMR Inventory – total metals
Crown Butte Mines Baseline data, leachability data

The source inventory completed by George Furniss for CBMI in 1996 provides a summary of rock types and styles of mineralization in McLaren waste piles, and documents a series of waste rock samples which will be analyzed during 1999. Historic Noranda/Crown Butte Mines mapping and drilling data are also useful in understanding the geological factors affecting geochemical processes. Geochemical data characterizing the in-situ remedial action taken by Crown Butte in 1994-1995, as well as data characterizing USFS vegetation impacts on soil pH, metal contents have also been identified.

The inherent complexities of McLaren wastes are obvious from the number of lithologies and range of mineralization described in Table 4. Field review of rock types and mineralization is particularly important at McLaren as there is very little available geochemical data about the Meagher limestone, which is a key component of the McLaren deposit. Histograms summarizing the variance in key ARD geochemical predictors for the McLaren wastes (Figure 5) show a more trimodal distribution, with a group of samples with very low ABP, a few samples around an ABA of 0, and one sample with a strongly neutralizing potential. The variation appears to be controlled by distribution of minerals with NP (Figure 6), as the AP distribution is bimodal (Figure 7). The observed modality in the distributions may also simply represent undersampling of a relatively normal distribution in ABP characteristics. The floor of the McLaren Pit is strongly acid generating based on the available data, and is unimodal for the available samples (Figure 8). As shown in Table 4, wastes from this portion of the district are likely to range in acid generation potential, from slightly to strongly acid generating.

Because the floor of the McLaren pit is rich in sulfide mineralization, surface water recharge promotes further sulfide oxidation in the subsurface. Paradoxically, waste removal may expose bedrock with very high sulfide contents.

TABLE 4
Cross Referencing Waste Source Inventory with available ARD Geochemical Data
(See attached spreadsheet for calculations, no. samples in each group)

USFS Identifier	Name	Lithology	Stats Group	Average	NP	AP	ABA	Total S.	Material type
FCSI-96-2A,4,23,14	Glengary Adit, Dump, trench, Upper Glengary Dump	Fisher Mtn Intrusive	14	**No ID**	-3.5	491.2	-494.8	15.7	**Glengary waste**
FCSI-99-11; FCSI-96-9	Como Basin, small como dump	Meagher Ls/ Park Shale Fisher Mtn Intrusive Some acid sulfate mineralization	9	**Cp hi S** **Cp mod S** **Cp low S** **Ti hi S** **Ti mod S** **Ti low S** **Cm hi S** **Qg till**	23 22 31 9 7 41 13 1	503 67.5 53 372 134.5 30 254 44.1	-480 -45 -22 -363 -128 11 -241 -46.9	ND ND ND ND ND ND ND ND	**Como waste** 4 rock types, large range in sulfide mineralization, NP recommend more than 1 channel sample
DCSI-96-1,2,4; DCSI-99-28	McLaren mine, highwall, dumps, spoils	Meagher against FM Intrusive Some acid sulfate mineralization	11, 15	**Cw (floor)** **Ti (floor)** **Ti mod S** **Ti low S** **Cm low S** **Cp hi S** **Cp mod S** **Cp low S** **NO ID**	11.6 78 19 37 783 74 97 30 37.1	169.9 66.6 89.5 98.5 4 214 99 39 97	-158.3 11.4 -71 -62 779 -140 -2 -8 -60.3	ND ND ND ND ND ND ND ND 6.7	**McLaren waste** 4 rock types, large range in sulfide, NP mineralization recommend more than 1 channel sample
FCSI-96-1A	Gold Dust Mine and Dump	Replacement mineralization with disseminated S in carbonate blocks entrained in breccia	5	**INTBX hi S** **INTBX** **INTBX Cw** **PCg-altered** **PCg - fresh** **Tdp**	42 40 65.1 6 11 80.7	54.4 26.6 103.1 59.4 8.1 64.8	-12.4 13.4 -38 -53.4 2.9 16.0	ND ND ND ND ND ND	**Gold Dust waste** Recommend more than 1 channel sample
FCSI-99- 29, 32, 33, 35, 36; FCSI-96-10, 11	Fisher Mountain Dump	Fisher Mtn Intrusive in contact with Meagher Ls.	12 also 11,15	**No ID**	1.5	74.4	-73.1	2.4	**Fisher Mountain Waste** (like McLaren)
FCSI-99-69, 72, 61, 53, 74, 70, 38, 68, 62, 71, 73, 48, 75, 39, 71, 17, 43, 16	Henderson Mtn Dumps, Homestake adit, dumps, pit	Homestake deposit, Pilgrim Ls not Meagher in upper deposit	10, 13	**INTBA Cpi** **No ID**	182 31	142 77.2	39.75 -46.2	4.6 -2.45	**Homestake Cpi** only for upper portion of deposit that was mined historically
	FC2E alluvium	Alluvium	1	To be calculated later					Cover material Alluvium
	FC1E diversion/till; FC2E till	Till	6, 7						Cover material Till
	SB4-west bedrock	Intrusive, alluvium, pC gneiss Till	4 8						Repository foundation Repository cover
	FC2E borrow,FC1-E borrow	PCg, PCg (gneiss)	3,4						Borrow material – PCg

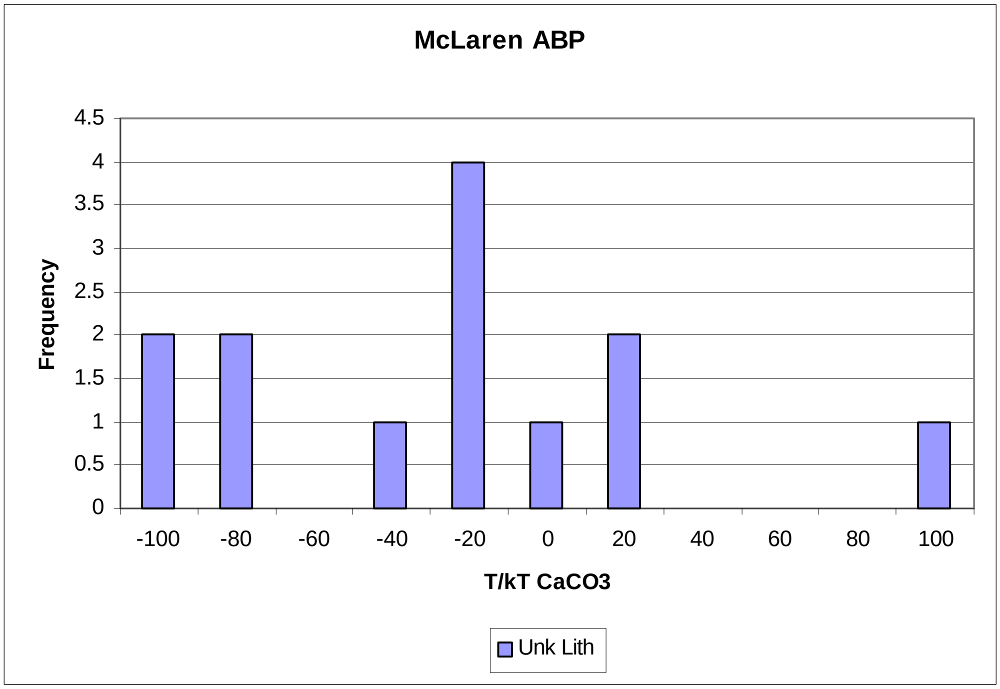

Figure 5. Histogram showing distribution of ABP values for McLaren Pit waste rock.

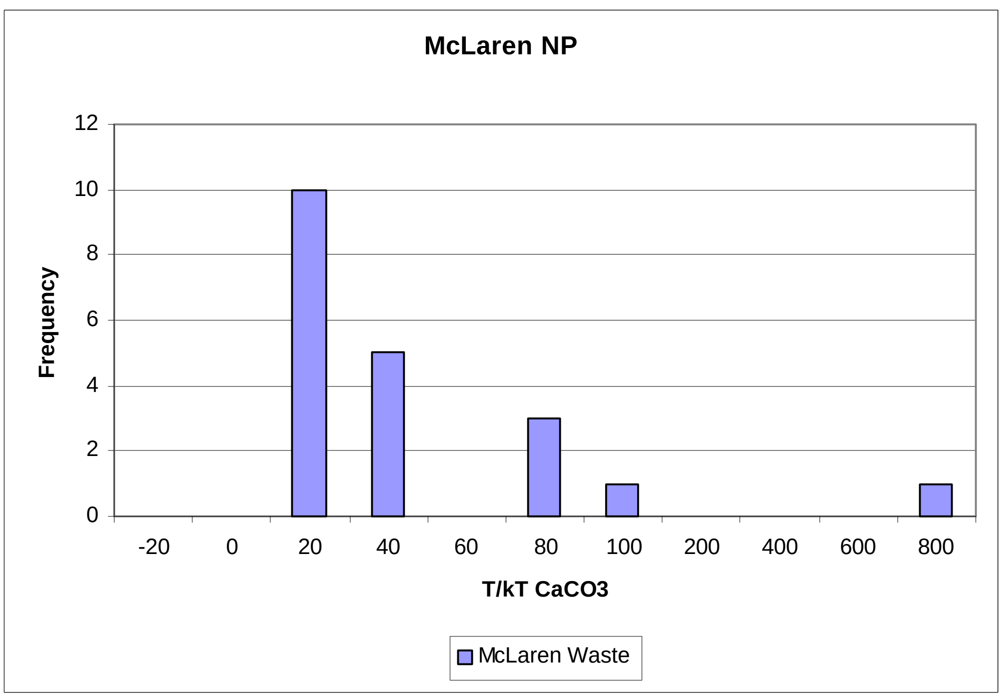

Figure 6. Histogram showing distribution of NP values for McLaren Pit waste rock.

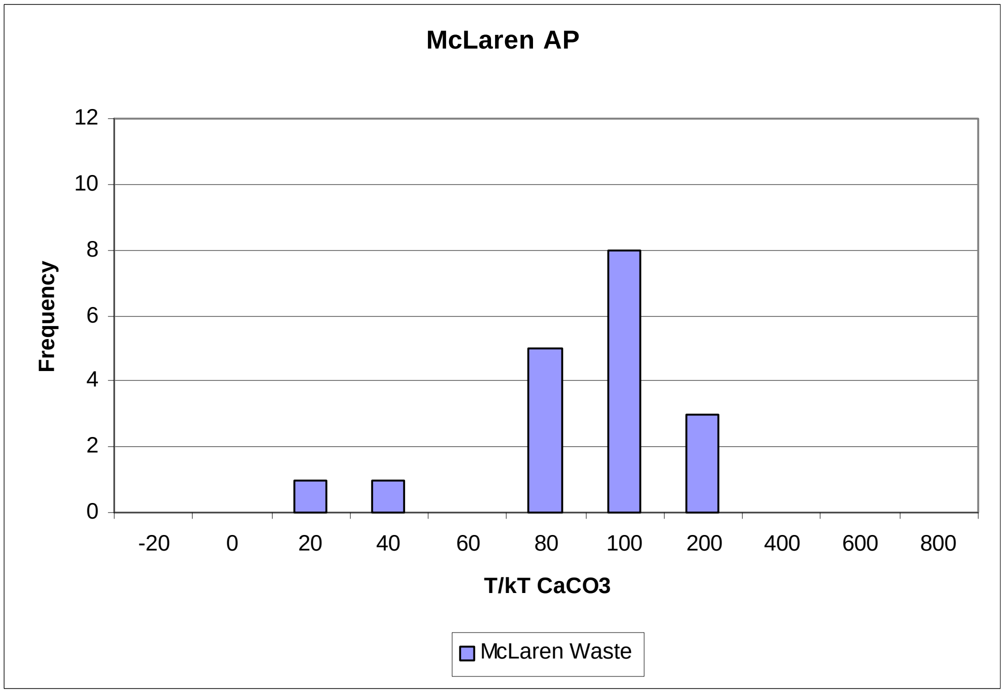

Figure 7. Histogram showing distribution of AP values for McLaren Pit waste rock.

