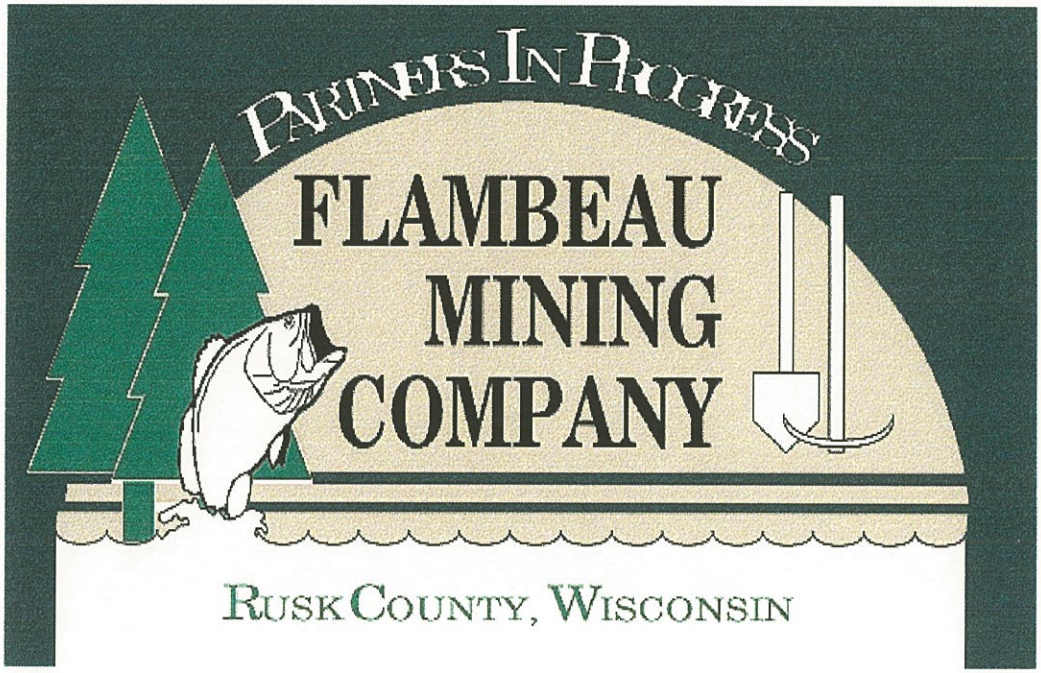
1997 Annual Report



January 1998

Flambeau Mining Company
N4100 Highway 27
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(715) 532-6690
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Kennecott
Minerals

January 30, 1998

Mr. Lawrence J. Lynch
Mine Reclamation Unit
Bureau of Solid and Hazardous Waste Management
101 South Webster Street, GEF II
Madison, WI 53707

Dear Mr. Lynch:

The Flambeau Mining Company (Flambeau) is submitting 12 copies of the attached 1997 Annual Report pursuant to Part 1-8 of the conditions of the Flambeau Mine Permit (Docket No. IH-89-14). This submittal also addresses other requirements of the Mining Permit and associated approvals.

If you have any comments or questions regarding this submittal, please contact me at (715) 532-6690 Ext. 717.

Sincerely,

Jana E. Murphy

Jana E. Murphy
Environmental & Reclamation Manager

Distribution

No. of Copies	Sent to
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1

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Project Engineer
Foth & Van Dyke Associates
2737 South Ridge Road
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FLAMBEAU MINING COMPANY
1997 ANNUAL REPORT

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TABLES

FIGURES

APPENDICES

1.0 PURPOSE AND NEED

This report serves to document the work that was done at the Flambeau Mine site in 1997 and to satisfy the requirements of the Mining Permit (MP) and the Type I and Type II storage area Conditional Approval (CA) letter dated March 9, 1993.

Mining Permit, Part 1, Condition 8:

> *In accordance with sec. 144.89, Stats., Flambeau shall submit a report annually to the Department summarizing the activities which took place on the mining site during the year and shall include other additional information specified in this permit and associated plan approvals.*

Mining Permit, Part 2, Condition 4:

> *The annual report required under sec. 144.89, Stats., shall include discussion of all modifications received during the previous year and shall include an inventory of all modifications received subsequent to permit issuance. The annual report shall also discuss deviations from the approved Mining Plan as a result of final engineering refinements of subsequent plan approvals if these deviations do not require modifications, under Part 2, Conditions 2 and 3.*

Mining Permit, Part 2, Condition 6:

> *Flambeau shall keep a log of all incidents, such as spills, pond overflows and embankment failure or leakage, reported to its environmental compliance staff. This log shall, at all reasonable times, be available for inspection by any duly authorized Department employee. A summary of incidents subject to various Department reporting requirements shall be included in the annual report required under sec. 144.89, Stats.*

Mining Permit, Part 2, Condition 7 (Excerpt):

> *The annual report required under sec. 144.89, Stats, shall include a summary of all exploration drilling activities conducted on the mining site during the previous year.*

Mining Permit, Part 2, Condition 14 (Excerpt):

> *The evaluation of the Type II collection system shall be included in the annual report required under this permit.*

Mining Permit, Part 3, Condition 10:

Flambeau shall conduct a program of in-field trials for reclamation methods and materials prior to final reclamation. A description of methods, materials, analyses and results shall be submitted to the Department on an annual basis.

Mining Permit, Part 4, Condition 9:

Monitoring data and results shall be submitted to the Department within 30 days after completion of the required analyses. The annual report required in this permit shall summarize the year's monitoring activities and any observed trends in the monitoring data.

Conditional Approval, Condition 13:

The annual report required under the Mining Permit should include documentation of the following:

a. *Inspection of the sideslopes of the surge pond and runoff pond for any sign of washout or deformation.*

b. *Inspection of the 36" diameter drain from the Type II stockpile, the entrance manhole, access manholes, outlet and the geomembrane-covered seam in the pipe junction prior to the outlet.*

c. *Inspection of the scuff strip below the outlet of the 36" pipe outlet in the surge pond.*

Groundwater Withdrawal Permit, Condition 4 (Excerpt):

At the end of each year of pit excavation and ore extraction, Flambeau shall submit to the Department of Natural Resources, Bureau of Water Supply a written tabulation of the monthly totals for: precipitation volume, surface water run-on, groundwater inflow and dewatering pumping.

The location of the information which fulfills the requirements of the above conditions are referenced in Table 1-1.

TABLE 1-1

Location Information Key

Condition No.	Location of Information
MP, Part 1-8	Section 2.1
MP, Part 2-4	Section 2.2 and Appendix A
MP, Part 2-6	Section 2.4
MP, Part 2-7	Section 2.5
MP, Part 2-14	Section 4.5
MP, Part 3-10	Section 3
MP, Part 4-9	Section 4 and Appendix C through I
CA, Condition 13a	Section 4.5 and Appendix B
CA, Condition 13b	Section 4.5
CA, Condition 13c	Section 4.5 and Appendix B
GWP, Condition 4	Section 4.5

2.0 Operating Activities

2.1 1997 Summary

2.1.1 Safety and Human Resources

Flambeau Mining Company (Flambeau) received safety recognition from the US Department of Labor Mine Safety an Health Administration's (MSHA) Sentinels of Safety Program. This was the fourth consecutive year of recognition. Flambeau employees completed the entire project under MSHA jurisdiction without a lost time accident, a reportable accident or an MSHA citation. As of December 31, 1997, Ames and Flambeau had combined to work at total of 1279 days without a lost time accident.

Focus for the safety program in 1997 was issues related to backfilling of the pit which included additional training as an increased number of contractors were employed. Community issues were addressed including the replacement of equipment backup alarms with strobe lights to reduce noise during night shift work.

Seven Summer Interns were employed during backfill operations. By the end of 1997, nine employees were severed and two transfered to other Kennecott properties. Five of those severed have found other employment. Heath assessments were completed on employees as they left to confim that exposures to working conditions had no adverse effects.

2.1.2 Operations

Normal mining operations were concluded in March 1997 with the removal of ore to the 880 level. Due to minor failures within the hanging wall formation during the latter part of 1996, additional drilling equipment was utilized to provide ground support functions, which allowed the timely completion of mining in March. Backfilling of the lower benches started immediately the same month. The hanging wall failures presented no problems to on-going operations as a result of the timeliness of the mining program.

As backfilling operations progressed between March and July, minor quantities of ore, within the permitted open pit design, were recovered from the west wall of the pit. In total, mine operations produced 111,000 tons of ore and 53,000 tons of waste rock during the year. Shipments for the year totaled 311,000 tons of ore and were completed in August.

2.1.3 Water Treatment

287.5 gpm

The wastewater treatment plant (WWTP) discharged an average 414,000 gallons per discharge day through outfall 001 to the Flambeau River. No difficulties were experienced in achieving the required effluent standards.

The WWTP discharged 76.94 million gallons of effluent to the Flambeau River during 1997 as compared to 132.44 million gallons during 1996. The average monthly discharge during 1997 was 6.41 million gallons per month as compared to 11.0 million gallons per month during 1996. As evident in Figure 2-1 , pit pumping decreased throughout the year as backfilling of the pit progressed. From WWTP start-up through December 1997 Flambeau's WWTP had discharged over 575 million gallons of effluent to the Flambeau River.

Mercury sampling on Flambeau's WWTP effluent was conducted in January, March, May, July and October 1997. The analytical results of the January and March sampling were less than the lab detection limit of 340 ng/l . At the request of the Wisconsin Department of Natural Resources (WDNR) , the May, July and October samples were analyzed to achieve a detection limit of at least 20-50 ng/l. The analytical results of these samples were less than 9.7 ng/l. EPA-approved analytical methods are not capable of achieving detection limits at Flambeau's WPDES permit limit of 2 ng/l. Flambeau continues to be in compliance with the WPDES permit.

During June and July 1997, 507,000 gallons of Type II sediment was removed from the surge and runoff ponds. The material was pumped to the Type II stockpile and following de-watering, was deposited in the pit during backfill operations. During late August and early September 1997, 387,000 gallons of sediment was removed from the surge and runoff ponds using vac-trucks. The material was limestone amended and deposited in the pit. Once clean, no additional Type II material was introduced to the ponds. Water was pumped from the pit directly to the WWTP.

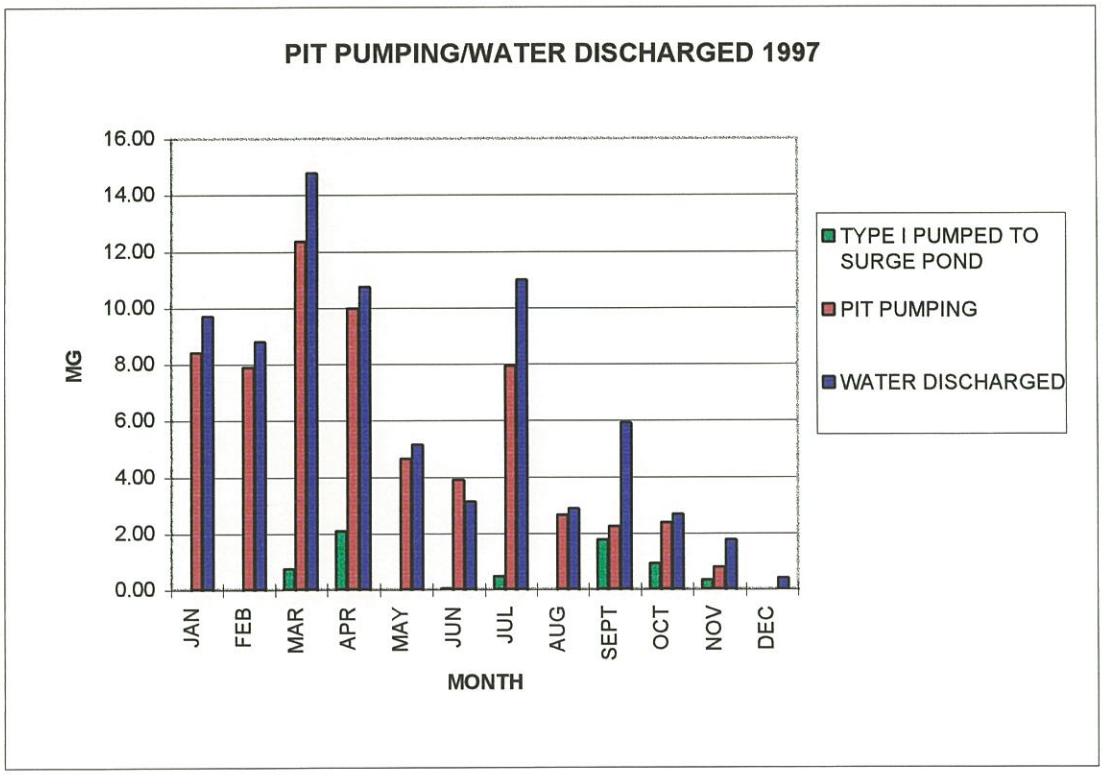
On September 4, 1997 the WWTP made a transition from treating Type II water to Type I water. The Type II solids within the WWTP were removed and deposited in the pit. Pit pumping was discontinued until the Type II solids were covered with Type I waste rock. Pit pumping was then resumed and water contacting Type I waste rock was pumped directly into the WWTP. Pit pumping to the Surge Pond was not resumed until the Type I waste rock was completely covered by till or sandstone.

2.1.4 Pit Backfill

Backfilling during 1997 resumed on March 10, 1997 with the placement of Type II waste rock in the Phase I (west) portion of the open pit at the 880 ft. elevation. The final configuration of the pit is provided in Figure 2-2. Limestone was applied to the Type II stockpile at a rate of 20.1 pounds of limestone per ton of waste rock. This conservative application rate had been approved by the Department in a letter dated

FIGURE 2-1
FLAMBEAU MINING COMPANY
PIT PUMPING/WATER DISCHARGED
1997

MONTH	PIT PUMPING (MG)	TYPE I PUMPED TO SURGE POND (MG)	WATER DISCHARGED (MG)
JAN	8.40	0.00	9.71
FEB	7.89	0.00	8.79
MAR	12.36	0.76	14.78
APR	9.98	2.08	10.75
MAY	4.66	0.00	5.15
JUN	3.89	0.05	3.13
JUL	7.94	0.47	10.98
AUG	2.65	0.00	2.88
SEPT	2.24	1.77	5.91
OCT	2.39	0.94	2.69
NOV	0.80	0.34	1.77
DEC	0.00	0.00	0.40



39,800 E
40,000 E
40,200 E
40,400 E
40,600 E
40,800 E
41,000 E
41,200 E
41,400 E
41,600 E
41,800 E
42,000 E
42,200 E
42,400 E
42,600 E

20,600 N
20,400 N
20,200 N
20,000 N
19,800 N
19,600 N

APPROXIMATE
PIT LIMITS

LEGEND

1120 — RECORD SURVEY CONTOUR (CONTOUR INTERVAL = 2')

---------- APPROXIMATE MINE PIT BOUNDARY

19,600 N MINE PIT SURVEY CONTROL GRID

FLAMBEAU MINING COMPANY

FIGURE 2-2

MINE PIT BOTTOM
RECORD SURVEY

Scale: 0 100' 200' | Date: DECEMBER, 1997

Prepared By: Foth & Van Dyke | By: JRB2

October 25, 1996. During early Spring 1997, Flambeau had provided additional submittals substantiating a variable limestone application which was based upon the specific characteristics of stockpiled Type II material. Upon receipt of the Department's approval dated May 15, 1997, Flambeau began applying limestone to the Type II stockpile at a variable rate.

Flambeau and its consultants, Foth & Van Dyke, managed the backfilling of the open pit in accordance with the Updated Resident Project Representative Manual (April 1997) and the Resident Project Representative Manual, Type I Waste Rock (July 1997). QA/QC data collected in accordance with these Manuals will be provided to the Department in a forthcoming submittal.

Abandonment of horizontal and vertical borings drilled as part of Flambeau's geotechnical program is incorporated in the pit backfill operations. Flambeau, through interaction with the Department, developed and submitted the methodology for the abandonment of these borings during the backfill operations. In a letter dated October 15, 1996, Flambeau provided a complete list identifying the location and identification number of the horizontal and vertical borings constructed to date. This letter is incorporated by reference. During the 1997 backfill Flambeau abandoned the vertical borings indicated in the October 15, 1997 letter and provided abandonment reports to the Department in a letter dated September 19, 1997. This letter is also incorporated by reference. Safety concerns and physical barriers restricted the abandonment of a limited number of horizontal borings. A summary of the horizontal borings abandoned during the 1997 backfilling process will be provided to the Department in a forthcoming submittal.

Backfill of Type I waste rock with scrapers initiated during June 1997. Type I waste rock was also characterized and, if necessary, amended accordingly with limestone. As predicted, not all Type I waste rock required limestone amendment. Type II backfill continued with 50-ton haul trucks, backhoe, and/or loader. As backfilling progressed, the Phase II portion of the Type II stockpile was prepared for HDPE liner removal and backfill. Overlying material was excavated leaving one to two feet of soil over the liner. Liner removal initiated during late July 1997 using scrapers initially. Ultimately dozers, backhoe, and loader were used to remove and load the liner into scrapers and/or haul trucks. The liner was backfilled with the Type II material. The Phase I, Type II stockpile liner was not removed until Type II waste rock was substantially backfilled. Liner disposal which included the areas of the Type II stockpile, crusher, and railspur was completed during early September 1997.

Backfill of Type II material was also completed during early September 1997. This included all Type II waste rock, Type II samples, drill core, Surge and Runoff Ponds sediments, railspur ballast, and any other materials exposed to Type II materials including haul road surfaces. Previous to resuming pumping from the pit to the Surge Pond, the Type II and Type I waste rock were completely backfilled and covered. Any solids within the WWTP were appropriately deposited in the pit with the material from which they were generated, ie., water

contacting Type I waste rock generated solids which were backfilled with the Type I waste rock. Type I waste rock backfill was also complete during early September 1997.

During September and October 1997 the remaining backfill consisting of saprolite, sandstone, and till was completed. Rough grading for the 1997 year was complete by October 17, 1997.