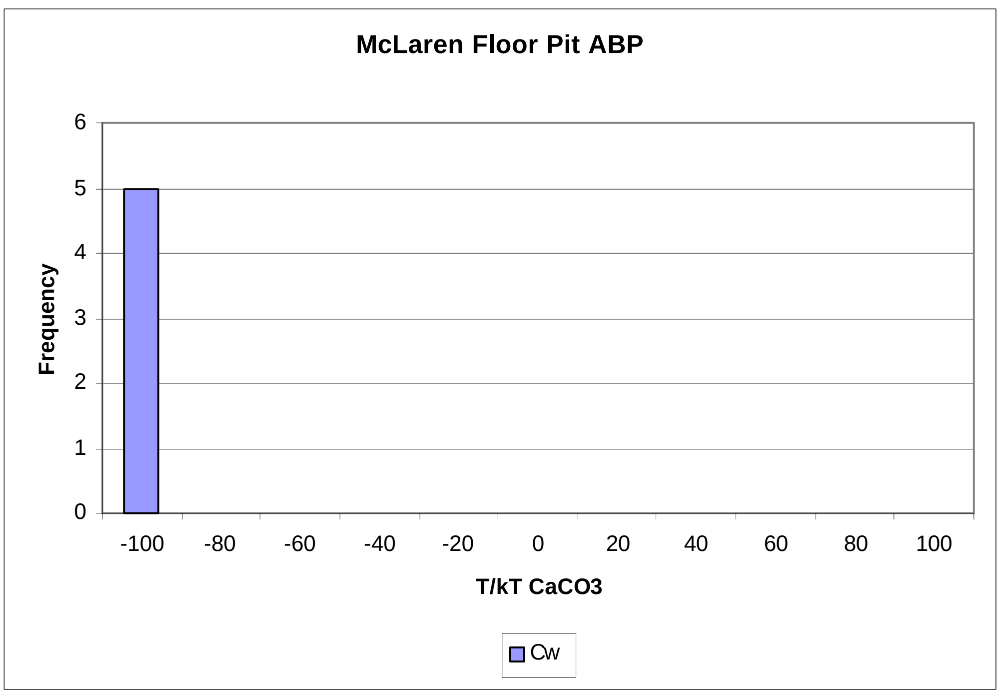

Figure 8. Histogram showing distribution of ABP values for McLaren Pit floor.

Total metal data are summarized in Appendix C for the McLaren deposit. They represent analyses conducted by the AMRB during its 1993 hazard ranking inventory, as well as lithology-specific analyses conducted by CBMI in 1990. Relative to the background analyses conducted by AMRB in 1993, the waste in the McLaren deposit is significantly enriched in average concentration of total As, Cd, Co, Cr, Cu, Fe, Hg, Mn, and Zn. No XRF data are available for the McLaren deposit. Leachability data presented in Appendix C show that much of the McLaren waste is capable of releasing Cu, Zn, Mn, Cd, Pb, and SO4 at concentrations of concern to receiving water.

2.5 Daisy Creek/McLaren Pit Data Gaps

Based on review of historical surface water and groundwater data obtained in the McLaren Pit area, and through comparison of these data with data recently collected by Maxim, it is our opinion the hydrology of the McLaren Pit area has been adequately characterized to direct future restoration activities in the area, with the following exceptions:

- URS (1998) indicated reclamation work completed by Crown Butte Mining from 1993 through 1995 resulted in significantly reduced metals loads to Daisy Creek. Flow in Daisy Creek is very dynamic due to the substantial volume of snowmelt runoff and extreme diurnal fluctuations that occur during spring and early summer. For these reasons, it is difficult to accurately measure annual discharge volumes in the drainage using periodic flow measurements because flow in the system can vary significantly from day to day and even from morning to late afternoon. The accuracy of calculating metal loads in Daisy Creek could be substantially improved if continuous flow data were collected on Daisy Creek and/or more frequent flow measurements are recorded and more frequent water samples collected for analysis.

  During several meetings held during the fall of 1999 with the USFS and various other state and federal agencies, Maxim recommended that continuous gaging stations be installed to improve the accuracy of calculated metals loads to Daisy Creek. Based on discussions that occurred during the most recent meeting, the USFS and other cooperating agencies agreed that loading data were not as important in monitoring the aquatic health of Daisy Creek as metals concentration data. Because of this, and because of difficulties associated with operating and maintaining a continuous gaging station at the New World project site, it was decided to collect water samples and measure flow on a more frequent basis during spring runoff than that scheduled under the long-term monitoring plan. In addition to increasing the frequency of surface water monitoring events during runoff, it was also decided to measure flow on as many as four occasions in a single day to document diurnal fluctuations. These increased monitoring efforts, scheduled for implementation during the spring runoff of 2000, should help improve the understanding of water quality and flow characteristics of Daisy Creek and provide additional data with which the effectiveness of future reclamation work can be assessed.

- The current conceptual model of groundwater flow in the McLaren Pit area is based on the premise that infiltration is the primary source of recharge to waste rock in the McLaren Pit, and little, if any, recharge to the waste rock is attributable to lateral or vertical flow from bedrock units. Metals-enriched water generated within the waste rock then migrates horizontally and vertically and ultimately discharges to Daisy Creek via seeps below McLaren Pit and via direct groundwater discharge to Daisy, Fisher, and Miller creeks. A key component of this conceptual model is the assumption that 50 to 75 percent of precipitation that falls on the McLaren Pit area infiltrates into the waste rock. If this conceptual model is accurate, then capping the McLaren Pit area would conceivably eliminate or reduce the volume of metals-enriched water generated within the waste rock. If, however, waste rock in the McLaren Pit area is also recharged by lateral or vertical flow from bedrock, then capping the McLaren Pit area may not improve the quality of water in Daisy Creek to the degree expected.

  In an effort to substantiate the current conceptual model of groundwater flow in the McLaren Pit area, it was decided to develop a water balance for the pit area. The water balance will be developed using infiltration rates obtained by a number of double ring infiltrometer tests completed in the pit area and hydraulic conductivities of the waste rock will be determined through grain size analyses.

- Limited additional geochemical sampling of the wastes, highwall, and adits in McLaren area are recommended, to verify available data and assist in characterizing the pit highwall and adit sources. Sampling programs should also be developed for adits and pit highwalls, which provides a basis for linking mapped rock type distributions with geochemical characteristics

3.0 COMO BASIN/GLENGARRY ADIT

Ore deposits in the Como Basin consist of massive sulfide replacement zones that are geologically similar to the McLaren deposit. Though much of the ore in the Como Basin is near surface, most historic mining activities in the Como Basin/Fisher Creek area were limited to relatively small underground workings, the most significant of which is the Glengarry Adit (see Figure 1). The Glengarry Adit was driven approximately 2,200 feet northwest under Como Basin. A southwest-trending adit extends from about 1,500 feet into the main Glengarry adit a distance of about 600 feet. This adit is connected to the surface by a two-compartment raise that daylights near the center of the main Como ore body. A small surface pit was reportedly excavated where this raise met the surface (Koerth 1999).

3.1 Geology

The geology of the Como Basin is dominated by rock of the Fisher Mountain Intrusive Complex and the Scotch Bonnet Intrusive Complex. Cambrian-age sedimentary rocks, including Park Shale, Meagher Limestone, and Wolsey Shale are present between the intrusive rocks. The Cambrian sedimentary rocks have been intruded by dikes and sills along vertical and near-vertical fractures. Cambrian-age Flathead Sandstone underlies blocks of the Park Shale, Meagher Limestone, and Wolsey Shale, and unconformably overly Precambrian granitic rock.

The Glengarry fault is a northeast-southwest trending structure with near vertical dip. The Glengarry fault cuts the center of Como Basin and it has been intruded by a late Tertiary-age dike. Blocks of the Meagher Limestone, downdropped along fault boundaries, were replaced by ore-forming fluids that accompanied emplacement of the Fisher Mountain Intrusive Complex. Ore deposits in Como Basin, including the Como and Glengarry deposits, are massive sulfide replacement ore bodies that are geologically similar to the McLaren deposit. Como Basin ore bodies are near surface, but previous mining activity in Como Basin were limited to underground workings, the most significant of which is the Glengarry adit.

The Glengarry adit was driven about 1,500 feet northwest under Como Basin, where it bifurcates. The main heading continues northwest for another 700 feet where it intersects the Glengarry fault. The southwest heading extends about 600 feet and cuts approximately 150 feet of the Glengarry fault. The southwest heading is connected to the surface near the center of the main Como ore body. Several short adits were also driven along the Glengarry structure on the south flank of Scotch Bonnet Mountain several hundred feet above and north of the termination of Glengarry adit. These workings, the Spalding Tunnels, penetrate replaced bocks of Meagher Limestone.

3.2 Surface Water

The Fisher Creek drainage collects water from the south side of Lulu Pass, the east flanks of Fisher and Henderson Mountains, and the west flanks of Scotch Bonnet and Sheep Mountains. Fisher Creek flows southeast for approximately 3.5 miles where it joins Lady of the Lake Creek to form the Clarks Fork of the Yellowstone River. The water quality of Fisher Creek is affected by natural acid rock drainage, acid drainage from specific point sources (most notably the Glengarry Adit), smaller discharging adits on Henderson and Scotch Bonnet Mountains, and surface disturbance near Lulu Pass.

3.2.1 Flow

Flow measurements and water samples have been collected at more than 20 locations on Fisher Creek and tributaries to Fisher Creek by various investigators from 1974 to the present. For this report, we focused our review on surface water data obtained at stations F-8A (Glengarry Adit), SW-3, SW-4, CFY-2, and SW-6

(Figure 2). Hydrographs for the upper reach of Fisher Creek (station SW-3) show that base flow conditions typically extend from late fall to about mid-May. Flow begins to increase during mid-May at the commencement of snowmelt, with peak flows typically occurring during early to mid-July. Base flow at station SW-3 is typically less than 0.5 cfs with peak flows typically ranging between 10 and 15 cfs. The highest flow at station SW-3 occurred on June 27, 1990 when a flow of 17.9 cfs was measured.

During base flow periods, discharge from the Glengarry Adit accounts for as much as one third of the total discharge at station SW-3. Base flow from the Glengarry Adit is typically about 0.04 cfs with peak flows measuring about 0.25 cfs. The highest discharge measured at the Glengarry Adit was 0.5 cfs on June 5, 1999. Yearly hydrographs for the Glengarry Adit show a pattern similar to those for Station SW-3, where the majority of discharge occurs during snowmelt. Like station DC-2 on Daisy Creek, 95% of the total annual discharge at station SW-3 occurs during snowmelt.

Fisher Creek is an effluent system, with flows increasing downstream as a result of groundwater seepage. During base flow, flows in Fisher Creek increase from less than 0.25 cfs at station SW-3 to about 0.5 cfs at station SW-4. Flows again appear to increase between station SW-4 to CFY -2 during baseflow, from about 0.5 cfs to about 1 cfs.

3.2.2 Water Quality

Graphs of selected metals and flow data for stations SW-3, SW-4, CFY-2, and SW-6 are graphically presented and tabulated in Appendix A. From review of water quality data collected at upstream station SW-3, it is apparent total metals concentrations in Fisher Creek peak during low flow conditions and decrease during high flow events, as a result of dilution. However, approximately 75% of the total metals load enters Fisher Creek during spring runoff.

Scatter plots relating selected metals concentrations to pH, specific conductance, and flow, for certain surface water stations in the District are included in Appendix B. As with the scatter plots generated with Daisy Creek data, metals concentrations in Fisher Creek correlate relatively well to specific conductance, as compared to correlations between metals and pH or flow.