2.1.5 Site Decommissioning

The following is a summary of the significant structures that were removed in 1997 as part of the pit backfill and site reclamation:

- Geomembrane and leachate collection system for Type II Stockpile.
- Ore crusher.
- Segment of railroad spur over geomembrane including track scale.
- Lysimeter located beneath the Type I Stockpile.
- Pump station for direction of surface runoff from the Type I Stockpile to the settling ponds.
- Visitor center and access walkway to top of topsoil stockpile.
- Contractor Maintenance Shop

2.1.6 Milestones

The following is a summary of significant milestones throughout the year:

Mining complete	March 1997
Mine administration site leased to LCIDC	May 1997
20 offsite acres sold to city for industrial use	May 1997
City and County Library opened	June 1997
Ore shipments complete	August 1997
Type II backfill complete	September 4, 1997
Type I backfill complete	September 6, 1997
Saprolite backfill complete	September 10, 1997
Sandstone backfill complete	September 19, 1997
Rough grading complete	October 17, 1997
Site stabilized for winter	October 30, 1997
1212 days without lost time accident	October 1997
Contractor demobilized	December 1997

2.2 DEVIATIONS AND MODIFICATIONS

Condition 2-4 in the Mine Permit requires an inventory of deviations and modifications to the Permit received subsequent to permit issuance.

During 1997 there were no modifications to the Mining Permit. Minor deviations related to the backfilling of the open pit were reviewed and approved by WDNR prior to backfill acitivities.

A list of deviations for 1997 is included in Appendix A.

2.3 CONSTRUCTION REPORTS

In its original letter authorizing mine start-up (March 9, 1993), WDNR requested that certain documentation be included in the Annual Report:

- Inspection of sideslopes of surge pond and runoff pond
- Inspection of Type II stockpile piping
- Inspection of scuff strip below the surge pond outlet

The required documentation is described in Section 4.5 of this report and included in Appendix E.

2.4 INCIDENT LOG

Mine Permit Condition 2-6 requires a log of all incidents such as spills, pond overflow, embankment failure or leakage. This log is maintained on-site and is available for inspection. A summary of the incidents reported to the environmental staff during 1997 is included in Table 2-1. Spills are reported in accordance with Wis. Adm. Code ch. NR 158, CERCLA Reportable Quantities and SARA Section 302 Extremely Hazardous Substances Reportable Quantities.

Table 2-1
Flambeau Mining Company
1997 Incident Log

DATE	INCIDENT	ACTION
5/16/97	~15 gal. hydraulic fluid spill due to burst hydraulic hose on limestone delivery truck.	Contaminated material contained and cleaned up. Spill prevention and control restressed with trucking company. WDNR notified on 5/16/97.
5/23/97	~40 gal. hydraulic fluid spill due to haul truck hydraulic pump failure.	Contaminated material contained and cleaned up. Continued inspection and replacement of parts as possible. WDNR notified 5/23/97.
7/24/97	~10 gal. hydraulic fluid spill due to scraper lift cylinder failure.	Contaminated material contained and cleaned up. Continued inspection and replacement of parts as possible. WDNR notified 7/25/97.
8/13/97	~5 gal. hydraulic fluid spill due to haul truck drive line failure.	Contaminated material contained and cleaned up. Continued inspection and replacement of parts as possible. WDNR notified 8/14/97.
9/29/97	~5 gal. transmission fluid spill due to water wagon pump seal failure.	Contaminated material contained and cleaned up. Continued inspection and replacement of parts as possible. WDNR notified 9/29/97.

2.5 DRILL HOLES

Mine Permit Condition 2-7 requires a summary of all exploration drilling activities conducted on the mine site during the previous year. No exploration drilling activities were conducted on the mine site during the previous year.

3.0 RECLAMATION ACTIVITIES

As required by the Mine Permit Section 3, reports on progress of reclamation activities are prepared throughout the year. An annual report is required by Condition 3-26(d). The 1997 Annual Reclamation Report dated November 14, 1997 was submitted to the WDNR and is incorporated by reference. Other reclamation updates submitted on January 30 and October 13, 1997 are incorporated by reference. Reclamation activities reported in the November 1997 report included summary of pit backfill activities, update on the native grasses and wildflower display near the Visitor's Center, collection of seeds for site reclamation, evaluation of temporary nursery, observation of hydric soil stockpile, site remedial seeding, and assessments of Wetland 1.

Wetland 1 is discussed in detail in Wetland Surface Flows, Section 4.2.6 of this report.

Reclamation activities during 1997 included routine inspection and maintenance of vegetation throughout the project area. The prairie seed test plots and aquascape were not evaluated during 1997. Sufficient data had been previously collect for reclamation planning purposes. A native grasses and wildflower display located adjacent to the Visitor's Center was decommissioned and plants were temporarily relocated and will be transplanted to the reclaimed site in 1998.

Seed from 21 native species from the Ladysmith area was collected August 25 - 29, 1997. Seed was hand collected by Taylor Creek Nursery personnel in road right-of-ways, along rail lines, and on private property with permission. The collected seed will be used for revegetating the mine site during 1998. Additional seed collection took place on October 10, 1997 by Flambeau High School students. They collected seed from thirty-one different species in the Ladysmith area.

4.0 SITE MONITORING

4.1 GROUNDWATER QUALITY SAMPLING AND ANALYSIS

Quarterly groundwater monitoring was performed in accordance with descriptions provided in the Updated Monitoring Plan (July 1991), the Revised Mining Permit Quality Assurance/Quality Control Document (August 1991) and the Local Agreement. Results of the monitoring were submitted to the WDNR Mine Reclamation Unit April 1, June 30, September 30, 1997 and January 7, 1998. Those reports are incorporated by reference.

Monitoring data for each groundwater monitoring site is graphed and tabulated in Appendix C. A statistical trend test (Mann-Kendall test) was performed on the results for each compound within each well. Those results are also shown with the tabulated data. Only those water quality parameters which showed a statistically significant trend upward or downward are discussed in this section. More detailed information on trend analysis and other trends is contained in Appendix C. Sample results from the following wells appeared to show statistical trends:

MW1000P-R	Conductivity	(Downward Trend)
	Alkalinity	(Downward Trend)
	Copper	(Upward Trend)
	Hardness	(Downward Trend)
	Iron	(Downward Trend)
	Manganese	(Downward Trend)
MW1002	Alkalinity	(Downward Trend)
	Hardness	(Downward Trend)
MW1004P	Hardness	(Downward Trend)
	Iron	(Downward Trend)
	Manganese	(Downward Trend)
	Sulfate	(Upward Trend)
MW1004S	pH Field	(Downward Trend)
MW1005	Alkalinity	(Downward Trend)
	Hardness	(Downward Trend)
MW1005P	Hardness	(Downward Trend)
	Iron	(Downward Trend)
	Manganese	(Downward Trend)
	Sulfate	(Upward Trend)

MW1005S	Alkalinity	(Downward Trend)
	Hardness	(Downward Trend)
MW1010P	Iron	(Downward Trend)
	TDS	(Downward Trend)

Monitoring wells MW1000P-R and MW1010P indicate a downward trend for iron. MW1010P also indicates a downward trend for TDS. MW1000P-R also indicates a downward trend for conductivity, alkalinity, hardness, manganese and TDS as well as an upward trend for copper. Monitoring wells MW1000P-R and MW1010P are located within the river pillar area between the open pit and the Flambeau River. Standing water levels recorded from these wells and the average river level indicate the groundwater flow has changed and currently flows from the river towards the open pit as was originally predicted. This change in flow direction would be expected to result in the slight downward trends being observed in these monitoring wells.

The upward copper trend observed in MW1000P-R may also be attributed to the change in groundwater flow direction and significant fluctuations in the Flambeau River elevation. During periods of low river elevation, there is the potential for an increased oxidation of sulfide-bearing rocks which crop out in the river basin adjacent to the river pillar. Copper concentrations from MW1000P-R are at least 17 times less than the groundwater standard. The statistical increasing trend for copper concentrations from MW1000P-R is slight and of no concern.

A downward trend was observed for alkalinity and hardness in MW1002. The downward trends are slight and the concentrations have remained relatively constant during the second half of 1994 through 1997 with the exception of a seemingly abnormal result for hardness in July, 1996.

A downward trend was observed for hardness, iron and manganese in MW1004P. The downward trend for hardness is very slight. The downward trend for iron and manganese is mostly associated with drop in concentrations during 1993. A slight upward trend was observed for sulfate in MW1004P.

A downward trend was observed for pH in MW1004S to a range of 5.84 s.u. to 6.90 s.u. between October 1994 and October 1997. This pH range is not significantly different from data collected from other groundwater monitoring wells in the area.

Monitoring wells MW1005P and MW1005S observed downward trends for hardness. These trends were slight with actual concentrations dropping only slightly from 1991 through 1997. A downward trend was also observed for alkalinity in MW1005S. Downward trends for iron and manganese and a slight upward trend for sulfate were observed in MW1005P. A downward trend in MW1005 was also observed for hardness. Hardness concentrations

observed in MW1005 have remained relatively consistent in 1996 and 1997.

The downward trend in groundwater elevations in some of the wells located within close proximity of the pit continued to a less significant degree in 1997 as compared to 1993 and the early part of 1994. The groundwater elevations appeared to somewhat stabilize during mid to late 1994 and continued this relatively steady state in early 1997 with only slight downward trends. As a result of the progress of the pit backfilling, wells located between the west end of the pit and the river showed significant increases in groundwater elevation in late 1997. Figure 4-1 presents the locations of monitoring wells. Graphs and further discussion on groundwater elevations are included in Appendix C.

4.2 SURFACE WATER

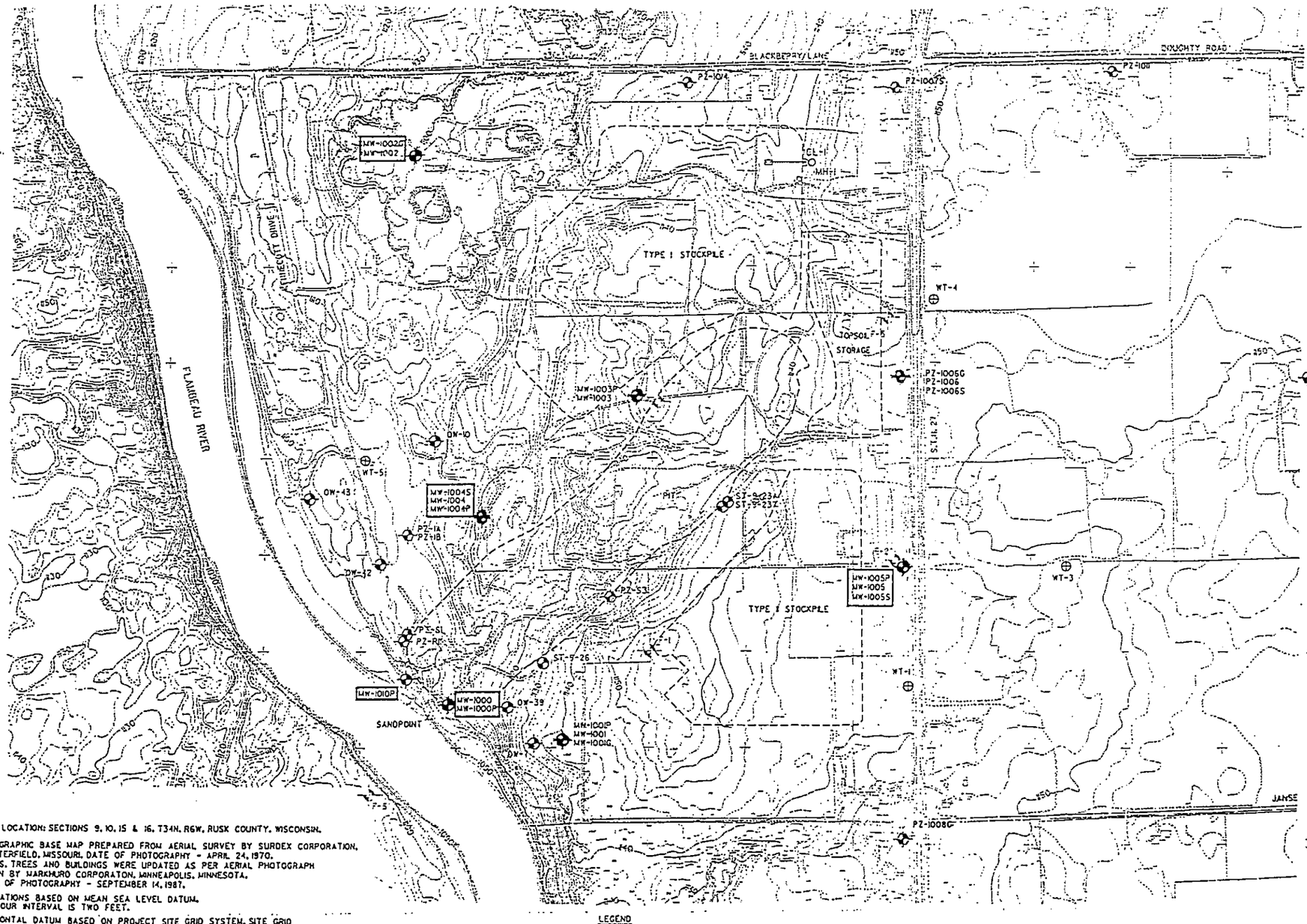
The surface water monitoring program includes sampling and analyses of the following elements: sediments, fish, macroinvertebrates, water quality, habitat characteristics and wetland surface flows. The Revised Mining Permit Quality Assurance/Quality Control Document (August 1991) specifies that an annual surface water monitoring report will be prepared and submitted to WDNR in March of each year. This portion of this report submitted in January, is the surface water monitoring report referenced in the Quality Assurance Document.

4.2.1 SEDIMENTS

Sediment samples are collected once per year at two locations in the Flambeau River. Sediment traps were installed upstream (Site S-1) and downstream (Site S-3) of the Flambeau discharge locations on June 17, 1997 and retrieved on August 18, 1997. WDNR was advised of the installation and collection dates.

Figure 4-2 shows the sediment sampling locations. Results from the downstream sample site are noted on Table 4-1. Results from the Blackberry Lane sampling site upstream of the mine are noted in Table 4-2. More detailed information about the sediment sampling is contained in Appendix D.

In general, the downstream sample (S-3) contained more sediment than the upstream sample (S-1). Sample S-1 appeared to contain more granular (sand and gravel) material than sample S-3. Comparison of 1997 analyses with all previous years' data indicates that no significant increase or decrease in parameter concentrations in river sediment is occurring. Downstream samples continue to compare favorably to upstream samples indicating that no observable impact on the Flambeau River sediments from mine activities has occurred.



NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATION, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8887 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

5. SEE FIGURE NO. 2-7 FOR THE LOCATION OF WETLAND STAFF GAUGE WT-2 AND FOR SURFACE WATER MONITORING LOCATIONS.

LEGEND

- EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- CONTROL MONUMENT
- MW-1005 MONITORING WELL
- PZ-R3 PIEZOMETER
- MW-1005 WELL ON THE WATER QUALITY MONITORING PROGRAM
- WT-5 WETLAND STAFF GAUGE

N

0 300' 600'
SCALE

GROUNDWATER AND COLLECTION LYSIMETER CONSTRUCTION AND OPERATION MONITORING PROGRAM

COLLECTION LYSIMETER/ WELL/PIEZOMETER NUMBER	ELEVATION OF SCREENED INTERVAL (FT. MSL.)	GEOLOGIC UNIT	PARAMETER*
MW-1000	1091-1081	PRECAMBRIAN, TILL	1, 2
MW-1000P	1049-1044	PRECAMBRIAN	1, 2
MW-1001	1118-1108	TILL	1
MW-1001G	1095-1090	TILL, SANDSTONE	1
MW-1001P	1051-1046	PRECAMBRIAN	1
MW-1002	1098-1086	SAND & GRAVEL	1, 2
MW-1002G	1055-1050	SAND & GRAVEL	1, 2
MW-1003	1113-1103	SANDSTONE	1
MW-1003P	1062-1057	PRECAMBRIAN	1
MW-1004	1112-1102	SAND & GRAVEL	1, 2
MW-1004S	1093-1088	SANDSTONE	1, 2
MW-1004P	1042-1037	PRECAMBRIAN	1, 2
MW-1005	1134-1124	TILL	1, 2
MW-1005S	1097-1092	SANDSTONE	1, 2
MW-1005P	1056-1051	PRECAMBRIAN	1, 2
PZ-1006	1143-1138	TILL	1
PZ-1006G	1119-1114	TILL	1
PZ-1006S	1101-1096	SANDSTONE	1
PZ-1007S	1110-1105	SANDSTONE	1
PZ-1008	1138-1128	TILL	1
PZ-1008G	1096-1091	SAND & GRAVEL	1
PZ-1009	1144-1134	TILL	1
PZ-1009G	1107-1102	TILL	1
MW-1010P	987- 982	PRECAMBRIAN	1, 2
PZ-1011	1108-1098	TILL	1
PZ-1012	1110-1100	TILL	1
PZ-R1	901- 881	PRECAMBRIAN	1
PZ-S1	1067-1062	PRECAMBRIAN	1
PZ-S3	1100-1095	SANDSTONE	1
SANDPOINT	1084-1082	SAND & GRAVEL	1
ST-9-23	1106-1101	SANDSTONE	1
ST-9-23A	1125-1120	SAND & GRAVEL	1
ST-9-26	1106-1101	TILL	1
PZ-1A	1099-1097	SAND & GRAVEL	1
PZ-1B	1103-1101	SAND & GRAVEL	1
OW-7	1088-1078	TILL	1
OW-10	1063-1059	TILL	1
OW-39	1107-1073	TILL	1
OW-42	1090-1058	SAND & GRAVEL	1
OW-43	1090-1022	SAND & GRAVEL	1
CL-1	N.A.	N.A.	3

*1 GROUNDWATER ELEVATION (QUARTERLY).

*2 SPECIFIC CONDUCTIVITY (FIELD), PH (FIELD AND LAB), TDS, IRON, MANGANESE, SULFATE, COPPER, TOTAL ALKALINITY, TOTAL HARDNESS (ALL QUARTERLY).

*3 PH (FIELD AND LAB), SPECIFIC CONDUCTANCE (FIELD), TOTAL CHROMIUM, COPPER, IRON, MANGANESE, SULFATE, TOTAL DISSOLVED SOLIDS, TOTAL ALKALINITY, TOTAL HARDNESS, VOLUME OF LIQUID REMOVED (ALL QUARTERLY).

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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66 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

FIGURE 4-1
CONSTRUCTION AND OPERATION GROUNDWATER AND COLLECTION LYSIMETER MONITORING PROGRAM

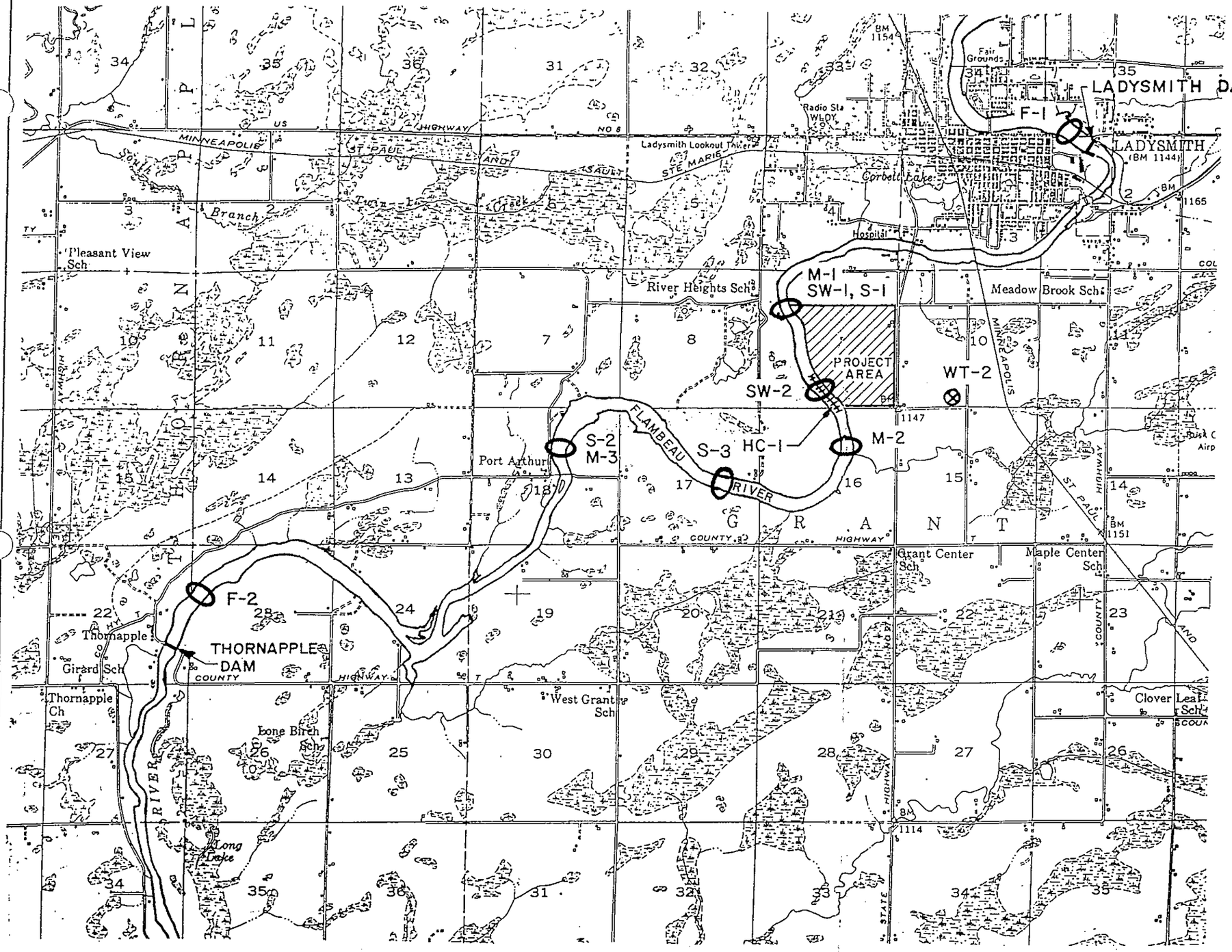
MICROFILM .09
DRAWING NO. REV.
DIVISION DRAWING NO.
SCALE SEE BAR SCALE

DESIGN BY: JBH DATE: 7-1-91
DRAWN BY:
CHK'D BY:
APPR'D BY:

REFERENCES

DWG. NO.	DESCRIPTION
3	

NO.	DATE	REVISIONS	BY	CHK'D	DES'R



NOTE: SEE FIGURE NO. 2-1 FOR THE LOCATION OF WETLAND STAFF GAUGES WT-1, WT-3, WT-4 AND WT-5.

N

0 4000' 8000'

SCALE

LEGEND

- SW-1 — SAMPLING LOCATIONS FOR SURFACE WATER SAMPLES
- S-1 — SAMPLING LOCATION FOR SEDIMENTS
- M-1 — SAMPLING LOCATION FOR MACRO-INVERTEBRATES
- F-1 — SAMPLING LOCATION FOR FISH
- HC-1 — LOCATION FOR HABITAT CHARACTERISTICS OBSERVATIONS
- WT-2 — WETLAND STAFF GAUGE

MAP SOURCE: U.S.G.S. LADYSMITH, WI. 15 MINUTE QUADRANGLE

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FIGURE 4-2
CONSTRUCTION AND OPERATION
SURFACE WATER MONITORING
SITE LOCATIONS

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION
	15	

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	DEPT MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	DEPT MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'G		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	DHS	12/89
CHK'D		
DES. ENG'R		
DEPT ENG'R		

TABLE 4-1

FLAMBEAU RIVER SEDIMENT SAMPLING RESULTS
DOWNSTREAM SAMPLING
(S-2 & S-3)

Metals (ppm)	1989 Baseline[1]	1991 (S-2)	1992 (S-2)	1993 (S-2)	1993 (S-3)	1994 (S-3)	1995 (S-3)	1996 (S-3)	1997 (S-3)
aluminum	NA	4000.0	12000.0	1500	4400	4000	3600	2500	2400
arsenic	1.1	1.5	4.1	<0.55	0.71	<1.6	1.5	<0.45	<0.71
cadmium	<0.5	0.6	<1.4	<0.055	0.11	0.13	0.085	0.64	0.70
chromium	4.8	13.0	24.0	23.8	9.6	10	6.6	6.3	6.1
copper	2.6	7.2	24.0	2.1	6.7	7.1	7.0	8.2	6.7
iron	2200	16000	25000	3100	8200	7700	7300	6700	7900
lead	<4.5	6.9	20	2.6	8.3	7.8	7.5	9.0	6.4
manganese	63	1600.0	570.0	610	830	860	780	840	910
mercury	<.01	0.1	<0.3	<0.057	<0.07	<0.03	<0.06	<0.02	0.059
nickel	NA	7.3	12.0	1.7	6.5	6.2	5.0	5.7	3.0
selenium	NA	0.4	<0.9	<0.28	<0.26	<1.6	<0.27	1.4	0.95
silver	NA	<1.1	<2.6	0.086	0.58	<0.08	0.04	<0.56	<0.40
zinc	28	45.0	79.0	9.6	33	46	26	28	24
Other									
Total Solids (%)	69	76.8	35.0	32	56	NA	44.8	49.8	30.6
Total Volatile Solids (%)	NA	2.5	12.0	5.8	6.24	NA	6.9	5.5	11

NA = Not Analyzed

[1] Environmental Impact Report, March 3, 1989, p. 3.7-1.1

TABLE 4-2

FLAMBEAU RIVER SEDIMENT SAMPLING RESULTS
BLACKBERRY LANE (UPSTREAM)
(S-1)

Metals (ppm)	1989 Baseline[1]	1991	1992	1993	1994	1995	1996	1997
aluminum	NA	3800.0	3300.0	4000.0	3900	2900	1900	2100
arsenic	0.9	2.2	2.2	1.4	<4.2	<0.41	1.6	<0.87
cadmium	<0.5	<0.7	<0.6	<0.06	<0.42	<0.03	0.72	1.2
chromium	5.5	11.0	10.0	11	10	4.4	4.1	5.6
copper	2.8	7.3	6.0	7.0	5.8	6.4	5.8	5.3
iron	3000	18000.0	16000.0	15000	11000	4800	6800	6500
lead	<4.5	6.0	5.8	8.5	3.3	3.3	<2.2	5.1
manganese	130	1900.0	1000.0	1300	1500	600	510	700
mercury	<.01	0.1	<0.1	<0.045	<0.04	<0.02	<0.02	0.024
nickel	NA	5.8	6.1	8.4	7.4	6.1	6.1	2.2
selenium	NA	0.4	<0.4	<0.32	4.2	<0.44	<0.28	<1.0
silver	NA	<1.2	<1.1	0.057	<0.21	<0.05	<0.57	<0.70
zinc	16	47	33.0	38.0	34	18	19	20
Other								
Total Solids (%)	85	73	78.6	79.2	NA	76.7	74.9	72.6
Total Volatile Solids (%)	NA	1.8	1.6	0.8	NA	<2.0	<2.0	<2.0

NA = Not Analyzed

[1] Environmental Impact Report, March 3, 1989, p. 3.7-1.1

4.2.2 FISH

Walleye are collected once per year during the annual low flow period. Samples are collected upstream and downstream of the mine. Samples of fish tissue are analyzed for metals, while length, sex and stomach contents of each fish are noted. In 1997, fish were collected on August 19 and 20 using a boat mounted with an electroshocker. Procedures described in the Updated Monitoring Plan (July 1991) and Revised Mining Permit Quality Assurance/Quality Control Document (August 1991) were followed.

General observations showed that species observed during the collection were consistent with those collected in previous years. The stomach contents of the walleye varied from empty to full with fish and/or vegetation. There were no significant differences in metal content of fish tissue sampled downstream of the mine compared to upstream of the mine. As compared to previous years, fish liver analytical data is consistent with data obtained in previous years. Mercury concentrations in fish tissues continued to be similar to those seen in the past at both the upstream and downstream locations. Appendix E contains more detailed information about the fish sampling. Fish sampling locations are shown in Figure 4-2.

4.2.3 MACROINVERTEBRATES

Crayfish are collected at three sampling locations once per year for metal analyses. The sampling and analyses are conducted in accordance with the Updated Monitoring Plan and the Revised Mining Permit Quality Assurance/Quality Control Document (August 1991). Samples were collected on September 26, 1997. Whole bodies were used for analysis and the results represent a composite for all crayfish collected per site. The analytical data continues to indicate that there is no relative difference in parameter concentrations when comparing upstream to downstream locations.

Samples were collected on September 26, 1997 to identify macroinvertebrate fauna. Following collection, specimens were sent to EA Engineering, Deerbrook, Illinois for identification and enumeration. The results of the 1997 macroinvertebrate sampling continue to show general populations have remained relatively stable with slight variations in populations from site to site and year to year. Macroinvertebrate sampling locations are shown on Figure 4-2.

Results for macroinvertebrate sampling are included in Appendix F.

4.2.4 SURFACE WATER QUALITY

Water samples are taken once per quarter from the Flambeau River at two monitoring locations. Samples are collected in accordance with procedures described in the Updated Monitoring Plan (July 1991) and the Revised Mine Permit Quality Assurance/Quality Control Document (August 1991). The sample identified as SW-1 is upstream of the mine site; SW-2 is downstream of the mine site. Figure 4-2 shows the locations of the surface water sampling.

Results of quarterly sampling have been submitted to WDNR on April 1, June 30, October 20, 1997 and January 7, 1998. Those submittals are incorporated by reference.

A summary of the 1997 surface water quality results are included on Table 4-3. The results from 1997 are generally consistent with data collected from the same locations in 1992-1996 and 1991 during baseline data collections. No significant difference in parameter concentrations is evident when comparing downstream water quality to upstream water quality; however, there is a slightly decreasing trend for aluminum at sample location SW-1. Trends of surface water quality results and statistical trend analysis are contained in Appendix C.

4.2.5 HABITAT CHARACTERISTICS

The annual habitat characterization along the eastern bank of the Flambeau River was conducted on August 18, 1997. The characterization followed procedures described in the Updated Monitoring Plan (July 1991) and the Revised Mining Quality Assurance/Quality Control Document (August 1991).

During the 1997 habitat characterization, substrate conditions of the Flambeau River were observed to have no appreciable differences that could be attributed to mining impacts as compared to 1992 observations which were previous to initiation of discharges from the mine's discharge channels.

As in previous years, the east bank just north of Outfall 002 to about 100 feet below Outfall 001 remains naturally erodible. In 1997, there was noted a gradual encroachment by vegetation onto the riprap of outfall 002. In contrast to previous years, in 1997 no debris or vegetation was observed on overhanging tree branches along the area of observation.

Additional detail including photographs is provided in Appendix G of this report.

4.2.6 WETLAND SURFACE FLOWS

Water levels in wetlands 1, 5C, 6C, 7 and 10A are measured monthly between March and December. Staff gauges designated WT 1 (Wetland 5C), WT 2 (Wetland 7), WT 3 (Wetland 6C), WT 4 (Wetland 10A) and WT 5 (Wetland 1) are measured. Figure 4-1 and Figure 4-2 show the staff gauge locations.

Measurements were provided to WDNR Mine Reclamation Unit on April 1, June 30, October 20, 1997 and January 7, 1998; those reports are incorporated by reference. Tables 4-4 through 4-8 summarize the wetland elevations for the five wetlands. Wetlands 5C, 6C, 7 and 10A showed readings similar to previous years. During 1997, Wetland 1 experienced conditions similar to those during 1994 through 1996.

TABLE 4-3
1997 QUARTERLY SURFACE WATER QUALITY DATA SUMMARY

	SW-1 (Upstream)				SW-2 (Downstream)			
	Jan-97	Apr-97	Jul-97	Oct-97	Jan-97	Apr-97	Jul-97	Oct-97
aluminum (ug/l)	64 (1)	260	85	110	58 (1)	240	80	72 (1)
arsenic (ug/l)	<1.8	<1.8	<1.4	<1.4	<1.8	<1.8	<1.4	<1.4
beryllium (ug/l)	<0.083	<0.083	0.11 (1)	<0.083	<0.083	<0.083	0.23 (1)	<0.083
cadmium (ug/l)	<0.16	<0.16	<0.16	<0.16	<0.16	0.16 (1)	<0.16	<0.16
chromium VI (ug/l)	<3.6	<18	<3.6	<3.6	<3.6	<18	<3.6	<3.6
chromium (ug/l)	2.5	0.82 (1)	1.1 (1)	<0.61	2.1 (1)	1.2 (1)	1.2 (1)	1.4 (1)
copper (ug/l)	<1.7	1.8 (1)	<1.7	2.2 (1)	<1.7	2.6 (1)	<1.7	<1.7
conductivity (field)	113	59	96	108	132	90	107	114
DO (mg/l)	7.5	9.6	7.3	7.9	7.4	8.4	8.1	8.3
hardness (mg/l)	44	20	35	39	52	21	37	40
lead (ug/l)	2.3 (1)	<2.0	<2.0	<2.0	2.1 (1)	<2.0	<2.0	<2.0
mercury (ug/l)	<0.067	<0.067	<0.050	<0.050	<0.067	<0.067	<0.050	<0.050
nickel (ug/l)	<0.75	0.76 (1)	<0.75	<0.75	<0.75	<0.75	1.1 (1)	<0.75
pH (lab)	6.8	5.6	7.1	7.4	6.9	5.4	7.2	7.4
pH (field)	7.6	6.8	7.3	7.3	7.6	6.5	7.3	7.4
selenium (ug/l)	1.8 (1)	<1.5	<1.6	<1.6	<1.5	<1.5	<1.6	<1.6
silver (ug/l)	<1.1	<1.1	<1.1	1.1 (1)	<1.1	1.6 (1)	<1.1	<1.1
sulfide (mg/l)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
TDS (mg/l)	100	98	94	72	84	100	99	80
TSS (mg/l)	<1.0	8.0	4.0	5.0	3.0	4.0	3.0	<1.0
zinc (ug/l)	21	13	<12	<12	<12	17	<12	<12

(1) < LOQ

TABLE 4-4

MONTHLY WETLAND STAFF GAUGE READING SUMMARY

Staff Gauge Location/
Water Level (MSL)

WETLAND 5C

(WT-1)

	1991	1992	1993	1994	1995	1996	1997
JAN	--	NRT	NRT	NRT	NRT	NRT	NRT
FEB	--	NRT	NRT	NRT	NRT	NRT	NRT
MAR	--	1140.62	NRT	NRT	NRT	NRT	NRT
APR	--	1140.47	1140.60	1140.73	1140.34	1140.24	1140.28
MAY	1140.84	1140.21	1140.47	1140.22	1140.11	NSW	NSW
JUN	1140.78	NSW	1140.34	1140.06	NSW	1140.14	NSW
JUL	1140.05	NSW	NSW	NSW	NSW	NSW	1140.10
AUG	NSW	NSW	1140.48	NSW	1140.65	NSW	1140.40
SEP	1140.21	1140.09	1140.51	1140.34	NSW	NSW	NSW
OCT	NSW	1140.68	1140.46	1140.28	1140.18	1140.29	1140.14
NOV	NRT	NRT	NRT	NRT	NRT	NRT	NRT
DEC	NRT	NRT	NRT	NRT	NRT	NRT	NRT

NRT = No reading taken due to frozen conditions
NSW = No standing water

TABLE 4-5

MONTHLY WETLAND STAFF GAUGE READING SUMMARY

Staff Gauge Location/
Water Level (MSL)

WETLAND 6C

(WT-3)

	1991	1992	1993	1994	1995	1996	1997
JAN	--	NRT	NRT	NRT	NRT	NRT	NRT
FEB	--	NRT	NRT	NRT	NRT	NRT	NRT
MAR	--	1146.9	NRT	NRT	NRT	NRT	NRT
APR	--	1146.72	NRT	1146.89	1146.67	1146.51	1146.51
MAY	1147.05	NSW	1146.78	NSW	1146.52	NSW	NSW
JUN	NSW	NSW	1146.66	NSW	NSW	NSW	NSW
JUL	NSW	NSW	NSW	NSW	NSW	NSW	NSW
AUG	NSW	NSW	NSW	NSW	NSW	NSW	NSW
SEP	NSW	NSW	NSW	NSW	NSW	NSW	NSW
OCT	NSW	NSW	NSW	NSW	1146.49	NSW	NSW
NOV	NRT	NRT	NRT	NRT	NRT	NRT	NRT
DEC	NRT	NRT	NRT	NRT	NRT	NRT	NRT

NRT = No reading taken due to frozen conditions
NSW = No standing water

TABLE 4-6

MONTHLY WETLAND STAFF GAUGE READING SUMMARY

Staff Gauge Location/
Water Level (MSL)

WETLAND 7

(WT-2)