Water quality data collected on Fisher Creek by Maxim during 1999 are presented on Table 5 along with applicable water quality standards. Review of Table 5 shows that water quality in Fisher Creek generally improves downstream, as none of the metals exceeded any water quality standards at downstream station CFY-2 during the May, 1999 event. However, aluminum and copper exceeded chronic aquatic life standards during July 1999.

Based on metals loads calculated by URS (1998), water quality in Fisher Creek did not appear to improve as a result of reclamation work completed in Como Basin, as total annual metals loads in Fisher Creek during 1995/1996 were similar to those calculated for the 1974/1975 water year. The most noticeable effect of reclamation work in Como Basin appears to be the reduction of total discharge from Glengarry Adit. During the 1995/1996 water year, total annual discharge from the adit was approximately 40% less than during the 1974/1975 water year.

In the upper reaches of Fisher Creek (above station SW-3), the Glengarry Adit contributes as much as 60% of the total iron load to Fisher Creek. For copper and aluminum, Glengarry Adit contributes about 20% of the total load. The balance of metals loading to upper Fisher Creek is attributable to runoff from Como Basin (FCT-11), an undisturbed area of Fisher Mountain (FCT-12), leachate from waste rock at the portal of Glengarry Adit (FC-2), minor workings on Scotch Bonnet and Sheep mountains, and groundwater inflow. Data collected by USGS (2000) and Amacher (1995) indicate a substantial contribution of metals loading to Fisher Creek occurs from between station SW-3 and FC-4, located about 2,000 feet downstream of SW-3. Table 6 summarizes the percentage of total load each of the primary source areas contribute to Fisher Creek for manganese, iron, copper, and aluminum.

TABLE 5
COMPARISON OF SURFACE WATER RESULTS TO STANDARDS
FISHER CREEK DRAINAGE SAMPLING STATIONS
1999 MONITORING EVENTS

Parameter (mg/l)	Aquatic Life (acute)	Aquatic Life (chronic)	Human Health Standard	SW-3			SW-4			CFY-2			
				May-99	Jul-99	Sep-99	May-99	Jul-99	Sep-99	Temporary Water Quality Standard	May-99	Jul-99	Sep-99
Aluminum	0.75	0.087	NA	3.9	1.5	3.1	<0.1	0.3	<0.1	**0.470**	<0.1	0.2	<0.1
Cadmium	0.002067(1)	0.001429(1)	0.005	0.0011	0.0002	0.0005	0.0004	0.0001	0.0003	**NA**	<0.0001	0.0001	0.0002
Copper	0.0073(1)	0.00529(1)	1.3	0.90	0.41	1.00	0.06	0.08	0.07	**0.110**	0.004	0.09	0.022
Iron	NA	1	NA	7.49	1.85	7.03	0.03	0.29	0.03	**0.750**	<0.01	0.23	0.04
Lead	0.082(2)	0.0032(2)	15	0.007	0.002	0.002	<0.001	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001
Manganese	NA	NA	NA	1.35	0.162	1.30	0.021	0.027	0.072	**0.082**	<0.005	0.019	0.017
Zinc	0.067(1)	0.067(1)	2.1	0.29	0.06	0.18	0.05	0.03	0.06	**0.044**	<0.01	0.04	0.04
pH (s.u.)	NA	NA	NA	3.4	4.2	3.3	6.7	7.1	7.1	**5.7**	7.1	7.2	6.9
Flow (cfs)	NA	NA	NA	0.22	7.53	0.31	0.42	45.706	1.46	NA	0.09	21.46	2.07

NOTES:

Shading/coloring indicates exceedance of respectively shaded/colored regulatory standard

*	All metals are reported as Total Recoverable Metals
mg/l	Milligrams per liter
(s.u.)	Standard unit
(cfs)	Cubic feet per second
<	Indicates analyte not detected above laboratory Practical Quantitation Limit (PQL)
(1)	Based on 50 mg/l hardness
(2)	Based on 100 mg/l hardness

TABLE 6
MAJOR SOURCES OF METALS LOADING IN FISHER CREEK

Source Area	Manganese	Iron	Copper	Aluminum
	Percent of Total			
Glengarry Adit (F-8A)	40	65	20	15
Fisher Mountain Runoff (FCT-12)	1	0	14	6
Como Basin Runoff (FCT-11	20	17	21	26
Glengarry Waste Rock (FC-2)	14	13	14	20
All Others	25	5	31	33

Source: Amacher 1998

3.3 GROUNDWATER

Groundwater occurs in two general hydrostratigraphic units in the Como Basin area: relatively thin unconsolidated material along drainage basins and consolidated bedrock. Aquifer tests conducted on bedrock wells completed in intrusive rocks in the Como basin area indicate hydraulic conductivities range from 3 x 10-4 to 5 x 10-5 cm/sec. Groundwater flow in Como Basin is primarily attributable to fracture flow. Cambrian-age sedimentary rocks in Como Basin were primarily fine-grained, shale, limestone, and dolomite, which were altered, lithified and compacted resulting in rock masses of low porosity and hydraulic conductivity.

Six monitoring wells have been installed in the Como Basin (Figure 3). MW-1 is 105 feet deep and is screened in the Wolsey Shale. EPA-11 is 152 feet deep and is completed in a Tertiary-age intrusive dike. Tracer-04 and Tracer-05 are 200 feet deep and are completed in the Fisher Mountain Intrusive. Wells EPA-12 and Tracer-6 are 153 and 175 feet deep, respectively, and are completed in Scotch Bonnet diorite.

3.3.1 <u>Groundwater Flow</u>

Water levels measured in bedrock wells completed in the Como Basin area at seasonal lows during spring, immediately prior to snowmelt and water levels peak during July. Based on water levels measured during 1996/1997, water levels fluctuate seasonally by as much as 65 feet. Groundwater typically rises from its seasonal low to its peak in about 45 days. The direction of groundwater movement in the Como Basin is to the southeast, down Fisher Creek Valley. Based on a study completed by the USGS (1999), as much as 35% of baseflow in upper Fisher Creek is attributable to groundwater inflow.

There are no paired well completions in the Como Basin where vertical groundwater movement could be evaluated. However, because Como Basin is a recharge area, a strong downward component of groundwater movement is expected during snowmelt. The vertical gradient would expect to decrease as water levels drop, and groundwater would tend to approach horizontal flow during periods of low groundwater levels.

3.3.2 <u>Groundwater Quality</u>

Groundwater quality data for Como Basin wells area are summarized in Table 7. In general, groundwater in Como Basin is of better quality than groundwater in the McLaren Pit area. Dissolved metals concentrations are typically lower, pH values are more basic, and sulfate concentrations are lower. Like the McLaren Pit area, the quality of groundwater in Como Basin appears to be poorest during periods of high water levels

TABLE 7
Como Basin
1999 Groundwater Monitoring Comparison

Sample Location	Sample Date	Laboratory Parameters							
		pH (S.U)	Dissolved Metals						
			Aluminum (mg/l)	Cadmium (mg/l)	Copper (mg/l)	Iron (mg/l)	Lead (mg/l)	Manganese (mg/l)	Zinc (mg/l)
Fisher Mountain Intrusive									
EPA-11	07/27/99	3.6	5.2	0.0093	0.530	307.00	0.320	15.300	1.41
EPA-11	**MAX***	4.3	5.2	0.0250	0.530	348.00	0.320	15.300	1.41
EPA-11	**MIN***	3.6	1.0	0.0058	0.042	294.00	0.003	10.800	0.92
EPA-11	**MEAN***	4.0	2.3	0.0148	0.202	314.60	0.147	12.820	1.23
TRACER-4	07/29/99	3.7	0.8	0.0004	0.070	119.00	< 0.001	9.870	1.96
TRACER-4	**MAX***	3.7	0.8	0.0050	0.070	119.00	0.010	9.870	1.96
TRACER-4	**MIN***	3.7	0.3	0.0004	0.010	107.00	0.001	7.720	0.98
TRACER-4	**MEAN***	3.7	0.6	0.0027	0.040	113.00	0.006	8.795	1.47
TRACER-5	07/26/99	3.6	25.1	0.0018	5.840	55.00	0.003	0.930	0.43
TRACER-5	**MAX***	3.6	25.1	0.0018	5.840	55.00	0.010	0.930	0.43
TRACER-5	**MIN***	3.6	21.7	0.0010	0.830	44.90	0.003	0.660	0.23
TRACER-5	**MEAN***	3.6	23.4	0.0014	3.335	49.95	0.007	0.795	0.33
Wolsey Shale									
MW-1	07/27/99	3.3	1.4	0.0007	0.330	45.00	0.008		0.17
MW-1	**MAX***	4.5	2.3	0.0050	2.580	85.60	0.092	6.760	0.52
MW-1	**MIN***	3.3	0.1	0.0005	0.010	11.50	0.000	0.990	0.05
MW-1	**MEAN***	3.7	1.2	0.0022	0.410	37.15	0.021	3.324	0.23
Scotch Bonnet Diorite									
EPA-12	05/11/99	6.2	< 0.1	< 0.0001	< 0.001	29.70	< 0.001	1.480	0.04
EPA-12	07/26/99	5.7	< 0.1	< 0.0001	< 0.001	27.30	< 0.001	1.450	0.07
EPA-12	**MAX***	6.8	0.2	0.0050	0.010	30.50	0.003	1.860	0.07
EPA-12	**MIN***	5.7	0.0	0.0001	0.001	9.22	0.001	1.170	0.01
EPA-12	**MEAN***	6.3	0.1	0.0012	0.004	20.80	0.002	1.480	0.03
TRACER-6	07/27/99	6.2	0.4	0.0010	0.180	17.60	< 0.001	3.280	0.08
TRACER-6	**MAX**	6.2	0.4	0.0010	0.180	17.60	0.010	3.280	0.08
TRACER-6	**MIN**	6.2	0.1	0.0010	0.010	9.10	0.001	1.480	0.01
TRACER-6	**MEAN**	6.2	0.3	0.0010	0.095	13.35	0.006	2.380	0.05

Note:

* Max, Min, and Mean are calculated using entire hisorical data for each sample location presented

(July). However, groundwater has not been sampled in Como Basin as frequent as it has in the McLaren Pit area to definitively document this trend.

Review of the data on Table 7 show that groundwater intercepted by wells EPA-12 and Tracer-6 (both completed in Scotch Bonnet diorite) is the best quality of that sampled in Como Basin. The pH values of water sampled from EPA-12 and Tracer- 6 have ranged from 5.7 to 6.8 and concentrations of dissolved metals are considerably lower than metals concentrations in other Como Basin wells. Well MW- 1, completed in the Wolsey Shale, has the lowest pH of any well in Como Basin. In the McLaren Pit area, wells completed in the Wolsey Shale intercept water with the most basic pH. The lower pH values measured in well MW-1, with respect to other Como Basin wells, are attributable to the fact that well MW-1 is the shallowest well in Como Basin and there is no overlying Meagher Limestone to buffer infiltrating snowmelt. Well Tracer-5, completed in Fisher Mountain intrusive rocks, intercepts water with the highest dissolved aluminum and copper concentrations of Como Basin wells.

Surface water in Fisher Creek appears to be chemically similar to groundwater in well Tracer-5, completed in Fisher Mountain intrusive rocks. These data support the premise that a considerable component of base flow in Fisher Creek is derived from groundwater in the Fisher Mountain Intrusive complex.

3.4 Como Basin/Glengarry Adit Geochemistry

Like the McLaren pit, the Como Basin experiences groundwater recharge of ARD during seasonal snowmelt. Groundwater in the vicinity of Como basin is controlled by near vertical fractures, joints, and faults, with limited to moderate interconnectedness. Water also flows into the abandoned Glengarry adit, where oxygen interacts with sulfide rich mineralization to produce ARD.