	1991	1992	1993	1994	1995	1996	1997
JAN	--	NRT	NRT	NRT	NRT	NRT	NRT
FEB	--	NRT	NRT	NRT	NRT	NRT	NRT
MAR	--	1153.85	NRT	NRT	NRT	NRT	NRT
APR	--	1153.74	1153.82	1153.89	1153.59	1153.64	1153.62
MAY	1154.00	1153.62	1153.57	1153.49	1153.50	1153.45	1153.39
JUN	1153.58	1153.37	1153.64	1153.37	1152.99	1153.50	1153.10
JUL	1153.51	1153.16	1153.46	1153.13	NSW	1153.27	1153.42
AUG	1153.15	1153.15	1153.56	NSW	1153.03	NSW	1153.52
SEP	1153.52	1153.06	1153.57	1153.48	1153.24	1152.90	1153.34
OCT	1153.44	1153.16	1153.51	1153.49	1153.58	1153.50	1153.48
NOV	NRT	NRT	NRT	NRT	NRT	NRT	NRT
DEC	NRT	NRT	NRT	NRT	NRT	NRT	NRT

NRT = No reading taken due to frozen conditions
NSW = No standing water

TABLE 4-7

MONTHLY WETLAND STAFF GAUGE READING SUMMARY

Staff Gauge Location/
Water Level (MSL)

WETLAND 10A

(WT-4)

	1991	1992	1993	1994	1995	1996	1997
JAN	--	NRT	NRT	NRT	NRT	NRT	NRT
FEB	--	NRT	NRT	NRT	NRT	NRT	NRT
MAR	--	1146.76	NRT	NRT	NRT	NRT	NRT
APR	--	1146.58	1146.74	1146.86	1146.64	1146.58	1146.43
MAY	1146.81	1146.46	1146.57	1146.48	1146.55	1146.38	1146.23
JUN	NSW	1146.16	1146.55	1146.39	1146.13	1146.49	1145.97
JUL	1146.11	1145.91	1146.41	1146.18	1145.83	1146.24	1146.38
AUG	NSW	1146.00	1146.55	1145.8	1146.52	NSW	1146.49
SEP	1146.26	1146.12	1146.57	1146.45	1146.14	1145.85	1146.23
OCT	1146.1	1146.34	1146.53	1146.43	1146.53	1146.51	1146.37
NOV	NRT	NRT	NRT	NRT	NRT	NRT	NRT
DEC	NRT	NRT	NRT	NRT	NRT	NRT	NRT

NRT = No reading taken due to frozen conditions
NSW = No standing water

TABLE 4-8

MONTHLY WETLAND STAFF GAUGE READING SUMMARY

Staff Gauge Location/
Water Level (MSL)

WETLAND 1

(WT-5)

	1991	1992	1993	1994	1995	1996	1997
JAN	--	NRT	NRT	NRT	NRT	NRT	NRT
FEB	--	NRT	NRT	NRT	NRT	NRT	NRT
MAR	--	1102.32	NRT	NRT	NRT	NRT	NRT
APR	--	1102.29	1102.49	1102.18	1101.93	1102.06	1101.91
MAY	1102.35	1102.25	1102.03	NSW	NSW	NSW	NSW
JUN	1102.28	1102.26	NSW	NSW	NSW	NSW	NSW
JUL	1102.23	1101.9	NSW	NSW	NSW	NSW	NSW
AUG	NSW	1102.21	NSW	NSW	NSW	NSW	NSW
SEP	1102.33	1102.46	1101.92	NSW	NSW	NSW	NSW
OCT	1102.32	1102.37	NSW	NSW	1101.97	NSW	NSW
NOV	NRT	NRT	NRT	NRT	NRT	NRT	NRT
DEC	NRT	NRT	NRT	NRT	NRT	NRT	NRT

NRT = No reading taken due to frozen conditions
NSW = No standing water

On July 15, 1997, the condition of Wetland 1 was evaluated for the fourth consecutive year. The investigation confirmed that Wetland 1 appears to be experiencing a decrease in hydric soil moisture content and mitigation of Wetland 1 is recommended. Mitigation plans to supply supplementary water to Wetland 1 are consistent with the plan submitted in the 1995 Annual Report. The objective of the mitigation plan is to saturate the soils of Wetland 1 by addition of water from May to October as necessary. On May 21, 1997 Flambeau submitted an application to divert water from the Flambeau River to Wetland 1. This submittal is incorporated by reference. This application is currently being processed by the Department and was published for public notice on January 1, 1998. Results of the most recent Wetland 1 evaluation is provided in Appendix H.

4.3 METEOROLOGY

As required in the Air Pollution Control Permit No. 89-DLJ-033, Condition 10, meteorological data is continuously collected from a meteorological station. Operation of the station is in accordance with the Updated Monitoring Plan (July 1991) and the Revised Quality Assurance/Quality Control Document (August 1991). The meteorological station is inspected routinely by Flambeau personnel to verify proper operation. On November 11, 1997 WDNR personnel conducted an audit of the meterological station. Records of data at the meteorological station are maintained at the Flambeau Mine site and are available to WDNR as required by the Air Permit.

4.4 TOTAL SUSPENDED PARTICULATES (TSP)

As described in the Updated Monitoring Plan (July 1991), Flambeau's Mine Permit, Part 3, Condition 4(b) requires TSP sampling during the reclamation phase to be conducted once every three days during the first year. If after one year of monitoring there has been no exceedance of a TSP standard, the sampling schedule may be reduced to no less than once every 6 days. In anticipation of the start of backfill activities Flambeau initiated the every third day TSP schedule on August 1, 1996. Flambeau continued this sampling schedule through November 29, 1996 corresponding to the temporary suspension of backfill activities. At that time Flambeau returned to the every sixth day TSP schedule and continued this sampling schedule through March 17, 1997. In correspondance with the recommencing of backfill activities, Flambeau initiated the every third day TSP schedule on March 17, 1997 and continued this schedule for the remainder of 1997.

The June 27, 1997 TSP concentration at Flambeau's northeast air monitor was calculated to be 185 ug/m^3, exceeding the ambient air quality standard for particulate matter of 150 ug/m^3. On August 25, 1997 Flambeau provided an exceedance investigation report in accordance with the Mining Permit, Part 4, Condition 4.e). Flambeau remained in compliance with permits and regulations since the second highest result at the northeast monitoring station in 1997 was 104 ug/m^3 which is well below the ambient air quality standard for particulate matter.

The highest result from the remaining monitoring locations was 94 ug/m^3 which is well below the required standard. The annual geometric mean of TSP measurements for air monitoring stations ranged from 15 ug/m^3 to 23 ug/m^3 which is very consistent with the 1994 through 1996 annual geometric means

TSP monitoring results were submitted to the WDNR Air Monitoring Section each month during 1997 as required in the Mine Permit Condition 4-9. The reports were submitted on the following dates: February 12, March 14, April 21, May 13, June 16, August 25, September 3, September 16, October 16, November 13 and December 16, 1997 and January 14, 1998. Copies of the reports are incorporated by reference.

Table 4-9 is a summary of the TSP monitoring results for 1997. Figures 4-3 to 4-6 illustrate 1997 trends for TSP at the Flambeau air monitoring stations. Air monitoring station locations are shown on Figure 4-7.

In addition to monitoring TSP, ambient air quality is monitored with respect to arsenic, beryllium, cadmium, chromium, mercury and nickel. Composites of the TSP filters collected over three month periods have been submitted for analyses as specified in Condition 4-4 of the Mine Permit.

Reports of the three month composites submitted to the WDNR Air Monitoring Section during 1997 are incorporated by reference and are summarized in Table 4-10. Analytical results for the final quarterly composite for 1996 were not available for the 1996 Annual Report and are included in this report. Analyses resulted in very low or non-detectable concentrations of these metals.

4.5 OPERATIONAL MONITORING

Monitoring of the Type I collection lysimeter was performed on a quarterly basis through the first three quarters of 1997. As mentioned in section 2.1.5 of this report, the lysimeter was removed as part of the backfilling process prior to the fourth quarter sampling period. The three samples collected during 1997 had pH values which were comparable to shallow groundwater samples. Sample comparison shows chromium, copper and iron values were within the range anticipated by Prediction of Chromium, Copper and Iron Concentration in Vadose Zone Water Reaching the Water Table Beneath the Unlined Type I Stockpile for the Kennecott Flambeau Project (July 1989) with the exception of the chromium result from the third quarter monitoring period. Flow rates remained relatively constant during 1997 and were similar to flow rates in 1996. Data is summarized in Table 4-11.

TABLE 4-9

FLAMBEAU MINING COMPANY
TSP Data Summary (ug/m3)

Date	0001 North Site	0003 Southeast Site	0004 Northeast Site	0005 Northwest Site
1/4/97	4	4	4	3
1/10/97	7	16	6	5
1/16/97	7	92	7	7
1/22/97	7	10	7	7
1/28/97	13	20	10	13
2/3/97	12	17	15	11
2/9/97	25	24	23	21
2/15/97	16	28	37	21
2/21/97	9	8	8	6
2/27/97	20	14	21	8
3/5/97	8	12	7	8
3/11/97	11	10	9	10
3/17/97	23	23	23	17
3/20/97	31	46	29	24
3/23/97	15	10	6	6
3/26/97	21	29	18	19
3/29/97	7	4	5	4
4/1/97	35	47	34	28
4/4/97	41	41	36	32
4/7/97	26	66	22	22
4/10/97	22	21	17	13
4/13/97	12	13	10	10
4/16/97	14	35	11	8
4/19/97	41	38	51	42
4/22/97	17	19	22	11
4/25/97	33	25	28	18
4/28/97	18	21	27	15
5/1/97	17	27	25	13
5/4/97	28	28	39	20
5/7/97	35	46	27	53

TABLE 4-9 (CONT.)

Date	0001 North Site	0003 Southeast Site	0004 Northeast Site	0005 Northwest Site
5/10/97	34	43	41	26
5/13/97	17	27	27	13
5/16/97	26	31	36	21
5/19/97	7	24	9	7
5/22/97	38	60	65	46
5/25/97	11	11	10	10
5/28/97	33	43	51	35
5/31/97	67	51	67	51
6/3/97	42	65	55	48
6/6/97	32	33	37	29
6/9/97	49	52	70	40
6/12/97	59	89	69	94
6/15/97	40	40	40	39
6/18/97	37	39	45	33
6/21/97	29	25	25	32
6/24/97	56	57	84	44
6/27/97	53	45	185	29
6/30/97	16	28	34	13
7/3/97	6	8	7	6
7/6/97	10	16	22	8
7/9/97	20	32	31	14
7/12/97	39	48	40	34
7/15/97	25	27	49	22
7/18/97	30	56	44	22
7/21/97	18	26	20	21
7/24/97	39	50	38	37
7/27/97	20	42	18	16
7/30/97	23	53	63	14
8/2/97	26	33	39	22
8/5/97	25	46	57	16
8/8/97	70	53	104	39
8/11/97	23	33	27	24

TABLE 4-9 (CONT.)

Date	0001 North Site	0003 Southeast Site	0004 Northeast Site	0005 Northwest Site
8/14/97	31	31	50	33
8/17/97	7	10	8	6
8/20/97	10	11	9	8
8/23/97	16	23	17	15
8/26/97	32	37	48	25
8/29/97	27	34	31	32
9/1/97	19	19	19	17
9/4/97	31	22	39	15
9/7/97	19	18	17	21
9/10/97	22	21	21	13
9/13/97	31	31	27	24
9/16/97	40	54	40	38
9/19/97	17	17	18	11
9/22/97	23	36	31	16
9/25/97	33	75	40	19
9/28/97	36	52	60	40
10/1/97	18	22	19	11
10/4/97	27	33	32	20
10/7/97	31	36	36	32
10/10/97	15	27	17	15
10/13/97	6	12	7	6
10/16/97	24	27	43	12
10/19/97	16	15	15	14
10/22/97	17	15	25	8
10/25/97	6	9	28	5
10/28/97	42	37	43	28
10/31/97	22	28	21	18
11/3/97	2	1	2	1
11/6/97	8	12	13	4
11/9/97	3	4	4	3
11/12/97	19	14	10	9
11/15/97	4	3	3	2

TABLE 4-9 (CONT.)

Date	0001 North Site	0003 Southeast Site	0004 Northeast Site	0005 Northwest Site
11/18/97	26	24	21	24
11/21/97	19	29	41	16
11/24/97	16	16	14	12
11/27/97	18	17	15	14
11/30/97	8	7	9	6
12/3/97	26	13	19	18
12/6/97	3	3	2	3
12/9/97	16	12	21	11
12/12/97	15	15	14	15
12/15/97	18	16	14	13
12/18/97	24	22	20	19
12/21/97	19	17	19	12
12/24/97	39	37	40	33
12/27/97	13	11	8	7
12/30/97	12	9	10	8

Figure 4-3

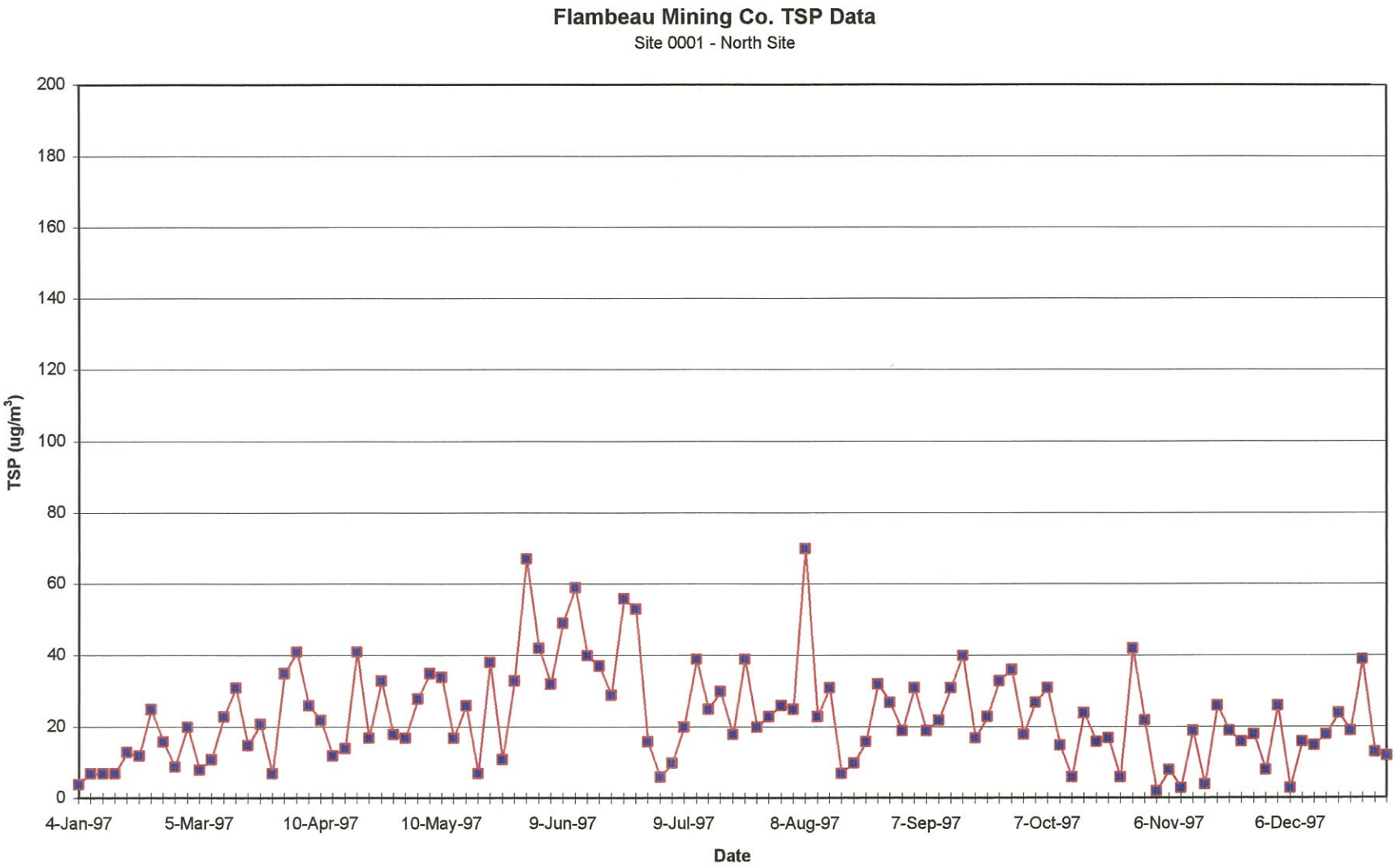

Flambeau Mining Co. TSP Data
Site 0001 - North Site
TSP (ug/m3)
200
180
160
140
120
100
80
60
40
20
0
4-Jan-97
5-Mar-97
10-Apr-97
10-May-97
9-Jun-97
9-Jul-97
8-Aug-97
7-Sep-97
7-Oct-97
6-Nov-97
6-Dec-97
Date

Figure 4-4

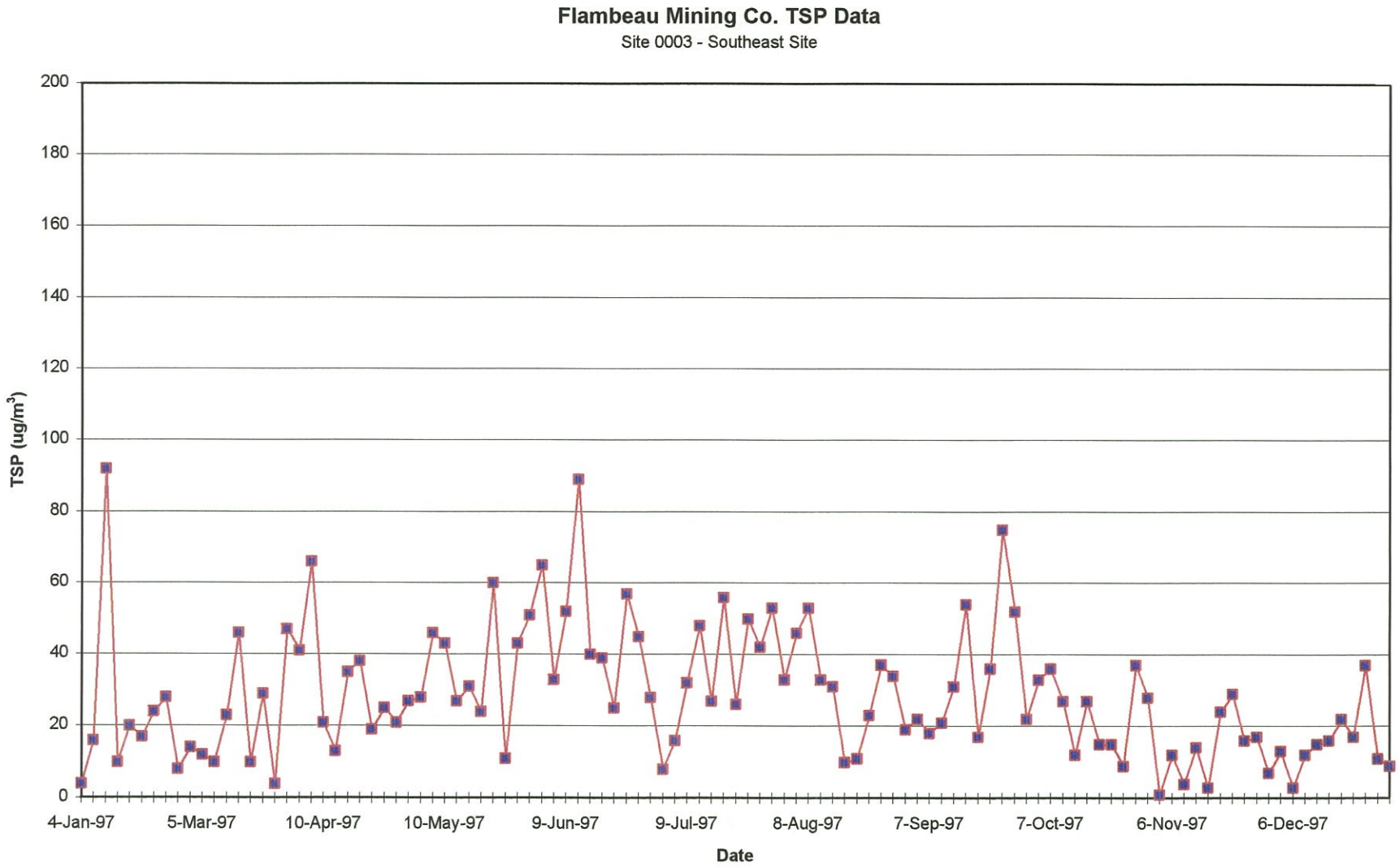

Flambeau Mining Co. TSP Data
Site 0003 - Southeast Site
TSP (ug/m3)
200
180
160
140
120
100
80
60
40
20
0
4-Jan-97
5-Mar-97
10-Apr-97
10-May-97
9-Jun-97
9-Jul-97
8-Aug-97
7-Sep-97
7-Oct-97
6-Nov-97
6-Dec-97
Date

Figure 4-5

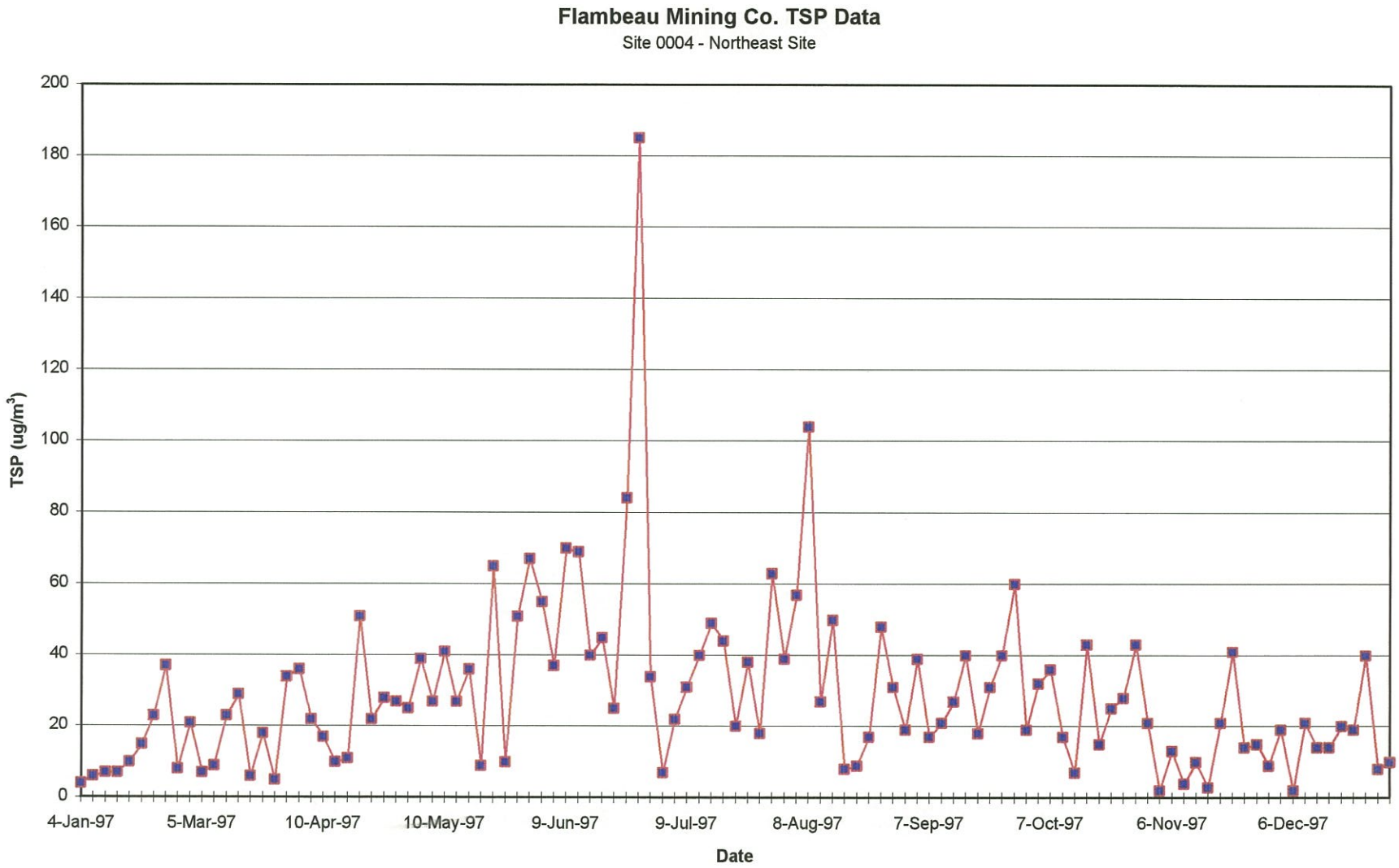
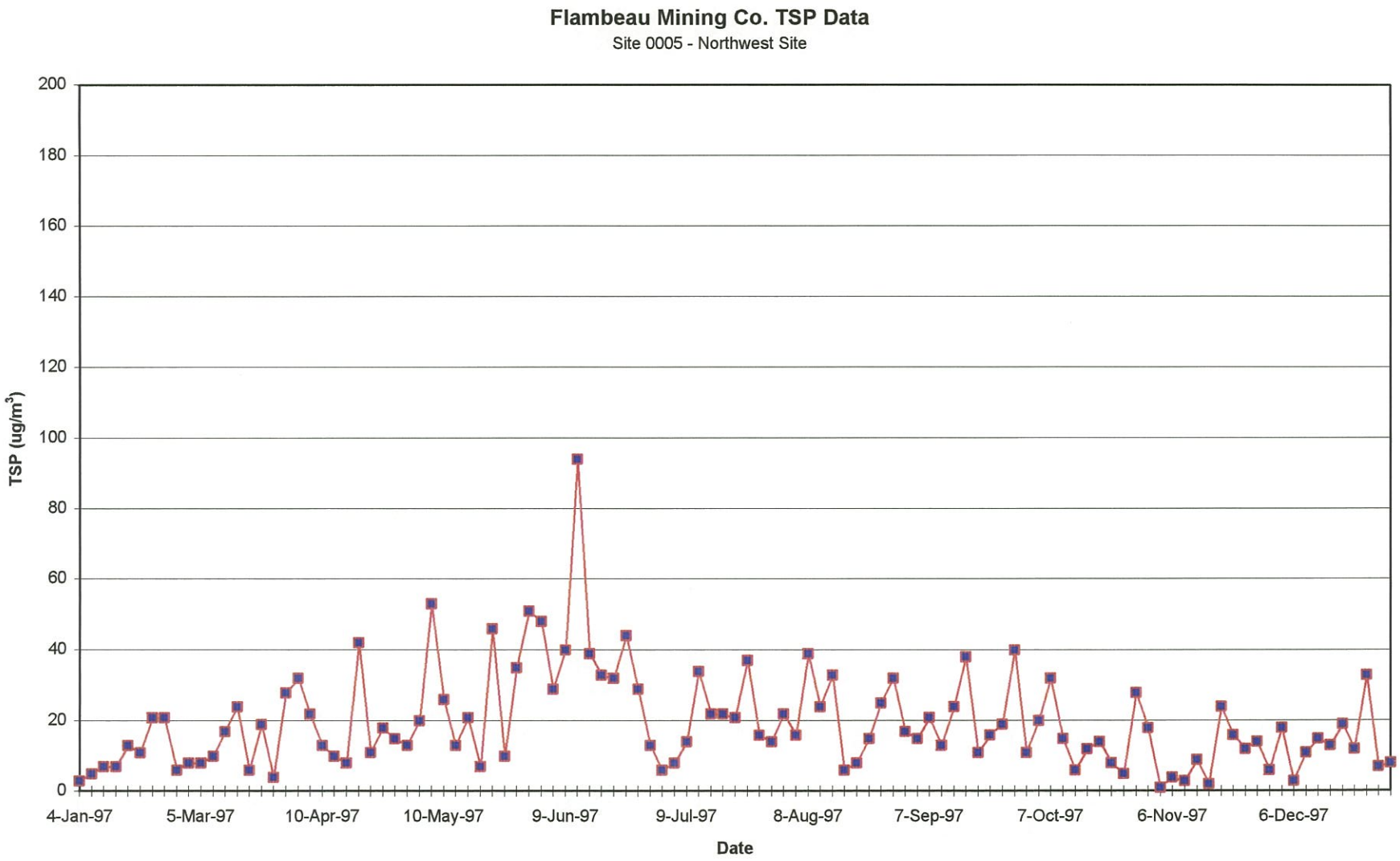
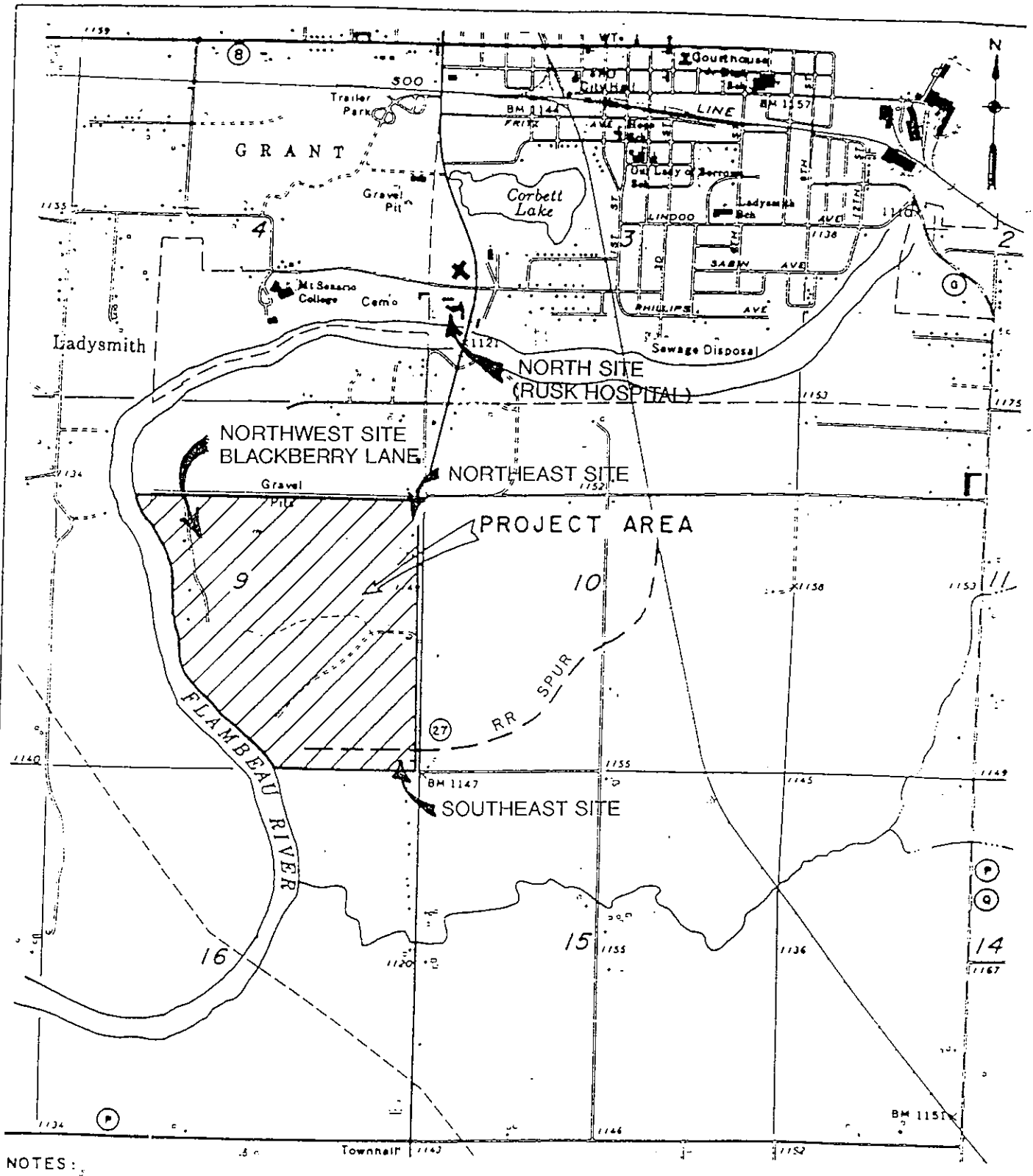

Flambeau Mining Co. TSP Data
Site 0004 - Northeast Site
TSP (ug/m3)
200
180
160
140
120
100
80
60
40
20
0
4-Jan-97
5-Mar-97
10-Apr-97
10-May-97
9-Jun-97
9-Jul-97
8-Aug-97
7-Sep-97
7-Oct-97
6-Nov-97
6-Dec-97
Date

Figure 4-6


Flambeau Mining Co. TSP Data
Site 0005 - Northwest Site
TSP (ug/m3)
200
180
160
140
120
100
80
60
40
20
0
4-Jan-97
5-Mar-97
10-Apr-97
10-May-97
9-Jun-97
9-Jul-97
8-Aug-97
7-Sep-97
7-Oct-97
6-Nov-97
6-Dec-97
Date



NOTES:

PROJECT AREA INCLUDES A 36 FOOT WIDE CORRIDOR ALONG RAILROAD SPURLINE EAST OF STH 27.

BASE MAP PREPARED FROM U.S.G.S MAPS 7.5 MINUTE SERIES, LADYSMITH AND THORNAPPLE WI. QUADRANGLES

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO.4-7
AIR MONITORING SITES

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	SJL	2/89
	CHECKED BY	GWS	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000	

Job No | Dwg No | REV

TABLE 4-10

TSP FILTER METAL RESULTS SUMMARY (ug/m3)

	Arsenic	Beryllium	Cadmium	Chromium	Mercury	Nickel
North Site						
9/5/96-11/29/96	0.000584	<0.000287	0.00112	0.00332	0.0000057	0.000983
12/5/96-2/27/97	0.000452	<0.000288	0.000299	<0.00580	<0.000175	0.000508
3/5/97-5/31/97	0.000692	0.0000101	0.000269	0.00353	0.000010	0.000957
6/3/97-8/29/97	0.000456	0.00000656	<0.00175	0.00262	0.0000098	0.00152
9/1/97-11/30/97	0.000593	0.00000973	0.000195	<0.00430	0.000053	0.000794
Southeast Site						
9/5/96-11/29/96	0.00117	0.00000980	0.000212	0.00349	0.000020	0.00119
12/5/96-2/27/97	0.0242	<0.000288	0.000520	<0.00580	0.0000910	0.00159
3/5/97-5/31/97	0.000238	0.0000172	0.000266	0.00378	0.000027	0.00390
6/3/97-8/29/97	0.000617	0.0000173	<0.00175	0.00298	0.0000063	0.00116
9/1/97-11/30/97	0.000575	<0.000198	0.000189	<0.00430	0.000019	0.00104

TABLE 4-10 (cont.)

TSP FILTER METAL RESULTS SUMMARY (ug/m3)

	Arsenic	Beryllium	Cadmium	Chromium	Mercury	Nickel
Northwest Site						
9/5/96-11/29/96	0.000504	<0.000287	0.000198	0.00368	0.0000027	0.00124
12/5/96-2/27/97	0.000530	<0.000288	0.000289	<0.00580	<0.000175	0.000707
3/5/97-5/31/97	0.000706	<0.000192	0.000147	0.00357	0.0000078	0.000849
6/3/97-8/29/97	0.000467	<0.00000196	<0.00175	0.00318	0.000078	0.00105
9/1/97-11/30/97	0.000405	0.0000187	0.000171	<0.00430	<0.000304	0.000904
Northeast Site						
9/5/96-11/29/96	0.000598	0.0000103	0.000292	0.00381	0.000011	0.00127
12/5/96-2/27/97	0.000614	<0.000288	0.000349	<0.00580	<0.000175	0.00092
3/5/97-5/31/97	0.000713	0.0000192	0.000120	0.00352	0.000019	0.00110
6/3/97-8/29/97	0.000506	0.00000833	<0.00175	0.00316	0.000013	0.00142
9/1/97-11/30/97	0.000482	<0.000198	0.000181	<0.00430	0.000059	0.000658

TABLE 4-11
TYPE I COLLECTION LYSIMETER MONITORING DATA
1997

PARAMETERS	UNIT	Modeled[1]	1Q JAN	2Q APR	3Q JUL
Alkalinity	mg/l	NA	190	200	No Analysis [3]
Chromium	ug/l	0.5 - 2.6	0.38 [2]	<0.26	8.7 [2]
Copper	ug/l	10.0 - 38.4	22	28	12 [2]
Hardness	mg/l	NA	190	220	260
Iron	mg/l	0.056 - 0.245	0.061	0.023	0.039
Manganese	ug/l	NA	860	1100	1500
pH, Lab	s.u.	NA	6.3	6.4	6.3
pH, Field	s.u.	NA	6.2	6.4	6.2
Diss Solids	mg/l	NA	240	230	400
Sulfate	mg/l	NA	26	24	25
Conductivity	micromho	NA	422	463	479
Inflow	gpd	NA	240	266	279

(1) Prediction of Chromium, Copper and Iron Concentration in Vadose Zone Water Reaching the Water Table Beneath the Unlined Type I Stockpile (July 1989).