The Como deposit is similar to the style of mineralization (Type I, Stratiform retrograde skarn and replacement deposited hosted mostly by the Meagher formation) observed in the McLaren pit. In Como Basin, mineralization occurs where epidote skarn and limestone replacement with massive pyrite and chalcopyrite were developed at the Meagher Limestone - Fisher Mountain Intrusive contact. Neutralization potential in rocks mined from this portion of the district is provided by calcite and calcsilicate mineralization in the Meagher limestone, and by feldspars and biotite in the Fisher Mountain Intrusive.

3.4.1 Data Summary

Available ARD data for Como Basin/Glengarry adit wastes and underground workings are summarized in Table 4. Available metals data are contained in Appendix C. Sources of these data are summarized below:

- ARD Geochemistry
  Crown Butte Data Base
  DEQ Database
  1991 Bechtel samples G-39, 88-135, 88-133, 88-150, G-35
  MDSL AMR Inventory – ABA analyses

- Metal/mobility
  MDSL AMR Inventory – total metal analyses
  AMRB Inventory – XRF metal analyses

- Water Treatment:
  U.S. Bureau of Reclamation, Glengarry Adit: Design Data package, Treatment of Water during 1998 Adit Inspection and Rehabilitation. Review of 3 alternatives to treat water during dewatering of flooded adit.

- Maps and Sections
  Detailed hydrogeologic cross-section(s) were prepared to evaluate the interaction between Como and Glengarry, and are available for use.

Geochemical data characterizing the in-situ remedial action taken by CBMI in 1994-1995, at the Glengarry dumps and in Como Basin, with any long term performance data.

Geochemical characteristics of receptor water and bedrock.

As shown in Table 4, wastes from this portion of the ore body are likely to range in acid generation potential, from slightly to strongly acid generating. The Glengary adit was dominantly developed in the Fisher Mountain Intrusive, so that wastes produced from the adit are for the most part only the intrusive rock type. This can be confirmed during mapping of the adit. A single composite of randomly collected samples for this one rock type is appropriate, unless visual inspection of the rocks on the dump indicates otherwise. It should be noted that this interpretation is based on only a few samples; however, and should be considered during future sampling efforts, both on the dump and in the adit.

The inherent complexity of Como Basin wastes is obvious from the number of lithologies and range of mineralization described in Table 4. Histograms summarizing the variance in key ARD geochemical predictors for some of these more complex waste deposits are shown as Figures 9 and 10. The Como wastes show a relatively normal population in terms of acid generation potential (Figure 9) with a skewed, log normal NP distribution (Figure 10). Because of the small number of samples available for the Glengarry adit, distribution histograms have not been provided.

Total metal data are summarized in Appendix C for the Como/Glengarry deposit. They represent analyses conducted by the AMRB during its 1993 hazard ranking inventory. Relative to the background analyses conducted by AMRB in 1993, the waste from the Como/Glengarry deposit is significantly enriched in average concentration of total As, Cu, Fe, and Pb. XRF data are also summarized in Appendix C. No leachability data are available for wastes from this portion of the mining district.

3.5 Como Basin/Glengarry Data Gaps

Based on review of historical surface water and groundwater data obtained in the Como Basin area, and comparison of these data with data recently collected by Maxim, it is our opinion the hydrology of the Como Basin area has been adequately characterized to direct future restoration activities in the area, with the following exceptions:

- Like Daisy Creek, the accuracy of calculating metal loads in Fisher Creek could be substantially improved if more frequent flow measurements are recorded and more frequent water samples collected for analysis.

  As a result, Maxim is scheduled to collect water samples and measure flow in Fisher Creek on a more frequent basis during spring runoff than that scheduled under the long-term monitoring plan. In addition to increasing the frequency of surface water monitoring events during runoff, Maxim will also measure flow on as many as four occasions in a single day to document diurnal fluctuations. These increased monitoring efforts, scheduled for implementation during the spring runoff of 2000, should help improve the understanding of water quality and flow characteristics of Fisher Creek and provide additional data with which the effectiveness of future reclamation work can be assessed.

- Additional geochemical sampling of Como waste piles and surface excavations, as well as the Glengarry adit, is recommended to obtain acid generation and metal release potential data.

4.0 GOLD DUST ADIT

The Gold Dust adit is located within the Fisher Creek drainage basin approximately 4,000 feet downstream from the Glengarry adit and about 1,000 feet west of Fisher Creek. The adit was driven to the southwest for a distance of approximately 2,600 feet. The adit bifurcates approximately 2,300 feet from the portal (see Figure 11). The tunnel penetrated Precambrian granodiorite and metasediments that are cross-cut by Tertiary-age dikes. Diatreme and mosaic breccia facies extend from 550 feet to 1,285 feet. Breccia clasts

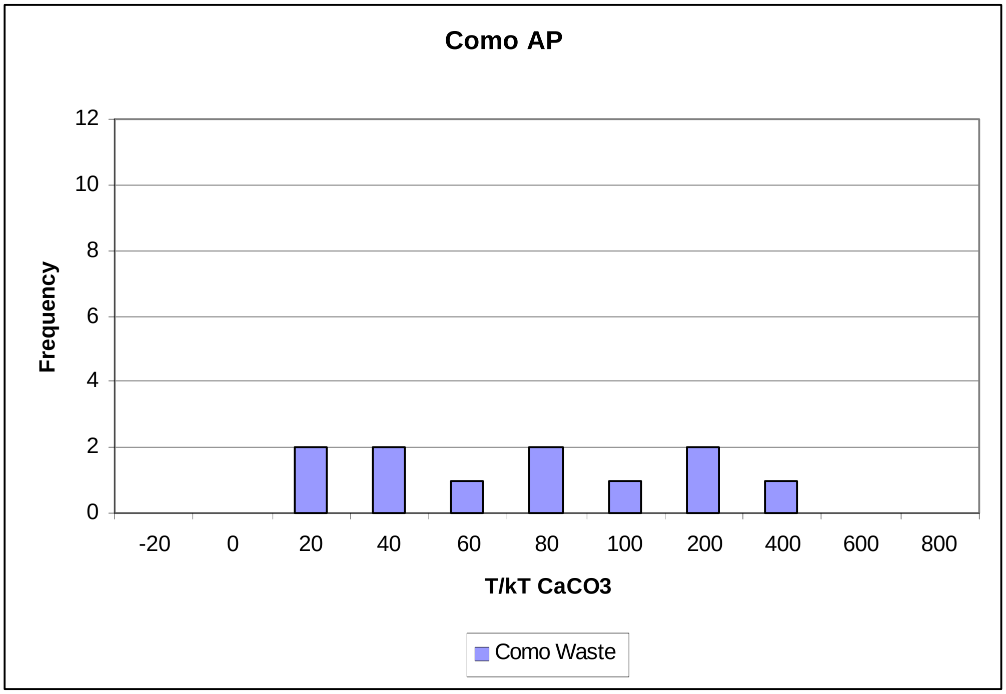

Figure 9. Histogram showing acid generating potential characteristics of Como wastes.

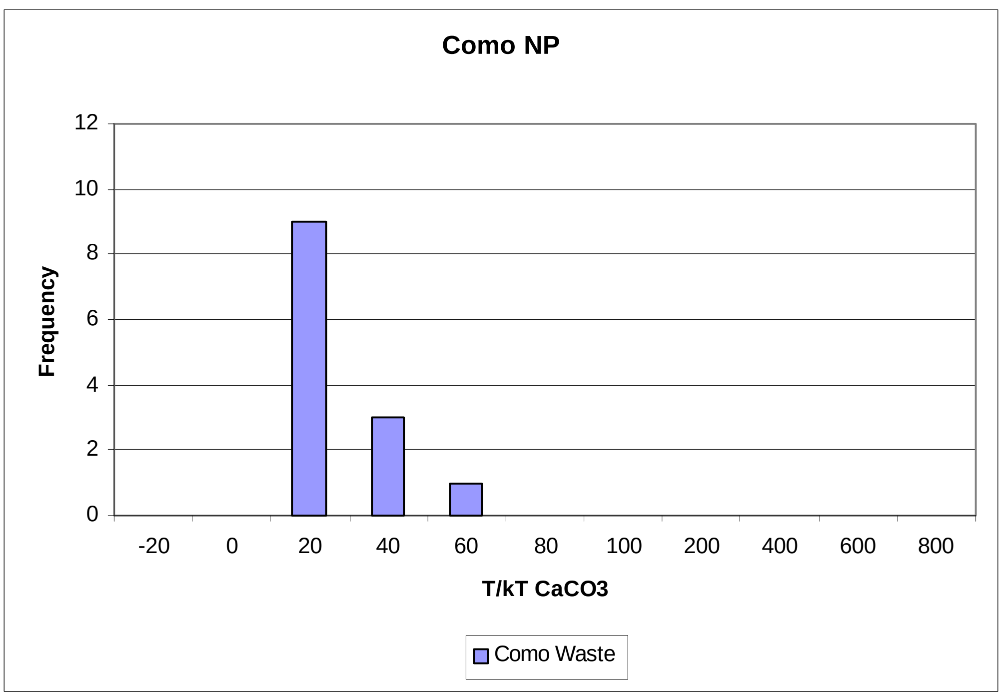

Figure 10. Histogram showing acid neutralization potential characteristics of Como wastes.

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Figure 11

blank

are predominately granodiorite, Wolsey Shale, and Tertiary porphyry intrusives. Veins of quartz-pyrite and quartz-pyrite-chalcopyrite cross cut the breccia. During 1992, Crown Butte Mining reported that the workings are in good condition and the rock is competent all the way to the working heading at 2,600 feet.

4.1 Water Quality

Drainage from the Gold Dust adit has ranged from less than 1 gpm to as much as 27 gpm with the highest flows occurring during June and July and low flows occurring from August through May. Twelve water samples have been collected from the Gold Dust Adit from 1989 through 1997. Selected water quality data are summarized in Table 8. Table 8 indicate the quality of water emanating from the Gold Dust is generally of good quality and does not appear to be a significant source of metals to Fisher Creek. Water is near neutral with pH values ranging from 6.8 to 7.9. Concentrations of total recoverable aluminum, cadmium, lead, and zinc were all near or below practical quantitation limits. Concentrations of total recoverable copper ranged from less than 0.001 to 0.108 mg/l and total recoverable iron concentrations ranged from 0.11 to 33.4 mg/l. The high total recoverable copper and iron concentrations were measured on a single occasion when the turbidity level was 120 ntus and total suspended sediment was 143 mg/l. The high turbidity was likely caused by human activity occurring in the adit at the time sampling was conducted.