(2) < LOQ

(3) No analysis due to laboratory error.

Condition 4 of the Groundwater Withdrawal Permit requires tabulation of monthly totals for precipitation, surface water run-on, groundwater inflow and dewatering pumping to allow an evaluation of the water handling balance within the pit. Estimates of groundwater inflow into the open pit are made by calculating flow based on the pumping rate from the pit.

Adjustments to the flow rate have been made for precipitation, evaporation and surface flow into the pit including contribution from the french drain installed at the base of the Type I stockpile. The flow rates are summarized in Table 4-12. Pit development is summarized in Table 4-13. Pit backfilling resulted in a signifcant decrease in the groundwater inflow during May, June and July. As a result of the rate of pit backfill, the groundwater inflow was very minimal by the end of July. Groundwater inflow was not measureable from August through the remainder of the year. The estimated groundwater inflow was 37.0 MG in 1997 as compared to 77.7 MG in 1996. Groundwater inflow in 1997 prior to significant pit backfilling was similar to 1995 and 1996. The 1997 monthly average inflow for January through April was 7.3 MG. This is comparable with the 1996 monthly average inflow of 6.5 MG and the 1995 monthly average inflow of 7.3 MG.

Leachate from the Type II stockpile was treated within Flambeau's WWTP prior to discharge to the Flambeau River. The Type II leachate was collected on a quarterly basis and analyzed for quality. In 1997, samples were collected the first three quarters. Backfill of Type II material and removal of the leachate collection system was completed in early September; therefore, a fourth quarter leachate sample was not available. The 1997 quarterly samples collected in January and April show pH values to a range of 3-4 s.u. and dissolved solids, conductivity, hardness, manganese and copper concentrations similar to the values observed in the third and fourth quarters of 1996. The 1997 third quarter sample resulted in a pH value of 5.7 s.u. and a decrease in the dissolved constituents as compared to the first two samples collected in 1997. This is a result of the neutralization and backfilling of the majority of stockpiled Type II material prior to the collection of the third quarter sample. Data is summarized in Table 4-14.

An annual camera inspection of pipes between the Type II stockpile and the surge pond is required by Condition 2-14 of the Mine Permit. The 1997 inspection was performed on November 19, 1997. The pipe integrity was verified. A report of the inspection was submitted to the WDNR Mine Reclamation Unit on December 3, 1997 and is incorporated by reference.

While performing the camera inspection on November 19, the entrance manholes, access manholes, outlet, and the geomembrane-covered seam in the pipe junction prior to the outlet were also inspected to verify integrity. All were found to require no maintenance. Manhole M1 and the culvert below the haul road had been previously removed during the backfilling process and were not incorporated in the annual inspection.

TABLE 4-12
Pit Inflow Summary
1997
(Million Gallons)

	1993	1994	1995	1996	1997			
	Groundwater Inflow	Groundwater Inflow	Groundwater Inflow	Groundwater Inflow	Groundwater Inflow	Precipitation	Surface Water Run-off	Dewatering Pumping
January	NC[1]	7.7	6.8	6.9	7.5	2.52	0.94	8.40
February	NC[1]	6.2	6.1	5.9	6.1	0.15	1.80	7.89
March	NC[1]	7.4	8.2	4.8	6.2	2.96	5.25	12.36
April	15.7	5.4	7.8	5.8	9.4	0.84	0.58	9.98
May	8.7	6.6	6.7	7.1	3.4	2.71	1.29	4.66
June	7.9	6.9	5.8	4.7	1.4	5.25	2.51	3.89
July	7.2	8.0	5.9	5.8	3.1	9.21	4.79	7.94
August	10.0	9.5	8.1	5.0	NC[2]	5.76	3.11	2.65
September	6.7	11.3	7.0	6.1	NC[2]	3.27	2.21	2.24
October	7.2	10.4	9.9	7.4	NC[2]	2.00	2.17	2.39
November	8.4	8.5	8.3	9.7	NC[2]	0.38	0.41	0.80
December	7.0	9.9	7.1	8.5	NC[2]	0.00	0.00	0.00
Estimated Yearly Groundwater Inflow:	78.8	97.8	87.7	77.7	37.1 37.0	[illegible]	25.1	[illegible]

NC[1]: Not Calculated. Previous to pit development.

NC[2]: Not Calculated. Subsequent to pit backfill.

Σ 3½
÷ 4
85.5 × 10⁶ gal/yr = 163 gpm

Table 4-13
Approximate Status of Pit Development During 1997

		Developed Mined Area (acres)												
Bench	Depth (ft)	Dec-96	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1120	-20	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52	24.52
1110	-10	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09	27.09
1100	0	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41
1090	10	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06	24.06
1080	20	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24	24.24
1070	30	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70	19.70
1060	40	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05	17.05
1050	50	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34
1040	60	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15
1030	70	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19
1020	80	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04	12.04
1010	90	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
1000	100	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54	9.54
990	110	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89	8.89
980	120	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
970	130	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34
960	140	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
950	150	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.86
940	160	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
930	170	1.26	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
920	180	0.02	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
910	190	0.00	0.03	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
900	200	0.00	0.00	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
890	210	0.00	0.00	0.09	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
880	220	0.00	0.00	0.09	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

TABLE 4-14
TYPE II LEACHATE MONITORING DATA
1997

PARAMETERS	UNIT	1Q JAN	2Q APR	3Q JUL
Alkalinity	mg/l	<1.5	<1.4	No Analysis [1]
Conductivity	micromho	2950	NR	870
Copper	ug/l	270,000	440,000	25,000
Hardness	mg/l	1,400	1,400	420
Iron	mg/l	73	88	0.25
Manganese	ug/l	20,000	24,000	4800
pH, Lab	s.u.	3.2	3.5	5.7
pH, Field	s.u.	3.5	3.4	5.8
Solids (Dissolved)	mg/l	2800	3700	1100
Sulfate	mg/l	2800	1000	510

NR: No Reading

(1) No analysis due to laboratory error.

The Type II leachate collection system was removed prior to completion of an assessment. Prior to its removal, the leachate collection system was functioning properly. During removal of the leachate collection, the system was visually inspected. Leachate lines were found to be free of obstructions and the pipe integrity appeared to have been maintained.

Inspections of the sideslopes of the surge pond and runoff pond and the scuff strip below the outlet of the 36-inch pipe outlet in the surge pond were conducted by Cooper Engineering on October 17, 1997. No additional sloughing or deformation of the side slopes has occurred in the surge pond. Liner material to the north of the runoff pond had been removed as part of the backfilling process prior to the inspection. Following the removal of this liner material, a precipitation event occured resulting in a small degree of washout under the north liner slope. An earthen berm has been constructed along the north crest of the runoff pond to direct surface runoff through piping into the runoff pond. Monitoring of pond sideslopes including the area under the runoff pond 32-inch pipe continues on a routine basis. The scuff strip within the surge pond shows no signs of movement or displacement from its original installed location. The report of the Cooper Engineering inspection is included in Appendix B.

Minor liner repairs were made on the HDPE liner material in the run-off pond during 1997. The WDNR was notified of the minor liner damage upon each discovery and informed of the planned repairs. During the week of July 7, 1997, sediment from the runoff pond was removed as part of the backfilling process. Upon completion of the sediment removal the pond was inspected by Flambeau. The inspection identified numerous indentations and two punctures of the liner material believed to have been caused by the sediment removal process. The damaged locations were identified and the pond remained empty until repairs were completed on July 17, 1997.

On July 26, 1997 a routine inspection identified liner damage at the toe of the first full panel on the west side in the northwest corner of the surge pond. Six holes and one puncture were identified. The damaged areas were temporarily repaired until permanent repairs were completed on June 27, 1997. Liner repair reports are included in Appendix E.

Hydric soils were maintained in a wet condition, as specified in the Vegetative Aquascape Plan (May 1991) and the Topsoil and Hydric Soils Management Plan (May 1991). A hydric soil sample collected July 24, 1997 was found to have a moisture content of 27%; a moisture content similar to previous years.

REFERENCES

1997 Annual Reclamation Report — November 1997

Air Pollution Control Permit — January 1991

Enivronmental Impact Report	March 1989
Updated Resident Project Representative Manual	April 1997
Resident Project Representative Manual, Type I Waste Rock	July 1997
Groundwater Withdrawal Permit	January 1991
Local Agreement	August 1988
Mining Permit	January 1991
Water Regulatory Permit	January 1991
Prediction of Chromium, Copper and Iron Concentration in Vadose Zone Water Reaching the Water Table Beneath the Unlined Type I Stockpile for the Kennecott Flambeau Project	July 1989
Revised Mining Permit Quality Assurance/Quality Control Plan	August 1991
Topsoil and Hydric Soils Management Plan	May 1991
Updated Monitoring Plan	July 1991
Vegetative Aquascape Plan	May 1991
Type I & Type II Conditional Approval	March 1993
Mine Permit Application	December 1989

SUBMITTALS

DOCUMENT	DATE	WDNR SUBMITTEE
Section 2.0 Operating Activities		
1996 Annual Report	January 1997	Larry Lynch[1]
1997 Certificate of Insurance	April 1997	Larry Lynch[1]
1997 Certificate of Insurance	June 1997	Larry Lynch[1]
Reclamation Bond	June 1997	Larry Lynch[1]
Drillhole Abandonment Reports	Aug, Sept 1997	Ken Markart[1]
Whole Effluent Toxicity Report	Mar, May, June, Sept, Dec, 1997	Tom Bauman[2]
Discharge Monitor Report	Monthly 1997	Janet LaRose[3]
State of Wisconsin Substance Release Form	May 1997	Jerry Carow[4]
State of Wisconsin Substance Release Form	May 1997	Jerry Carow[4]
State of Wisconsin Substance Release Form	July 1997	Jerry Carow[4]
State of Wisconsin Substance Release Form	August 1997	Jerry Carow[4]
State of Wisconsin Substance Release Form	September 1997	Jerry Carow[4]
WI Stat. 166.20 Reporting	June 1997	Wes Taylor[5]
Contaminated Soil Disposal Spill Dated 12/2/94 & 12/14/94	July 1997	Norm Dunbar[6]
1996 Emission Inventory	February 1997	Paul Cahoon[7]
1996 Emission Inventory Certificate	June 1997	WDNR[8]
1996 Effluent Environmental Fee Summary	March 1997	WDNR[8]

SUBMITTALS (CONT'D)

DOCUMENT	DATE	WDNR SUBMITTEE
1996 Hazardous Waste Report	February 1997	WDNR[8]
1996 Environmental Fees (Effluent Discharges & Hazardous Waste)	June 1997	WDNR[8]
Low Level Mercury Analytical Results	June 1997	Jim Hansen[9]
Waste Rock Stockpile License Renewal Application	March 1997	Larry Lynch[1]
Revised Waste Rock Stockpile License Renewal Application	April 1997	Larry Lynch[1]
Wastewater Treatment Plant (WWTP) Solids Temporary Storage	April 1997	Larry Lynch[1]
Flambeau Mining Company - WWTP Solids Management	September 1997	Larry Lynch[1]
Application to Withdraw Surface Water	May 1997	Todd Naas[10]
Section 3.0 Reclamation Activities		
List of 1997 Reclamation Activities	January 1997	Larry Lynch[1]
Mid Summer Progress Report, 1997	October 1997	Larry Lynch[1]
1997 Annual Reclamation Report	November 1997	Larry Lynch[1]
1997 Backfill Plan - Response to Department Comments (File Ref. 2720-2)	May 1997	Larry Lynch[1]
Updated Resident Project Representative Manual (April 1997) - Testing Modification	May 1997	Larry Lynch[1]
Type I Stockpile- Proposed Material Handling for Backfill (June 11, 1997)	June 1997	Larry Lynch[1]
Type II Backfill - Revised Table 3-1	June 1997	Larry Lynch[1]
Updated Resident Project Representative Manual (April 1997) - Testing Modification	June 1997	Larry Lynch[1]

SUBMITTALS (CONT'D)

DOCUMENT	DATE	WDNR SUBMITTEE
Updated Resident Project Representative Manual	April 1997	Larry Lynch(1)
1997 Backfilling Plan for Stockpiled Type II Material	March 1997	Larry Lynch(1)
Addendum No. 1 to the "1997 Backfilling Plan for Stockpiled Type II Material" Report	April 1997	Larry Lynch(1)
Resident Project Representative Manual, Type I Waste Rock	July 1997	Larry Lynch(1)
Reclamation Plan Changes	July 1997	Larry Lynch(1)
Flambeau Project - Construction Phasing Plan	September 1997	Larry Lynch(1)
Updated Resident Project Representative Manual (April 1997) - Testing Change Notification	September 1997	Larry Lynch(1)
Golf Course Option	November 1997	Larry Lynch(1)
Supplement to Surface Reclamation Plan (Decmeber 1997) and Golf Course Option	December 1997	Larry Lynch(1)
1997 Mid-summer Reclamation Report	October 1997	Larry Lynch(1)
1997 Annual Reclamation Report	November 1997	Larry Lynch(1)
Section 4.0 Site Monitoring		
Environmental Monitoring Ground Water Quality Results	Quarterly 1997	Larry Lynch(1)
Air Monitoring Results (TSP)	Monthly 1997	Steve Schuenemann(11)

SUBMITTALS (CONT'D)

DOCUMENT	DATE	WDNR SUBMITTEE
Air Monitoring TSP Exceedance Investigation Report	August 1997	Steve Schuenemann[11]
Air Monitoring Project-TSP Filer Metal Analytical Results	Apr, June, Aug, Oct, Nov 1997	Steve Schuenemann[11]
Air Monitoring Calibration Data Sheets	Feb, May, July, Sept, Nov, 1997	Steve Schuenemann[11]
Potable Water Analysis Results	Feb, Apr, July, Nov 1997	Park Roush[12]
1997 Camera Inspection	December 1997	Larry Lynch[1]

1 Mine Reclamation Unit
Larry Lynch
Ken Markart

2 Bureau of Wastewater Management
Tom Bauman

3 Wisconsin Dept. Of Natural Resources
Janet LaRose

4 Wisconsin Dept. Of Natural Resources
Jerry Carow

5 Wisconsin Dept. Of Natural Resources
Wes Taylor - Toxics Coordinator

SUBMITTALS (CONT'D)

6 Wisconsin Dept. Of Natural Resources
Norm Dunbar

7 Wisconsin Dept. Of Natural Resources
Paul Cahoon

8 Wisconsin Dept. Of Natural Resources

9 Wisconsin Dept. Of Natural Resources
Jim Hansen

10 Wisconsin Dept. Of Natural Resources
Todd Naas

11 Air Monitor Section
Steve Schuenemann

12 Wisconsin Dept. Of Natural Resources
Park Roush

APPENDIX A

LIST OF DEVIATIONS

LIST OF MODIFICATIONS & DEVIATIONS
FROM APPROVED MINING PERMIT PLAN
(PER CONDITION 2-4)

Permit/Application	Section	Modification or Deviation	Authorization		
			Method	Person	Date
Deviations					
Mine Permit Application (Dec. 1989)	5.9.4	Concrete removed from the load-out zone of the railroad spur was backfilled with the Type II material in the pit.	Verbal Approval	Ken Markart	08/28/97
Mine Permit (Jan. 1991)	Part 2 Condition 13	Wastewater Treatment Plant precipitate was temporarily stored in the southeast corner of the Type II waste rock stockpile.	Approval Letter	Ken Markart	05/01/97
Surface Water Management Plan (May 1991)	3.1.3	Surface water runoff from former Type I Stockpile area was diverted to adjacent gravel pit.	Verbal Approval	Larry Lynch	Sept. 1997
Mine Permit Application (Dec. 1989)	4.7.3.2.8 4.7.3.3.11	Temporary sandstone stockpile in explosive magazine area to be backfilled in temporary basin located at west end of pit.	Verbal Concurrence	Ken Markart	Sept. 1997
Mine Permit Application (Dec. 1989)	5.7	Open Pit Reclamation Plan: Type II material revisions regarding backfilling techniques, QA procedures, and alkali amendment rates and procedures.	Approval Letter	Larry Lynch	5/30/97
Mine Permit Application (Dec. 1989)	5.7.2.1.3	Open Pit Reclamation Plan revisions regarding Type I backfilling techniques, QA procedures and alkali amendment rates and procedures.	Approval Letter	Larry Lynch	08/14/97

APPENDIX B

SURGE POND/RUNOFF POND SIDE SLOPE EVALUATION

Cooper Engineering Company, Inc.
310 WEST SOUTH STREET • RICE LAKE, WI 54868-2420
TELEPHONE (715) 234-7008 FAX (715) 234-1025

October 20, 1997

Ms. Jana E. Murphy
Flambeau Mining Company
P.O. Box 166
Ladysmith, WI 54848

Re: 1997 Annual Liner Inspection

Dear Ms. Murphy:

Per your request, on October 17, 1997, at 11:00 a.m., Craig Walkey, Cooper Engineering Company, Inc. arrived at the mine to perform the annual inspection of the HDPE liners and general integrity of the runoff pond, surge pond and refueling island. No damage to the liner material was found that required repair. However, maintenance was identified at the runoff pond. The description of this repair is described below.

The annual inspection was performed in accordance with the March 9, 1993, Wisconsin Department of Natural Resources conditional approval of the Lined Facilities, Items 13.a. and c., and is summarized as follows:

Surge Pond
Prior to inspection, the pond was drained to low water level. Mr. Walkey conducted the HDPE liner inspection using a rope and harness system. No major liner damage was observed. Inspection of the pipes, pipe collar connections to the liner material and pipe scuff pads found no damage or maintenance repairs.

Inspection of the side slopes found no new washout, erosion, or slope deformation.

Runoff Pond

The pond was lowered for inspection and the same rope and harness system was used. No liner damage was observed. Inspection of the pipes, pipe collar connections to the liner material and pipe scuff pads found no damage or maintenance repairs.