TABLE 8
Gold Dust Adit (F-28)

Sample Date	Flow (cfs)	PH (s.u.)	Total Suspended Solids (s.u.)	Aluminum Total Recoverable (mg/L)	Copper Total Recoverable (mg/L)	Iron Total Recoverable (mg/L)	Lead Total Recoverable (mg/L)	Manganese Total Recoverable (mg/L)	Zinc Total Recoverabl e (mg/L)
7-8-97	0.065		U20						
6-16-94	26.93	7.24							
7-10-91	11.2	7.79	U2	U0.1	0.009	0.34	J20	0.05	0.04
7-14-95	17.92	6.88	U10	U0.1	J4D0.003	J4D0.78	0.015	0.04	UJ10.021
7-23-93	14.8						U0.01		
8-8-90	4	7.31		U0.1	U0.01	0.52	U0.002	0.02	0.02
8-14-91			3	0.1	0.008	1.2		0.2	0.04
8-23-90	1.5						U0.01		
9-6-90	4.5	7.08		U0.1	U0.01	0.28	U0.003	0.07	UJ0.03
9-12-96	9.4	6.23	U10	U0.1	U0.001	0.11		0.04	UJ10.02
9-20-89	1.3	7.17							
9-22-93	13								
9-25-90	1.8	5		U0.1	0.002	0.31	U0.002	0.07	0.06
9-26-91	2	7.76	143	1.6	0.108	33.4	0.014	5.76	0.3
9-26-95	13.46	6.7	U10	U0.1	UJ10.003	0.78	U0.002	0.07	UJ10.007

4.2 Gold Dust Adit Geochemistry

The source-pathway conceptual model shown in the Overall Work Plan (Maxim 1999) for the Gold Dust adit involves groundwater interaction with mineralized rock exposed in the adit walls, as well as surface water interaction with wastes placed in the dump outside the adit. The Gold Dust Adit is collared in Precambrian Gneiss, continues through the Homestake intrusive and into the Homestake breccia deposit. Mineralization primarily occurs in diatreme and intrusion breccias where clasts of Meagher and Pilgrim limestone have been replaced by acid generating pyrite and chalcopyrite (along with minor sulfides sphalerite, bornite, covellite), with clasts of potentially neutralizing carbonate and chlorite mineralization. The Homestake intrusive mineralization consists of pyritic dacite porphyry, with feldspar, biotite and hornblende offering some limited neutralization potential. The Precambrian Gneiss has been shown to be relatively neutral with little potential to generate ARD.

4.2.1 Data Summary

Available ARD data for the Gold Dust adit wastes and underground workings are summarized in Table 4. Available metals data are contained in Appendix C. Sources of these data are summarized below:

ARD Geochemistry
Crown Butte Data Base
DEQ Database
1992 CBMI characterization – composite, lithologic analysis of holes 658, 687, 779. Also, ABA-GD-DS series
MDSL AMR Inventory – ABA analyses

Underground was mapped by George Furniss (CBMI) for sulfide distribution

Metal/mobility
MDSL AMR Inventory – total metal, XRF analyses

Gold Dust wastes, while less risky from an ARD standpoint based on the ABP data provided as Figure 12, are also relatively complex in terms of lithologies and range of mineralization, as shown in Table 4. The distribution of ARD parameters is normal, however, for both AP (Figure 13) and NP (Figure 14). Wastes from this portion of the district are likely to vary in acid generation potential, from neutralizing to moderately acid generating, with an average ABP value close to 0.

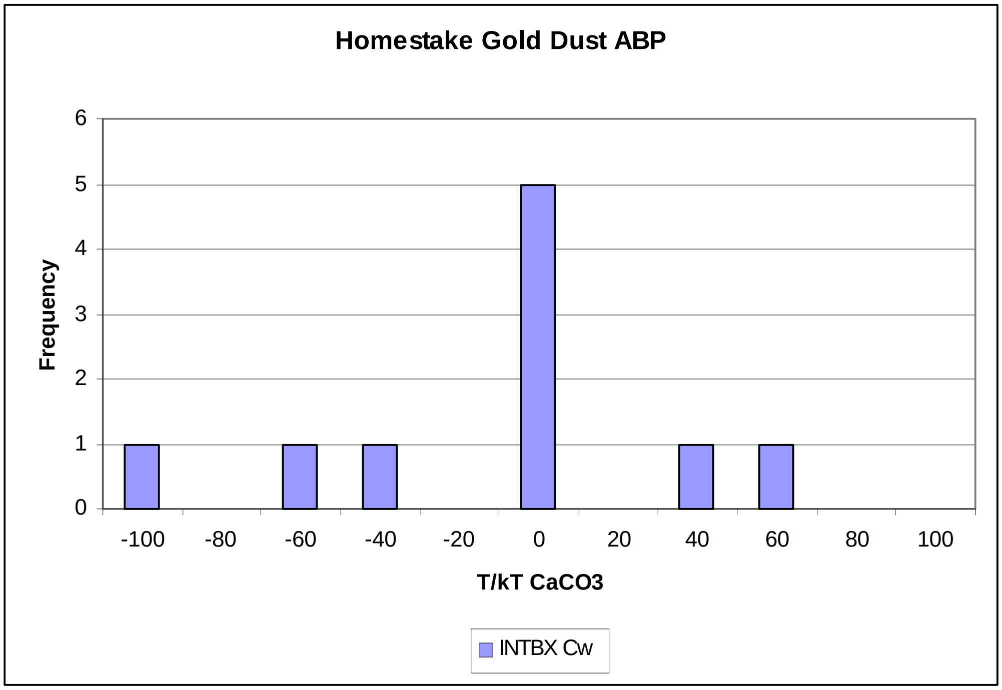

Figure 12. Histogram showing distribution of ABP for Gold Dust Adit wastes.

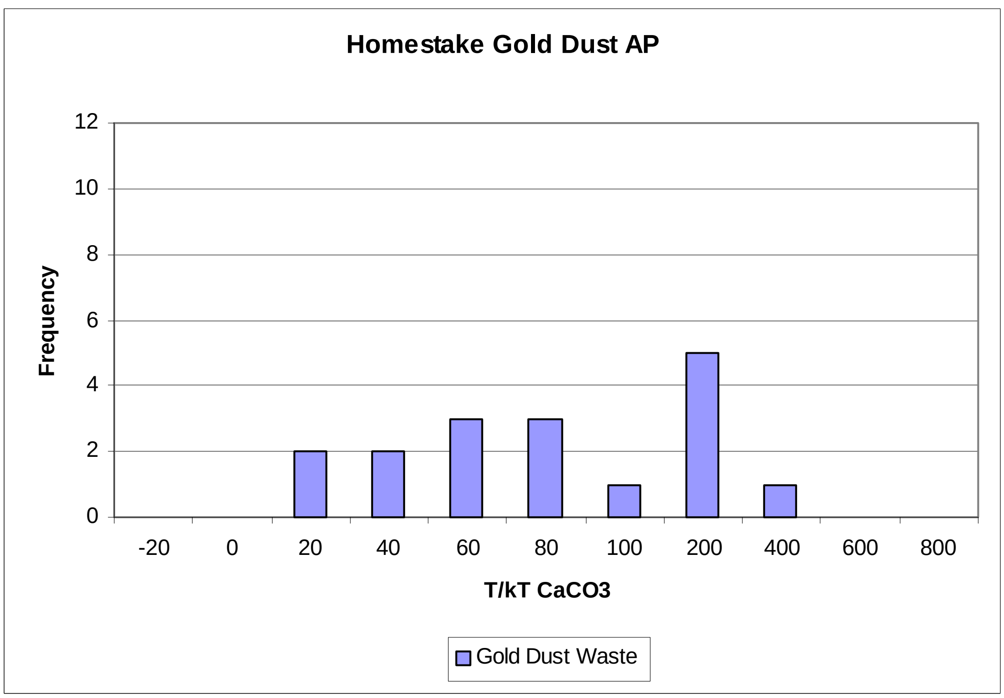

Figure 13. Histogram showing distribution of AP for Gold Dust Adit wastes.

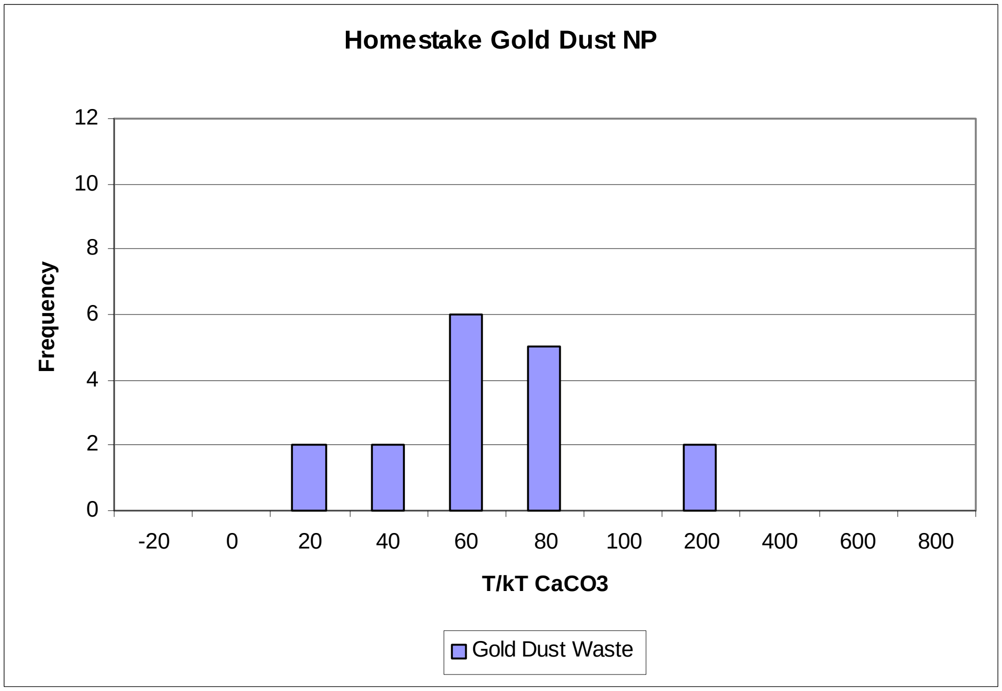

Figure 14. Histogram showing distribution of NP for Gold Dust Adit wastes.

5.0 REFERENCES

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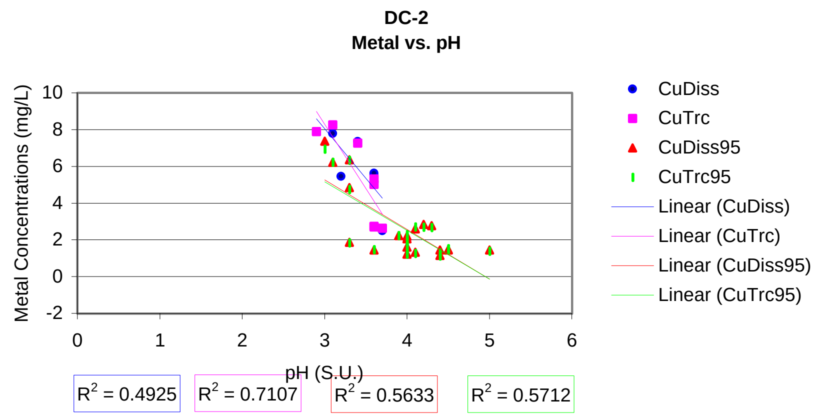
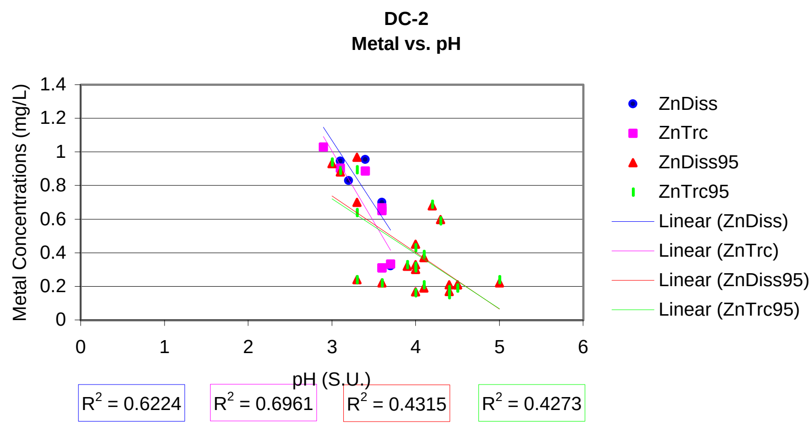
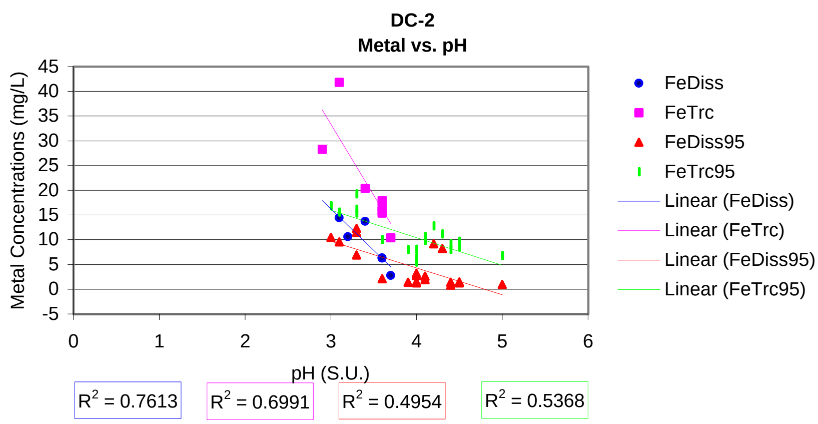
United States Geological Survey (USGS). 2000. Quantification of Metal Loading in Fisher Creek by Tracer Injection and Synoptic sampling, Park County, Montana. August, 1977. Water-Resources Investigations Report 99-4119. Prepared in Cooperation with the U.S. Environmental Protection Agency.

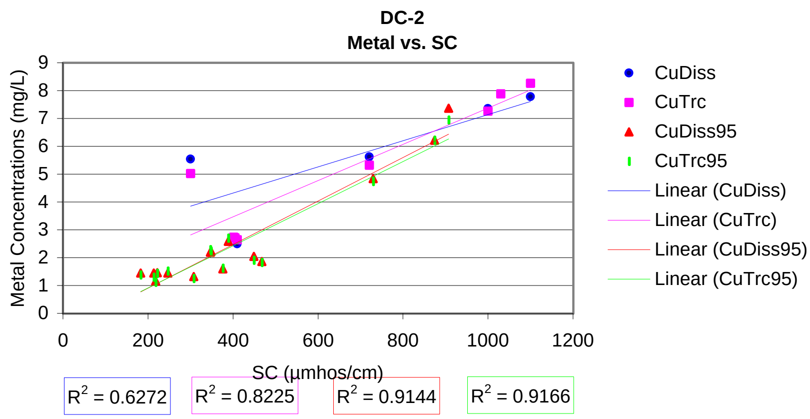
APPENDIX A

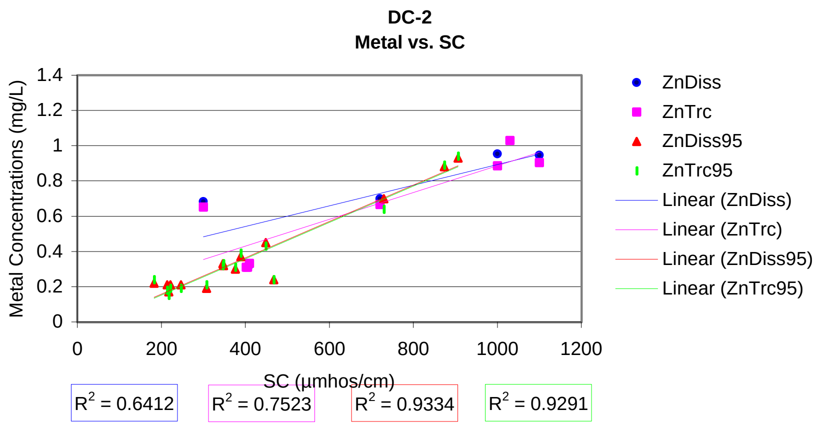
Graphs of Selected Water Quality Data for Daisy and Fisher Creeks

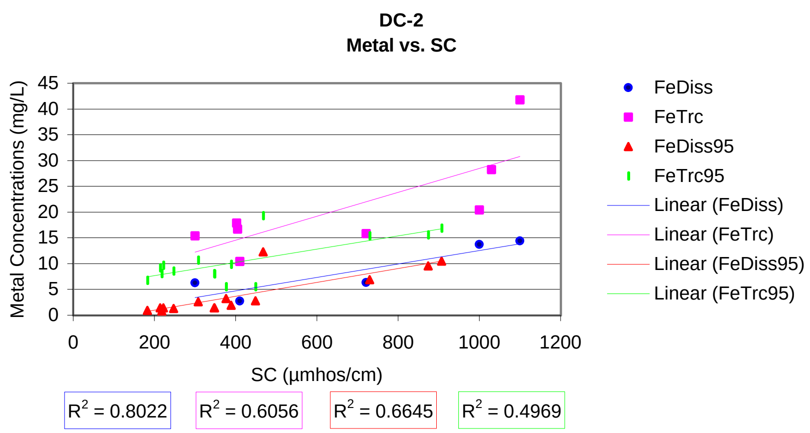

DC-2
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
Linear (CuDiss95)
Linear (CuTrc95)
R^2 = 0.4925
R^2 = 0.7107
R^2 = 0.5633
R^2 = 0.5712

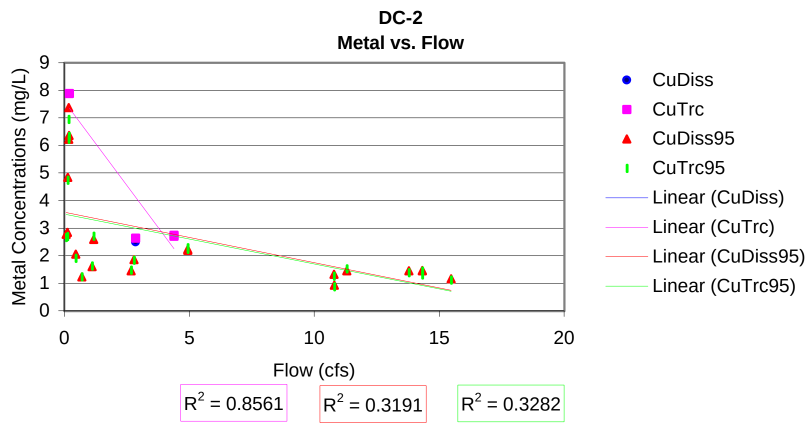

DC-2
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
Linear (ZnDiss95)
Linear (ZnTrc95)
R^2 = 0.6224
R^2 = 0.6961
R^2 = 0.4315
R^2 = 0.4273

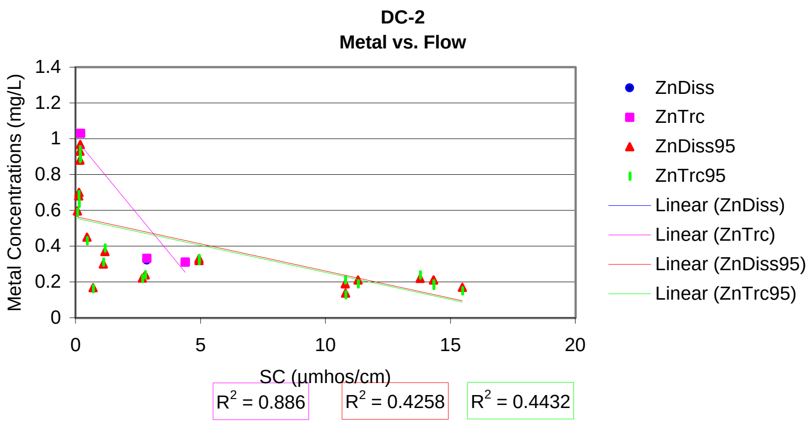

DC-2
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
Linear (FeDiss95)
Linear (FeTrc95)
R^2 = 0.7613
R^2 = 0.6991
R^2 = 0.4954
R^2 = 0.5368

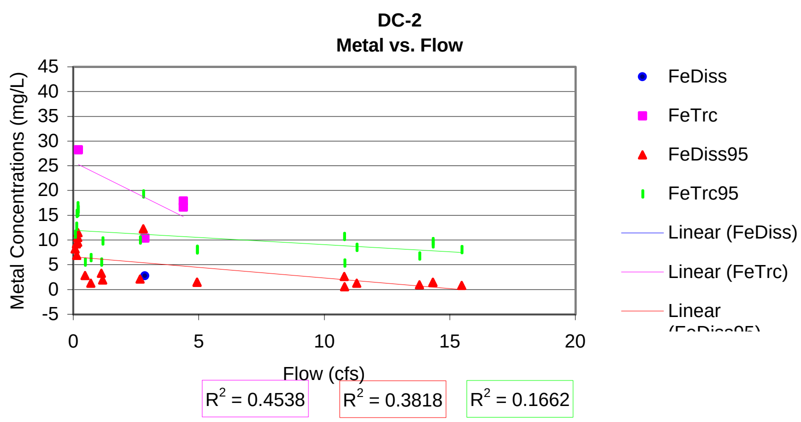

DC-2
Metal vs. SC
Metal Concentrations (mg/L)
SC (µmhos/cm)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
Linear (CuDiss95)
Linear (CuTrc95)
R2 = 0.6272
R2 = 0.8225
R2 = 0.9144
R2 = 0.9166

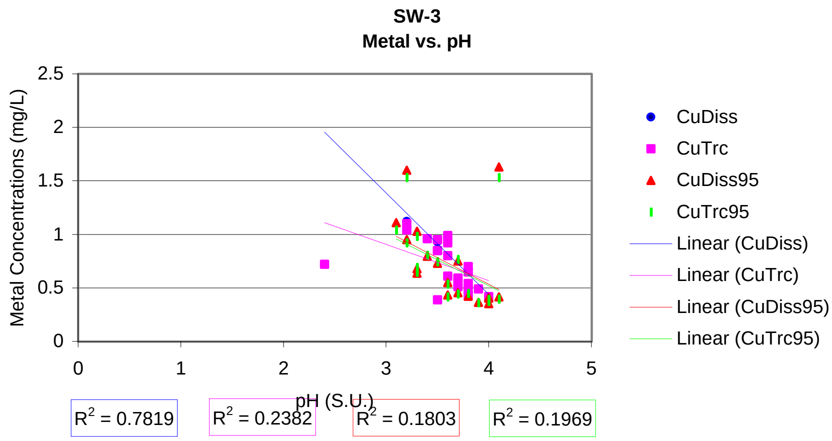

DC-2
Metal vs. SC
Metal Concentrations (mg/L)
SC (µmhos/cm)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
Linear (ZnDiss95)
Linear (ZnTrc95)
R2 = 0.6412
R2 = 0.7523
R2 = 0.9334
R2 = 0.9291

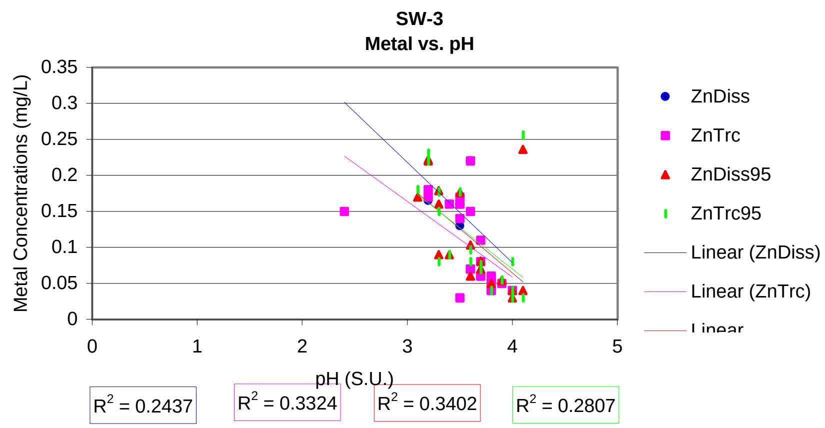

DC-2
Metal vs. SC
Metal Concentrations (mg/L)
SC (µmhos/cm)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
Linear (FeDiss95)
Linear (FeTrc95)
R2 = 0.8022
R2 = 0.6056
R2 = 0.6645
R2 = 0.4969