The liner material on the north top of dike was removed to the north during the mine restoration project. An earthen berm was constructed along the north dike face to direct surface water runoff away from the pond. There is evidence of washout under the north liner slope to the bottom of the pond. This may have occurred before the berm was completed. We would recommend that the berm along the north dike face be monitored and maintained to control surface water runoff to the runoff pond.

Refueling Island

No damage was discovered nor were maintenance repairs necessary.

Sincerely,

Craig Walkey, P.E.

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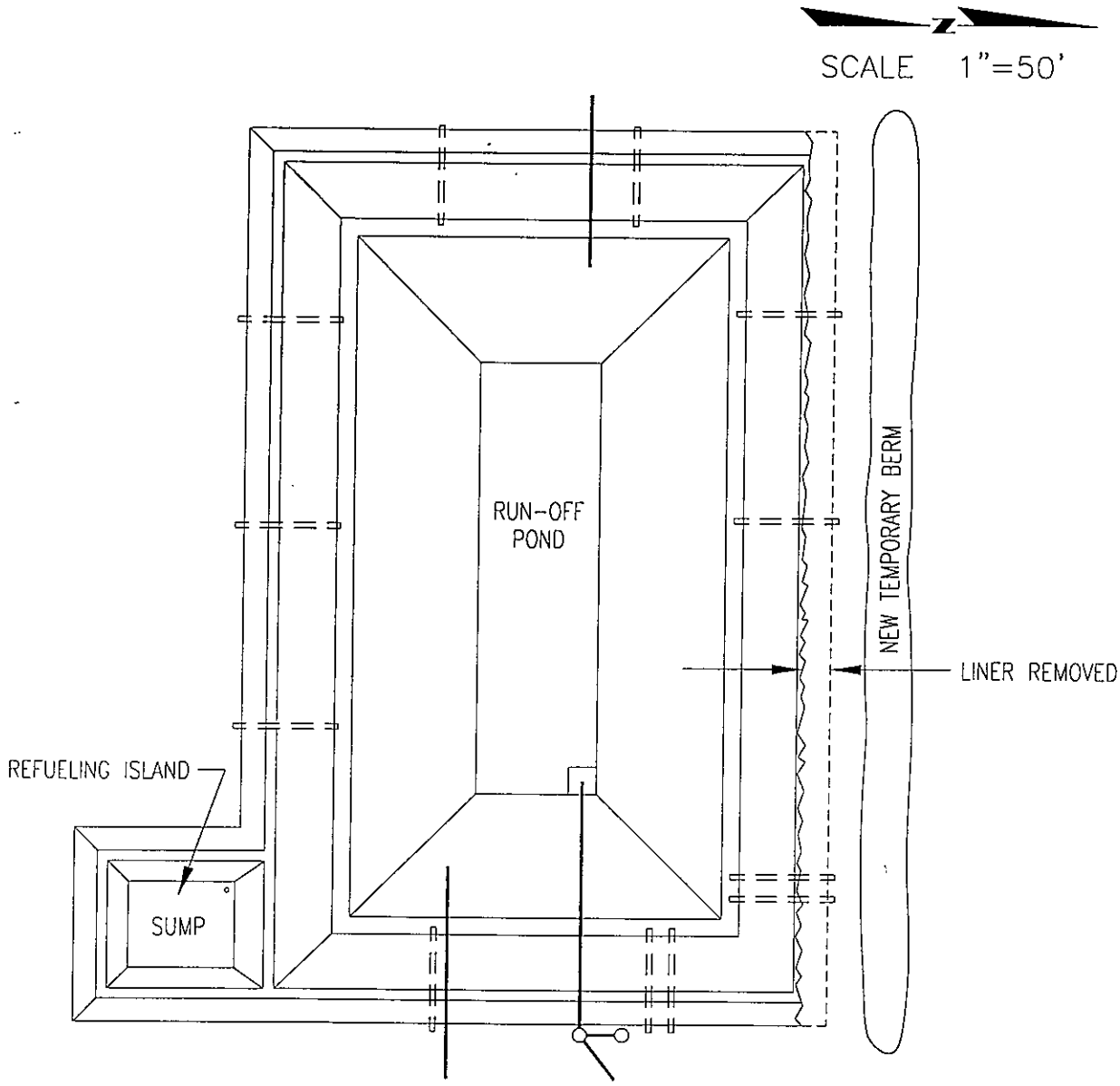

RUN-OFF POND INSPECTION
FLAMBEAU MINING COMPANY
OCTOBER 17, 1997

COOPER ENGINEERING COMPANY
310 WEST SOUTH STREET RICE LAKE, WISCONSIN
TELEPHONE 715-234-7008
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APPENDIX C

GROUNDWATER QUALITY & ELEVATION/SURFACE WATER QUALITY/TRENDS

Foth & Van Dyke
Memorandum

January 2, 1998

TO: Jana Murphy, Flambeau Mining Co

CC: Jim Hutchison, Foth & Van Dyke
Jerry Sevick, Foth & Van Dyke

FR: Steve Lehrke, Foth & Van Dyke

RE: Flambeau Mining Company - 1997 Annual Report Groundwater and Surface Water Trends

Background

The groundwater and surface water sample results collected between July of 1991 and October of 1997 for the quarterly monitoring program have been graphically displayed and tested statistically to determine whether any significant increasing or decreasing trends are occurring in groundwater or surface water chemistry. July of 1991 was selected as the start date for the trend tests since this is when construction began on-site. Groundwater quality results during this time period are listed in Table 1A, and surface water quality results during this time period are listed in Table 2A. Trend graphs of the groundwater and surface water quality results are presented in Attachments 1 and 2, respectively. Trend graphs of groundwater elevations are presented in Attachment 3.

It should be noted that MW-1000P was damaged in the first quarter in 1996 and was replaced with MW-1000P-R at the exact same location and the same specifications. This monitoring point will be referred to as MW-1000P-R in this report.

Statistical Methods

The non-parametric Mann-Kendall test for trend was used to statistically determine whether any trends were present in the data between July of 1991 and October 1997. This test was used rather than a parametric test such as regression analysis due to the non-normal distribution of many of the data sets which is typical for groundwater and surface water quality results In addition, the Mann-Kendall test determines whether any general trends are present, regardless if they are linear or curvilinear. The Type I error for each test was set to 0.01. The procedure for the Mann-Kendall test is given in Gilbert (1987)[1].

---

[1]Gilbert, Richard O. (1987) *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold. New York, NY.

As can be seen in the groundwater and surface water trend graphs (Attachments 1 and 2), several parameters had initially high detection limits which were later reduced. This resulted in detections at lower levels than the initial detection limits. Since the non-detected values with high detection limits cause increased uncertainty in the trend tests, all non-detects were treated in the following manner: If the detection limit is equal to or less than the minimum detected value, the result is replaced with zero. If the detection limit is greater than the minimum detected value, but less than or equal to two times the minimum detected value, the result is replaced with the minimum detected value. If the detection limit is greater than two times the minimum detected value, the result is omitted from the trend analysis.

This is a conservative approach in addressing non-detected values in the data sets. For example, with the second case (the detection limit greater than the minimum detected value but less than two times the minimum detected value) the result used in the trend test will always be at least one-half the original detection limit. Using one-half the detection limit for non-detected values is an approach commonly used in groundwater statistics and is one of the approaches discussed in USEPA (1992)[2].

In addition, with the first case (the detection limit is less than or equal to the minimum detected value) any number less than the minimum detected value gives the same outcome as using zero in the trend test. Since the Mann-Kendall test is a non-parametric test, the ranks of the data values are used in the test rather than the values themselves. Therefore, replacing the non-detected value with zero would be no different than replacing it with a value just below the detection limit.

Summary statistics for each parameter and well, along with the trend analysis results are given in Table 1B for groundwater and Table 2B for surface water. In the trend test results, a "+" indicates a statistically increasing trend and a "-" indicates a statistically decreasing trend. If neither a "+" or "-" is given, no significant trend is present.

Results

In general, groundwater trends remain very similar to those reported in the 1996 annual report, with mostly decreasing trends occurring. The following trends were present for groundwater:

Well	Parameter	Trend
MW-1000P-R	Conductivity	Decreasing
	Alkalinity	Decreasing
	Copper	Increasing
	Hardness	Decreasing
	Iron	Decreasing
	Manganese	Decreasing

[2]USEPA, 1992. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Addendum to Interim Final Guidance.* Office of Solid Waste, Washington, D.C.

Well	Parameter	Trend
MW-1002	Alkalinity	Decreasing
	Hardness	Decreasing
MW-1004P	Hardness	Decreasing
	Iron	Decreasing
	Manganese	Decreasing
	Sulfate	Increasing
MW-1004S	pH Field	Decreasing
MW-1005	Alkalinity	Decreasing
	Hardness	Decreasing
MW-1005P	Hardness	Decreasing
	Iron	Decreasing
	Manganese	Decreasing
	Sulfate	Increasing
MW-1005S	Alkalinity	Decreasing
	Hardness	Decreasing
MW-1010P	Iron	Decreasing
	TDS	Decreasing

The observed trends in groundwater concentrations are for the most part decreasing. The only increasing trends are for copper in MW-1000P-R, and sulfate in MW-1004P and MW-1005P. The indicated trend for copper in MW-1000P-R is the result of increased concentrations during the fourth quarter of 1994. Since then, copper concentrations in MW-1000P-R have remained relatively constant

Monitoring well MW-1000P-R is located within the river pillar area between the open pit and the Flambeau River. The standing water levels recorded in MW-1000P-R shows that prior to July 1993 the water levels were greater than the average level of the Flambeau River thus indicating that groundwater flowed from the area of the open pit to the river. After July 1993 the water levels were lower than the average river level indicating that, as expected, a groundwater flow reversal had been created due to the operation of the pit. Therefore, after July 1993 groundwater in the river pillar area has flowed from the river towards the open pit.

Copper concentrations in MW-1000P-R generally ranged from 0.01 - 0.02 mg/l when detects were noted from July 1991 to October 1994, after which they have increased to a concentration range of 0.03 - 0.06 mg/l. The increases in copper concentrations are likely attributable to increased oxidation of the copper sulfide-bearing rocks which crop out in the river basin adjacent to the river pillar. Fluctuations in river stages by the operators of the Ladysmith dam have likely led to periods of greater exposure, and thus potential oxidation of these minerals.

The increasing trends of sulfate in MW-1004P and MW-1005P are minor with highest concentrations being 6.9 and 6.7 mg/l, respectively.

Decreasing trends are present for conductivity, alkalinity, hardness, iron, and manganese in MW-1000P-R, and iron and TDS in MW-1010P. The most noticeable decrease in concentrations occurred during the beginning of 1994. These changes are considered to be related to the progressive replacement of normal groundwater in the river pillar region with river water resulting from the changes in the groundwater flow direction.

The decreasing trends of alkalinity and hardness in MW-1002 are only slight decreasing trends, dropping approximately 10 to 20 mg/l between 1991 and 1997. The decreasing trends of hardness in MW-1004P, MW-1005P, hardness and alkalinity in MW-1005S, and alkalinity in MW-1005 are also relatively small, with actual concentrations dropping only slightly between 1991 and 1997. Hardness in MW-1005 steadily decreased between 1992 and 1997, dropping approximately 200 mg/l.

Decreasing trends were observed for iron and manganese in MW-1004P and iron in MW-1005P. The decreasing trend of these parameters is due mainly to a drop in concentrations during the middle of 1993. Before and after this time period, concentrations remained relatively consistent.

The final trends observed in the groundwater results were a decreasing trend of pH in MW-1004S and a decreasing trend of manganese in MW-1005P. The pH in MW-1004S ranged from 6.37 to 8.64 between July of 1991 and July of 1994, and it ranged from 5.84 to 6.90 between October 1994 and October 1997. These ranges of pHs at MW-1004S fall within typical pH values of groundwater in this region. Manganese in MW-1005P generally fell between 0.1 and 0.2 mg/l between 1991 and 1993, but between 0.04 and 0.15 between 1995 and 1997.

The majority of groundwater wells exhibited a decrease in groundwater elevations (Attachment 3) beginning in late 1992 and stabilizing during mid to late 1994. With the backfill of the mine, the dewatering of the pit has undergone many changes during 1997. The pit was essentially backfilled from March 1997 through mid-October 1997. Hence, groundwater has begun to resaturate surrounding areas around the pit. Wells MW-1000P-R, MW-1004P, and PZ-R1 have recorded marked increases in groundwater elevations of greater than 15 ft. MW-1010P and PZ-S1 have recorded increases of groundwater elevations of 5 -10 ft. Marked groundwater changes in the other wells has not been observed.

No trends, either increasing or decreasing, were noted in the surface water samples for either the upgradient sample point (SW-1) or the downgradient sample point (SW-2).

Conclusions

Overall, groundwater trends continue to be very similar to those observed in the past. Several decreasing trends continue to be noted generally due to the progressive replacement of normal groundwater in the river pillar region with river water resulting from the changes in groundwater flow direction. A very small number of increasing groundwater trends were observed and are

likely attributable to increased oxidation of the copper sulfide-bearing rocks which crop out in the river basin adjacent to the river pillar.

No trends, either increasing or decreasing were noted for the surface water results.

SGL:lmc

Attachments

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-91	Oct-91	Jan-92	Apr-92	Jul-92	Oct-92	Jan-93	Apr-93
MW-1000P-R									
Conductivity (Field)	umhos	225	327	190	183.2	194	201	203	198
pH (Field)	S.U.	8.39	7.41	5.75	6.91	6.64	6.9	6.22	6.24
Alkalinity	mg/l	65	90	88	84	81	95	84	82
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	0.014	< 0.014	< 0.014	0.02
Hardness	mg/l	84	110	110	88	120	100	88	90
Iron	mg/l	0.65	0.84	1.7	1.3	0.47	0.8	0.15	0.27
Manganese	mg/l	0.85	0.88	0.82	0.83	0.73	0.78	0.71	0.94
Sulfate	mg/l	< 10	< 10	11	14	12	12	< 10	12
TDS	mg/l	190	160	120	120	140	160	100	130
MW-1002									
Conductivity (Field)	umhos	157	189	138	145	118	181	127	136
pH (Field)	S.U.	8.33	6.78	6.88	6.05	5.61	6.94	6.96	6.33
Alkalinity	mg/l	50	49	47	49	41	53	53	66
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	60	60	67	48	120	82	66	90
Iron	mg/l	0.99	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	0.059	< 0.01
Manganese	mg/l	0.0051	< 0.004	< 0.004	< 0.004	0.004	0.015	0.0047	< 0.004
Sulfate	mg/l	< 10	< 10	< 10	11	< 10	11	< 10	9
TDS	mg/l	160	170	100	85	87	130	90	120
MW-1002G									
Conductivity (Field)	umhos	277	272	221	199	198	254	197	239
pH (Field)	S.U.	7.56	6.98	6.93	6.25	6.02	6.94	7.14	6.13
Alkalinity	mg/l	86	88	80	84	79	85	75	44
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	100	120	110	110	160	130	94	76
Iron	mg/l	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.01
Manganese	mg/l	0.0054	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Sulfate	mg/l	< 10	10	11	14	11	11	12	8
TDS	mg/l	240	280	140	150	150	180	98	74
MW-1004P									
Conductivity (Field)	umhos	175	352	302	282	295	342	291	329
pH (Field)	S.U.	8.15	7.15	6.8	6.88	6.74	7.46	6.24	7.74
Alkalinity	mg/l	160	170	160	170	160	190	170	170
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	150	170	150	160	170	180	160	160
Iron	mg/l	0.33	0.22	0.32	0.37	0.38	0.32	0.39	< 0.01
Manganese	mg/l	0.13	0.13	0.12	0.14	0.13	0.13	0.14	< 0.004
Sulfate	mg/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	3
TDS	mg/l	210	310	160	180	180	260	160	160
MW-1004S									
Conductivity (Field)	umhos	161	135	146	153	175	258	174	168
pH (Field)	S.U.	8.64	7.25	7.03	6.7	6.5	6.96	6.37	7.77
Alkalinity	mg/l	50	49	27	60	74	100	73	51
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	60	60	62	72	150	110	92	70
Iron	mg/l	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.01
Manganese	mg/l	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Sulfate	mg/l	< 10	10	11	12	< 10	< 10	< 10	11
TDS	mg/l	160	170	95	100	110	220	95	120

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-91	Oct-91	Jan-92	Apr-92	Jul-92	Oct-92	Jan-93	Apr-93
MW-1005									
Conductivity(Field)	umhos	1028	981	870	905	912	1013	945	971
pH(Field)	S.U.	7.73	7.34	6.12	6.32	6.01	6.13	6.21	6.11
Alkalinity	mg/l	84	92	86	90	90	110	94	78
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	380	360	1000	520	440	420	400	500
Iron	mg/l	17	20	18	17	19	22	24	24
Manganese	mg/l	0.51	0.49	0.46	0.38	0.44	0.47	0.52	0.54
Sulfate	mg/l	15	12	14	16	15	15	23	15
TDS	mg/l	570	770	530	680	640	600	140	630
MW-1005P									
Conductivity(Field)	umhos	512	479	391	417	426	501	440	458
pH(Field)	S.U.	8.49	7.66	6.85	6.97	6.81	7.26	6.39	6.52
Alkalinity	mg/l	260	260	260	260	270	270	260	250
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	230	230	240	240	260	260	240	250
Iron	mg/l	1.2	1	0.75	1	0.95	1.2	1.1	0.46
Manganese	mg/l	0.22	0.15	0.16	0.13	0.15	0.1	0.11	0.15
Sulfate	mg/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	2
TDS	mg/l	290	440	280	350	270	320	220	240
MW-1005S									
Conductivity(Field)	umhos	377	351	303	324	331	391	418	360
pH(Field)	S.U.	7.68	7.37	6.88	7.48	6.68	7.38	6.99	6.38
Alkalinity	mg/l	170	170	170	180	170	190	180	81
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.01
Hardness	mg/l	170	170	250	290	220	270	180	210
Iron	mg/l	3	3.8	3.6	3.7	4.1	3.9	4.1	4.4
Manganese	mg/l	0.21	0.22	0.21	0.2	0.21	0.2	0.21	0.23
Sulfate	mg/l	< 10	< 10	< 10	< 10	< 10	< 10	10	8
TDS	mg/l	220	370	< 20	210	220	260	160	200
MW-1010P									
Conductivity(Field)	umhos	337	326	292	314	285	389	357	357
pH(Field)	S.U.	8.47	8.26	6.87	7.62	6.86	7.49	7.21	6.62
Alkalinity	mg/l	140	160	150	160	160	180	190	170
Copper	mg/l	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
Hardness	mg/l	140	130	130	140	180	160	130	130
Iron	mg/l	< 0.055	< 0.055	0.15	< 0.055	< 0.055	< 0.055	0.055	0.055
Manganese	mg/l	0.26	0.28	0.25	0.2	0.086	0.14	0.031	0.14
Sulfate	mg/l	< 10	10	16	14	< 10	< 10	32	28
TDS	mg/l	180	250	200	340	180	280	210	270