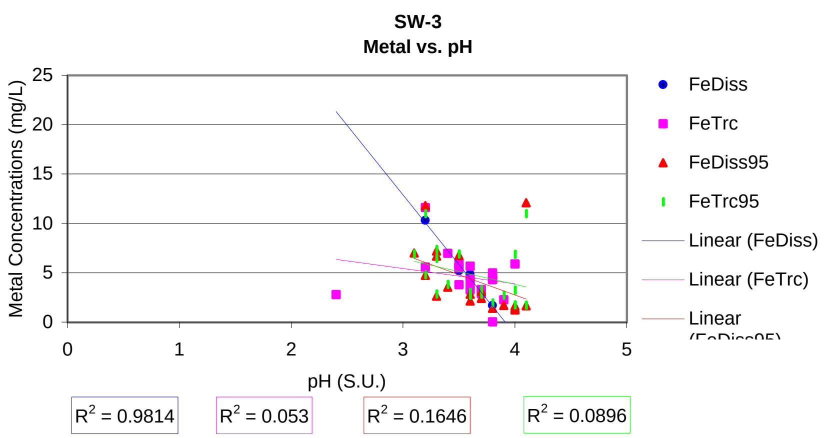

DC-2
Metal vs. Flow
Metal Concentrations (mg/L)
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
Flow (cfs)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
Linear (CuDiss95)
Linear (CuTrc95)
R2 = 0.8561
R2 = 0.3191
R2 = 0.3282

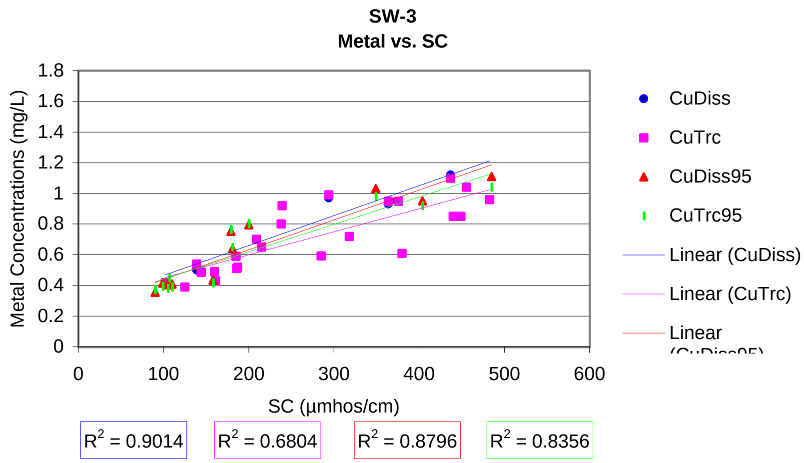

DC-2
Metal vs. Flow
Metal Concentrations (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
SC (µmhos/cm)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
Linear (ZnDiss95)
Linear (ZnTrc95)
R2 = 0.886
R2 = 0.4258
R2 = 0.4432

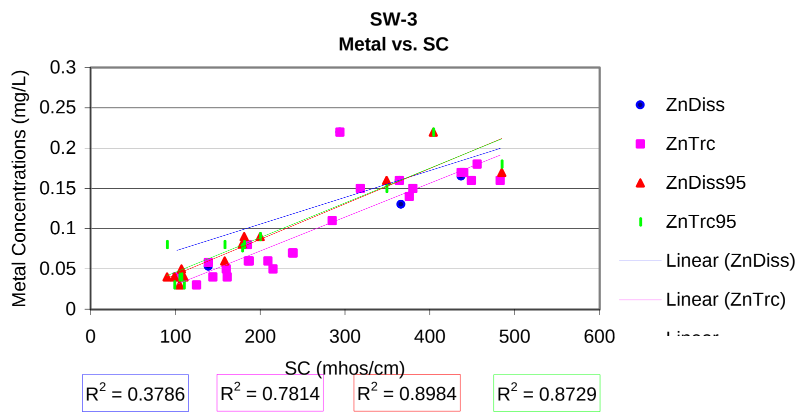

DC-2
Metal vs. Flow
Metal Concentrations (mg/L)
45
40
35
30
25
20
15
10
5
0
-5
0
5
10
15
20
Flow (cfs)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
Linear
R2 = 0.4538
R2 = 0.3818
R2 = 0.1662

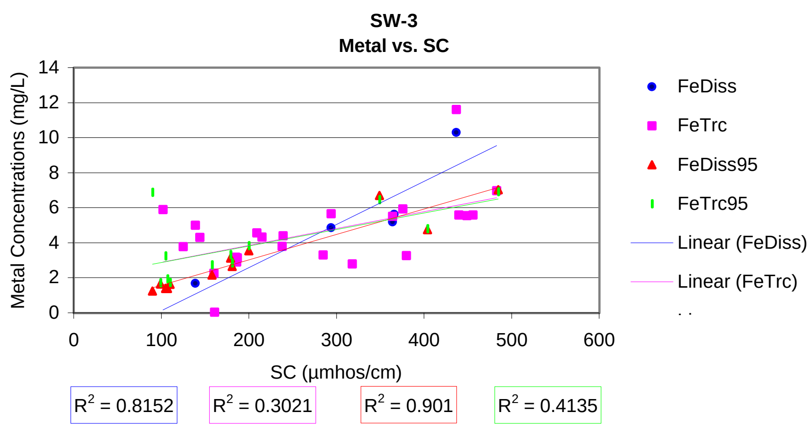

SW-3
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
Linear (CuDiss95)
Linear (CuTrc95)
R2 = 0.7819
R2 = 0.2382
R2 = 0.1803
R2 = 0.1969

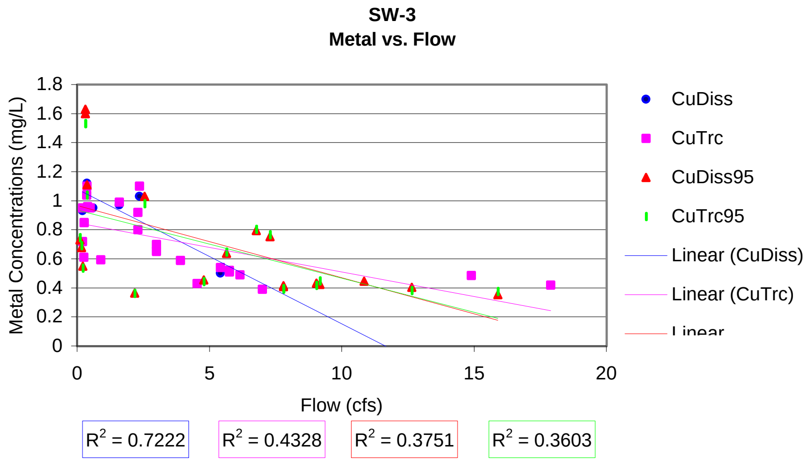

SW-3
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
R2 = 0.2437
R2 = 0.3324
R2 = 0.3402
R2 = 0.2807

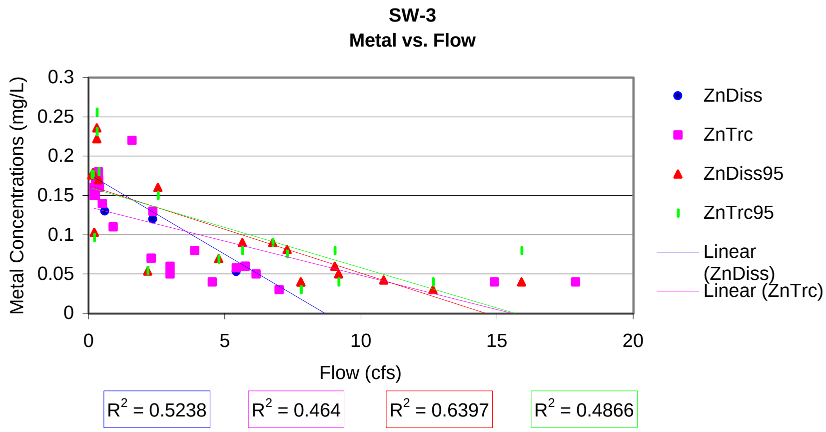

SW-3
Metal vs. pH
Metal Concentrations (mg/L)
pH (S.U.)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
Linear
R2 = 0.9814
R2 = 0.053
R2 = 0.1646
R2 = 0.0896

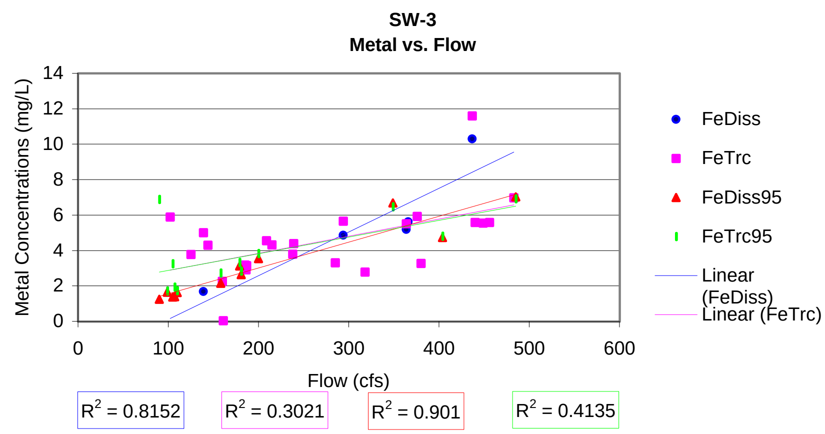

SW-3
Metal vs. SC
Metal Concentrations (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
500
600
SC (µmhos/cm)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
Linear
R^2 = 0.9014
R^2 = 0.6804
R^2 = 0.8796
R^2 = 0.8356

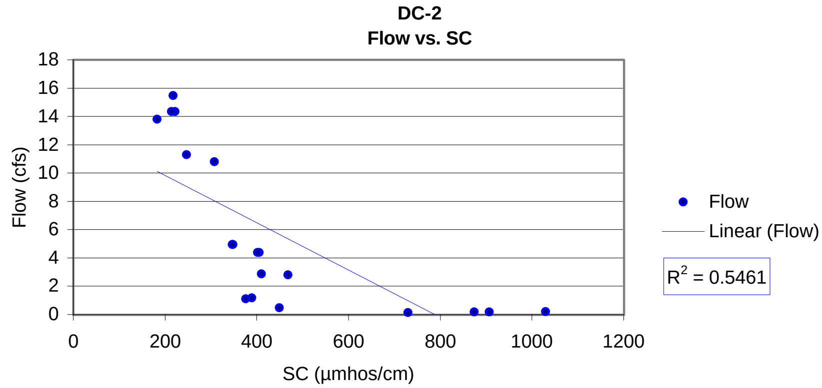

SW-3
Metal vs. SC
Metal Concentrations (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
0
100
200
300
400
500
600
SC (mhos/cm)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
R^2 = 0.3786
R^2 = 0.7814
R^2 = 0.8984
R^2 = 0.8729

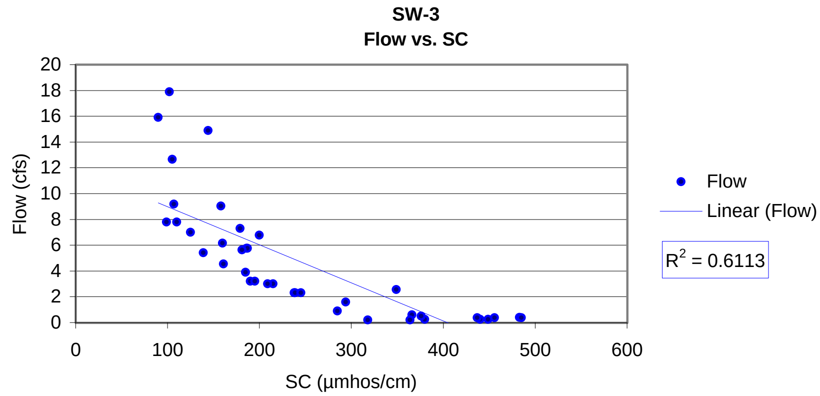

SW-3
Metal vs. SC
Metal Concentrations (mg/L)
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
SC (µmhos/cm)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
R^2 = 0.8152
R^2 = 0.3021
R^2 = 0.901
R^2 = 0.4135


SW-3
Metal vs. Flow
Metal Concentrations (mg/L)
Flow (cfs)
CuDiss
CuTrc
CuDiss95
CuTrc95
Linear (CuDiss)
Linear (CuTrc)
R^2 = 0.7222
R^2 = 0.4328
R^2 = 0.3751
R^2 = 0.3603


SW-3
Metal vs. Flow
Metal Concentrations (mg/L)
Flow (cfs)
ZnDiss
ZnTrc
ZnDiss95
ZnTrc95
Linear (ZnDiss)
Linear (ZnTrc)
R^2 = 0.5238
R^2 = 0.464
R^2 = 0.6397
R^2 = 0.4866


SW-3
Metal vs. Flow
Metal Concentrations (mg/L)
Flow (cfs)
FeDiss
FeTrc
FeDiss95
FeTrc95
Linear (FeDiss)
Linear (FeTrc)
R^2 = 0.8152
R^2 = 0.3021
R^2 = 0.901
R^2 = 0.4135

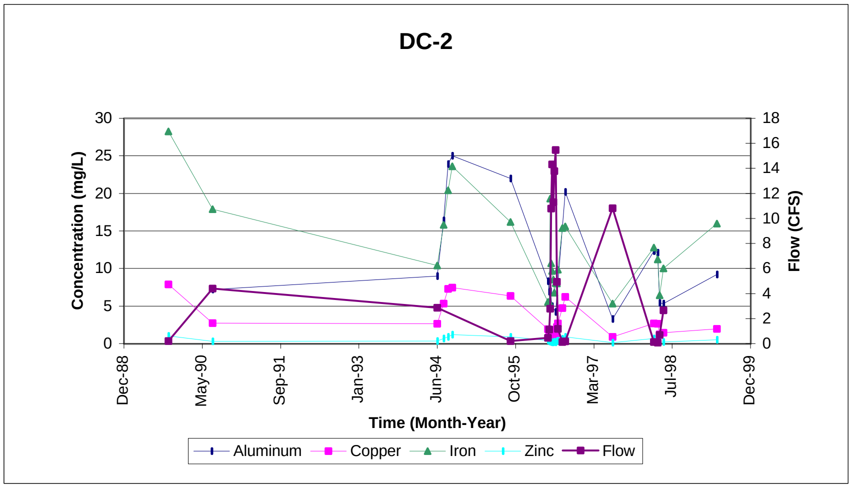

DC-2
Flow vs. SC
Flow (cfs)
SC (µmhos/cm)
Flow
Linear (Flow)
R2 = 0.5461


SW-3
Flow vs. SC
Flow (cfs)
SC (µmhos/cm)
Flow
Linear (Flow)
R2 = 0.6113

APPENDIX B

Scatter Plots of Selected Surface Water Quality Data

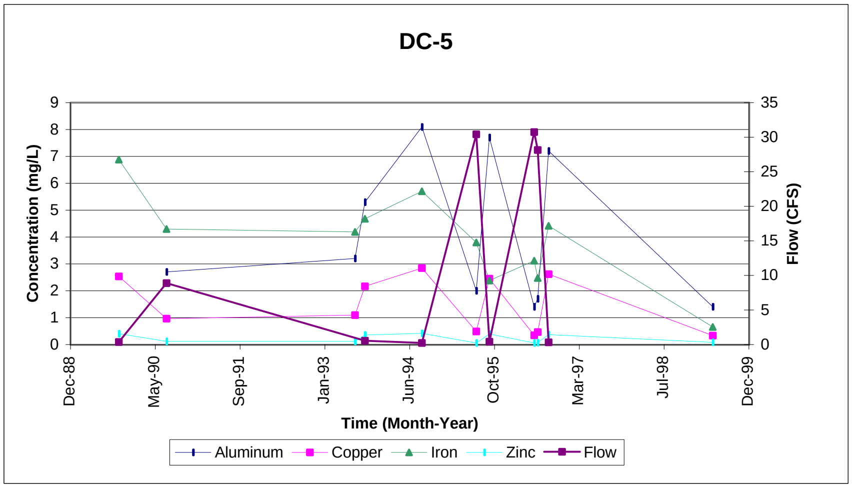
Daisy Creek
Total Recoverable Metals and Flow Rate in Daisy Creek



Site Code	Sample Date	Flow (cfs)	Total Recoverable (mg/L)			
			Aluminum	Copper	Iron	Zinc
DC-2	10/03/1989	0.2		7.89	28.26	1.03
DC-2	07/12/1990	4.39	7.2	2.74	17.9	0.31
DC-2	06/15/1994	2.86	9	2.64	10.4	0.332
DC-2	07/26/1994		16.4	5.32	15.8	0.667
DC-2	08/23/1994		23.9	7.27	20.4	0.886
DC-2	09/20/1994		25	7.44	23.6	1.2
DC-2	09/26/1995	0.194	22	6.33	16.2	0.894
DC-2	05/21/1996	0.467	8.3	1.91	5.55	0.43
DC-2	05/30/1996	1.116	6.9	1.62	5.52	0.31
DC-2	06/05/1996	2.79	7	1.83	19.3	0.24
DC-2	06/12/1996	10.8		1.25	10.7	0.21
DC-2	06/18/1996	14.33	5	1.44	9.69	0.19
DC-2	06/26/1996	11.3		1.52	8.54	0.19
DC-2	07/02/1996	13.79		1.38	6.76	0.24
DC-2	07/09/1996	15.48	4.2	1.11	8.05	0.15
DC-2	07/18/1996	4.937		2.23	8	0.33
DC-2	07/25/1996	1.175		2.7	9.84	0.39
DC-2	08/21/1996	0.138		4.74	15.4	0.64
DC-2	09/10/1996	0.18	20.2	6.22	15.6	0.89
DC-2	07/09/1997	10.81	3.27	0.876	5.32	0.129
DC-2	03/30/1998	0.13	12.3	2.69	12.8	0.688
DC-2	04/22/1998	0.072	12.1	2.66	11.2	0.589
DC-2	05/04/1998	0.699	5.4	1.23	6.43	0.162
DC-2	05/29/1998	2.67	5.34	1.47	10	0.22
DC-2	05/06/1999		9.2	1.94	16	0.51

Data Source: Hydrometrics 10/89 to 9/96, URS 7/97 to 5/98, Maxim 5/99

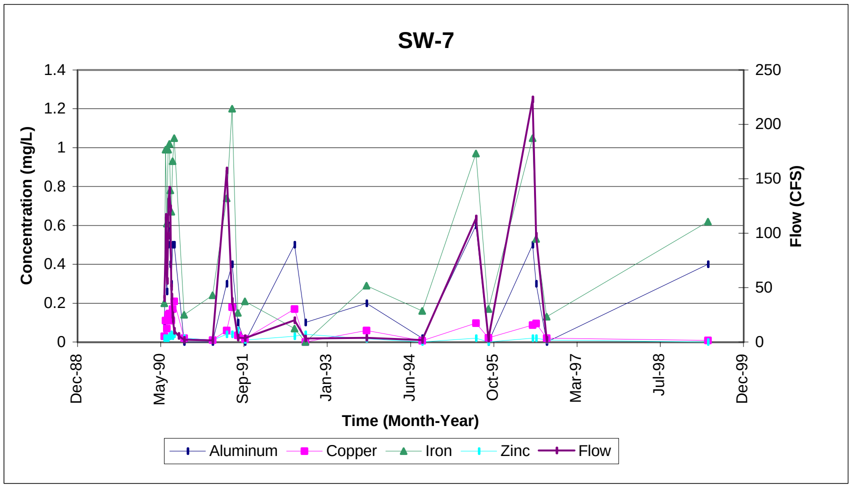
Daisy Creek
Total Recoverable Metals and Flow Rate in Daisy Creek



Site Code	Sample Date	Flow (CFS)	Total Recoverable (mg/L)			
			Aluminum	Copper	Iron	Zinc
DC-5	10/03/1989	0.37		2.54	6.88	0.4
DC-5	07/12/1990	8.91	2.7	0.97	4.3	0.12
DC-5	07/28/1993		3.2	1.09	4.19	0.12
DC-5	09/23/1993	0.54	5.3	2.17	4.68	0.36
DC-5	08/25/1994	0.24	8.1	2.85	5.7	0.42
DC-5	07/13/1995	30.43	2	0.485	3.8	0.062
DC-5	09/27/1995	0.42	7.7	2.45	2.38	0.391
DC-5	06/18/1996	30.74	1.4	0.346	3.12	0.06
DC-5	07/09/1996	28.14	1.7	0.46	2.48	0.07
DC-5	09/10/1996	0.312	7.2	2.62	4.42	0.37
DC-5	05/06/1999		1.4	0.33	0.65	0.08

Data Source: Hydrometrics 10/89 to 9/96, Maxim 5/99

Daisy Creek
Total Recoverable Metals and Flow Rate in Daisy Creek



Site Code	Sample Date	Flow (CFS)	Total Recoverable (mg/L) Aluminum	Copper	Iron	Zinc
SW-7	05/28/1990	40.3	0.1	0.03	0.2	0.02
SW-7	06/05/1990	81.11	0.4	0.11	0.99	0.02
SW-7	06/06/1990	115.1				
SW-7	06/13/1990	69.81	0.26	0.07	0.61	0.02
SW-7	06/15/1990	56.3				
SW-7	06/20/1990	97.51	0.5	0.14	0.99	0.02
SW-7	06/22/1990	129.15				
SW-7	06/27/1990	138.8	0.6	0.147	1.02	0.03
SW-7	06/28/1990	140.13				
SW-7	07/03/1990	122.9	0.4	0.11	0.78	0.03
SW-7	07/10/1990	50.2	0.3	0.11	0.67	0.04
SW-7	07/12/1990	41.7				
SW-7	07/17/1990	24.7	0.5	0.17	0.93	0.03
SW-7	07/19/1990	20.9				
SW-7	07/26/1990	10.4	0.5	0.21	1.05	0.04
SW-7	08/22/1990	5.6				
SW-7	09/25/1990	2.2	<0.1	0.02	0.14	0.02
SW-7	03/15/1991	1.5	<0.1	0.01	0.24	0.01
SW-7	06/06/1991	157.6	0.3	0.06	0.74	0.04
SW-7	07/10/1991	37.7	0.4	0.18	1.2	0.04
SW-7	08/13/1991	4.1	0.1	0.034	0.15	0.06
SW-7	09/24/1991	3.5	<0.1	0.017	0.21	0.01
SW-7	07/19/1992	20	0.5	0.17	0.07	0.03
SW-7	09/22/1992	3.23	0.1	<0.087	<0.2	0.04
SW-7	09/23/1993	3.71	0.2	0.06	0.29	0.016
SW-7	08/25/1994	1.69	0.02	0.007	0.16	<0.008
SW-7	07/13/1995	113.48	0.6	0.098	0.97	0.02
SW-7	09/27/1995	2.8	<0.1	0.021	0.17	<0.027
SW-7	06/18/1996	223.08	0.5	0.087	1.05	0.02
SW-7	07/09/1996	97.63	0.3	0.096	0.53	0.02
SW-7	09/10/1996	2.1241	<0.1	0.019	0.13	0.01
SW-7	05/06/1999		0.4	0.008	0.62	<0.01

Data Source
Hydrometrics 10/89 to 9/96 *MAXIM 5/99*