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-93	Oct-93	Jan-94	Apr-94	Jul-94	Oct-94	Jan-95	Apr-95
MW-1000P-R									
Conductivity (Field)	umhos	217	233	135	124	133	116	116	106
pH (Field)	S.U.	6.6	7.03	6.9	7.7	7.5	7.2	7.1	7.4
Alkalinity	mg/l	82	62	43	44	39	34	30	38
Copper	mg/l	0.016	0.013	0.022	0.023	0.017	0.058	0.052	0.058
Hardness	mg/l	86	120	54	54	49	36	36	35
Iron	mg/l	0.061	0.032	< 0.015	0.021	0.026	0.047	0.12	0.026
Manganese	mg/l	0.73	0.91	0.34	0.5	0.42	0.36	0.29	0.32
Sulfate	mg/l	15	12	12	12	11	17	9.0	14.0
TDS	mg/l	140	110	70	95	90	120	88	90
MW-1002									
Conductivity (Field)	umhos	273	138	151	105	109.4	122	143.2	106
pH (Field)	S.U.	6.83	7.52	7.5	7.5	7	7	6.7	7.4
Alkalinity	mg/l	42	42	39	35	31	38	38	42
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0016	< 0.00047	0.002
Hardness	mg/l	52	52	50	45	44	46	47	42
Iron	mg/l	0.034	< 0.015	< 0.015	< 0.015	< 0.015	0.0056	0.0073	0.0039
Manganese	mg/l	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.00047	0.0027	0.00027
Sulfate	mg/l	10	6	7	7	6.6	6.1	6.2	7.3
TDS	mg/l	100	78	82	86	94	87	120	170
MW-1002G									
Conductivity (Field)	umhos	480	262	278	267	238	269	301	255
pH (Field)	S.U.	6.72	7.38	7	7.4	6.7	6.8	6.7	6.9
Alkalinity	mg/l	64	82	94	92	92	88	90	93
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0016	< 0.00047	0.0014
Hardness	mg/l	80	110	120	120	120	110	110	100
Iron	mg/l	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	0.0054	0.0072	0.0044
Manganese	mg/l	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.00047	0.0021	< 8.6E-05
Sulfate	mg/l	11	11	14	12	12	14	12	15
TDS	mg/l	140	190	180	170	170	200	240	170
MW-1004P									
Conductivity (Field)	umhos	347	329	371	287	317	303	315	292
pH (Field)	S.U.	7.4	7.61	7.3	7.4	7.1	7.1	6.7	7.4
Alkalinity	mg/l	170	170	140	160	160	170	170	170
Copper	mg/l	< 0.012	< 0.012	< 0.012	0.015	< 0.012	< 0.0016	0.0033	0.011
Hardness	mg/l	150	160	150	150	150	160	150	130
Iron	mg/l	0.042	0.048	< 0.015	0.033	0.024	0.035	0.014	0.025
Manganese	mg/l	0.022	0.04	0.02	0.045	0.028	0.029	0.029	0.031
Sulfate	mg/l	5	3	2	3	2.5	3.9	1.7	4.7
TDS	mg/l	180	230	160	180	190	200	190	250
MW-1004S									
Conductivity (Field)	umhos	178	186	123	109	200	124	142.4	131
pH (Field)	S.U.	7	7.41	7	7.8	6.8	6.7	6.2	6.7
Alkalinity	mg/l	24	32	42	38	140	44	100	55
Copper	mg/l	< 0.012	< 0.012	0.016	< 0.012	< 0.012	< 0.0016	0.0011	0.007
Hardness	mg/l	56	46	44	51	52	54	57	45
Iron	mg/l	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	0.0064	0.0049	0.0087
Manganese	mg/l	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.00047	0.0034	0.00087
Sulfate	mg/l	11	9	10	8	8	8.6	7.1	7.8
TDS	mg/l	110	98	74	100	100	150	140	150

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-93	Oct-93	Jan-94	Apr-94	Jul-94	Oct-94	Jan-95	Apr-95
MW-1005									
Conductivity(Field)	umhos	110	1005	1072	1082	1093	1028	1035	1014
pH(Field)	S.U.	6.12	6.68	6.3	7.6	6.2	6.1	6.2	6.2
Alkalinity	mg/l	74	84	81	88	75	78	84	79
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0016	< 0.00047	0.0013
Hardness	mg/l	410	390	440	450	450	420	370	320
Iron	mg/l	18	25	24	24	31	28	29	28
Manganese	mg/l	0.42	0.61	0.53	0.54	0.69	0.63	0.65	0.6
Sulfate	mg/l	18	17	18	13	14	20	14	18
TDS	mg/l	590	680	560	620	600	820	660	770
MW-1005P									
Conductivity(Field)	umhos	519	462	487	487	456	452	511	420
pH(Field)	S.U.	7.59	7.53	7.3	7.2	6.9	7.2	7.1	7.5
Alkalinity	mg/l	250	250	250	250	240	250	270	270
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0016	0.0044	0.0037
Hardness	mg/l	230	220	230	230	230	250	230	200
Iron	mg/l	0.61	0.17	0.19	0.2	0.22	0.24	0.04	0.08
Manganese	mg/l	0.14	0.069	0.035	0.16	0.1	0.062	0.041	0.041
Sulfate	mg/l	3	< 2	< 2	< 2	< 2	2.5	< 0.56	< 0.56
TDS	mg/l	260	300	260	270	270	280	340	300
MW-1005S									
Conductivity(Field)	umhos	372	321	357	344	322	320	425	315
pH(Field)	S.U.	7.28	7.28	7.2	7.5	6.9	7.3	6.7	7.0
Alkalinity	mg/l	170	170	160	160	160	160	160	160
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.0016	< 0.00047	< 0.00068
Hardness	mg/l	160	160	160	160	160	160	150	130
Iron	mg/l	4.2	4.2	4	4.1	4.1	3.7	4.2	4.0
Manganese	mg/l	0.22	0.24	0.2	0.2	0.2	0.19	0.22	0.2
Sulfate	mg/l	9	6	9	8	7.2	13	8.9	9.3
TDS	mg/l	200	220	190	200	210	240	240	190
MW-1010P									
Conductivity(Field)	umhos	313	294	283	276	322	309	337	311
pH(Field)	S.U.	7.21	7.51	7.3	7.4	7.2	7.5	7.6	7.4
Alkalinity	mg/l	150	160	160	160	160	160	160	170
Copper	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	0.0032	0.0067	0.0097
Hardness	mg/l	130	130	150	150	150	150	160	130
Iron	mg/l	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	0.0046	0.0040	0.0050
Manganese	mg/l	0.035	0.018	0.17	0.014	0.01	0.014	0.06	0.051
Sulfate	mg/l	11	5	3	3	3.4	4.5	3.3	5.0
TDS	mg/l	180	230	170	180	190	200	250	240

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-95	Oct-95	Jan-96	Apr-96	Jul-96	Oct-96	Jan-97	Apr-97
MW-1000P-R									
Conductivity(Field)	umhos	116	119	112.4	149.4	113.5	109	112.4	132.9
pH(Field)	S.U.	8.1	7.3	6.86	7.07	7.26	7.4	7.22	7.46
Alkalinity	mg/l	34	36	27	53	35	38	27	36
Copper	mg/l	0.043	0.061	0.049	0.031	0.033	0.057	0.033	0.032
Hardness	mg/l	36	39	33	40	38	36	33	43
Iron	mg/l	0.0096	0.027	0.011	0.018	0.0066	0.01	0.0093	0.043
Manganese	mg/l	0.24	0.11	0.054	0.064	0.12	0.14	0.15	0.19
Sulfate	mg/l	10	11	8.5	16	9.3	7.1	9.8	9.9
TDS	mg/l	99	75	87	130	140	76	160	160
MW-1002									
Conductivity(Field)	umhos	99	120	153.7	142.2	119.6	155.1	123.8	140
pH(Field)	S.U.	7.2	6.6	6.98	6.75	6.78	6.9	7.47	7.4
Alkalinity	mg/l	33	30	35	32	34	41	42	41
Copper	mg/l	0.00097	0.0016	< 0.00068	0.0017	0.0016	0.0035	0.00099	0.00079
Hardness	mg/l	35	38	41	36	97	42	46	46
Iron	mg/l	< 0.0017	0.0040	0.0031	0.017	0.021	0.0063	0.011	0.007
Manganese	mg/l	0.00042	0.0014	0.00012	0.00098	0.0005	0.0002	0.00018	0.00087
Sulfate	mg/l	5.3	7.9	5.4	5.9	5.9	6.9	6.3	7
TDS	mg/l	76	86	65	120	94	85	110	110
MW-1002G									
Conductivity(Field)	umhos	275	239	232	264	221	226	245	260
pH(Field)	S.U.	6.9	6.9	6.79	6.55	6.71	6.8	7.15	7
Alkalinity	mg/l	90	100	85	110	79	86	80	81
Copper	mg/l	< 0.00068	< 0.00068	< 0.00068	< 0.00068	< 0.00054	< 0.00054	0.0019	0.00054
Hardness	mg/l	100	110	100	100	93	93	96	100
Iron	mg/l	0.0019	< 0.0017	< 0.0017	0.0039	0.0038	0.0039	0.0024	0.0029
Manganese	mg/l	< 8.6E-05	< 8.6E-05	< 8.6E-05	0.00014	< 0.00018	< 0.00018	0.00018	0.00018
Sulfate	mg/l	11	14	11	11	11	11	9.6	10
TDS	mg/l	190	160	150	220	200	120	180	200
MW-1004P									
Conductivity(Field)	umhos	317	308	295	258	287	340	238	311
pH(Field)	S.U.	7.2	7.0	7.3	6.93	7.21	7.2	7.42	7.25
Alkalinity	mg/l	170	170	150	150	150	160	160	140
Copper	mg/l	0.02	0.0043	0.0033	0.0073	0.0033	0.0059	0.0062	0.016
Hardness	mg/l	130	150	130	130	130	120	120	130
Iron	mg/l	0.044	0.0086	0.0094	0.011	0.0047	0.0042	0.015	0.008
Manganese	mg/l	0.077	0.028	0.027	0.022	0.017	0.014	0.034	0.017
Sulfate	mg/l	1.8	8.1	2.3	4.2	4.3	4.2	5.5	6.9
TDS	mg/l	190	170	150	210	200	160	220	210
MW-1004S									
Conductivity(Field)	umhos	126.3	144.9	144.9	168.2	153.5	159.5	163.7	165.8
pH(Field)	S.U.	6.9	6.3	6.61	5.84	6.31	6.3	7.03	6.51
Alkalinity	mg/l	50	79	50	61	55	66	61	60
Copper	mg/l	0.0066	0.0076	0.0034	0.0026	0.0039	0.0018	0.0051	0.0018
Hardness	mg/l	50	59	54	52	46	59	62	59
Iron	mg/l	0.0031	0.0040	0.0038	0.0048	0.0023	0.0049	0.0061	0.0049
Manganese	mg/l	0.0005	0.0013	0.0011	0.00032	0.00072	0.00029	0.00025	0.00072
Sulfate	mg/l	6.2	9.4	5.8	6.2	6.9	6.5	6.6	8.2
TDS	mg/l	110	110	120	130	130	100	150	110

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-95	Oct-95	Jan-96	Apr-96	Jul-96	Oct-96	Jan-97	Apr-97
MW-1005									
Conductivity(Field)	umhos	1049	976	963	967	858	948	921	812
pH(Field)	S.U.	6.3	6.2	6.17	5.97	6.07	6.2	5.91	6.34
Alkalinity	mg/l	75	55	78	73	68	64	79	66
Copper	mg/l	< 0.00068	< 0.00068	< 0.00068	< 0.00068	< 0.00054	0.005	0.015	0.0045
Hardness	mg/l	320	360	330	300	300	320	300	280
Iron	mg/l	28	32	28	23	19	17	23	21
Manganese	mg/l	0.64	0.7	0.6	0.55	0.47	0.43	0.54	0.51
Sulfate	mg/l	14	21	14	14	14	14	13	12
TDS	mg/l	730	740	560	530	650	550	600	620
MW-1005P									
Conductivity(Field)	umhos	454	470	464	486	441	471	462	480
pH(Field)	S.U.	7.2	7.2	7.31	6.85	6.9	7.2	7.04	7
Alkalinity	mg/l	280	260	240	250	240	260	260	250
Copper	mg/l	0.0018	0.0021	< 0.00068	< 0.00068	0.0039	0.0082	0.0027	0.0016
Hardness	mg/l	200	230	210	210	210	200	210	220
Iron	mg/l	0.07	0.17	0.28	0.049	0.064	0.37	0.073	0.41
Manganese	mg/l	0.09	0.072	0.097	0.035	0.14	0.067	0.024	0.077
Sulfate	mg/l	< 0.56	5.3	0.93	2.2	2.6	3.6	5.4	5.8
TDS	mg/l	290	260	270	300	300	280	280	320
MW-1005S									
Conductivity(Field)	umhos	358	354	360	329	323	329	321	344
pH(Field)	S.U.	6.9	7.1	7.27	6.8	6.8	7.1	6.8	6.8
Alkalinity	mg/l	170	170	160	160	150	160	160	160
Copper	mg/l	< 0.00068	< 0.00068	< 0.00068	< 0.00068	< 0.00054	0.00063	0.004	0.0016
Hardness	mg/l	140	160	140	140	140	130	140	150
Iron	mg/l	3.8	4.3	3.7	3.9	3.6	3.6	3.8	4.1
Manganese	mg/l	0.2	0.22	0.2	0.2	0.19	0.2	0.2	0.21
Sulfate	mg/l	6.9	14	7	7.6	8.8	8	7.4	9.5
TDS	mg/l	220	220	190	240	230	220	250	250
MW-1010P									
Conductivity(Field)	umhos	315	291	313	309	285	302	282	346
pH(Field)	S.U.	7.6	7.4	7.01	7.16	7.42	7.6	7.23	7.43
Alkalinity	mg/l	160	140	140	160	140	150	140	150
Copper	mg/l	0.021	0.063	0.045	0.016	0.074	0.039	0.056	0.015
Hardness	mg/l	130	140	130	140	130	130	130	150
Iron	mg/l	0.0017	0.037	0.0023	0.0036	< 0.001	0.0026	0.0018	0.008
Manganese	mg/l	0.011	0.021	0.013	0.1	0.12	0.021	0.028	0.12
Sulfate	mg/l	2.4	9.6	3.4	3.8	5.9	5.8	5.8	6.7
TDS	mg/l	200	200	180	200	200	170	180	170

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-97	Oct-97
MW-1000P-R			
Conductivity(Field)	umhos	107.1	132
pH(Field)	S.U.	6.72	6.55
Alkalinity	mg/l	33	40
Copper	mg/l	0.029	0.034
Hardness	mg/l	39	45
Iron	mg/l	0.0079	0.0044
Manganese	mg/l	0.061	0.11
Sulfate	mg/l	7.8	5.9
TDS	mg/l	110	82
MW-1002			
Conductivity(Field)	umhos	118.4	114
pH(Field)	S.U.	6.38	6.02
Alkalinity	mg/l	30	40
Copper	mg/l	0.0013	0.00086
Hardness	mg/l	45	46
Iron	mg/l	0.0087	0.003
Manganese	mg/l	0.0008	0.00052
Sulfate	mg/l	6.6	6
TDS	mg/l	88	76
MW-1002G			
Conductivity(Field)	umhos	271	228
pH(Field)	S.U.	6.51	6.35
Alkalinity	mg/l	78	88
Copper	mg/l	0.00054	0.00054
Hardness	mg/l	100	98
Iron	mg/l	0.0051	0.001
Manganese	mg/l	0.00018	0.00018
Sulfate	mg/l	9.3	7.8
TDS	mg/l	200	160
MW-1004P			
Conductivity(Field)	umhos	277	349
pH(Field)	S.U.	6.94	6.91
Alkalinity	mg/l	140	150
Copper	mg/l	0.014	0.04
Hardness	mg/l	140	140
Iron	mg/l	0.0035	0.0047
Manganese	mg/l	0.012	0.01
Sulfate	mg/l	6.5	5.3
TDS	mg/l	200	120
MW-1004S			
Conductivity(Field)	umhos	202	201
pH(Field)	S.U.	6.36	6.13
Alkalinity	mg/l	55	58
Copper	mg/l	0.002	0.0016
Hardness	mg/l	64	75
Iron	mg/l	0.0091	0.0057
Manganese	mg/l	0.00038	0.00093
Sulfate	mg/l	8	15
TDS	mg/l	130	100

Prepared By: SGL Checked By: JBH1

Table 1A

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Jul-97	Oct-97
MW-1005			
Conductivity(Field)	umhos	755	804
pH(Field)	S.U.	6.22	6
Alkalinity	mg/l	63	77
Copper	mg/l	0.0059	0.00054
Hardness	mg/l	300	280
Iron	mg/l	29	23
Manganese	mg/l	0.8	0.59
Sulfate	mg/l	12	10
TDS	mg/l	220	510
MW-1005P			
Conductivity(Field)	umhos	448	505
pH(Field)	S.U.	7.03	6.9
Alkalinity	mg/l	240	240
Copper	mg/l	0.002	0.00054
Hardness	mg/l	230	230
Iron	mg/l	0.087	0.17
Manganese	mg/l	0.066	0.062
Sulfate	mg/l	6.7	5
TDS	mg/l	280	260
MW-1005S			
Conductivity(Field)	umhos	689	351
pH(Field)	S.U.	6.83	6.77
Alkalinity	mg/l	140	150
Copper	mg/l	0.00071	0.00054
Hardness	mg/l	150	150
Iron	mg/l	4	4.2
Manganese	mg/l	0.2	0.21
Sulfate	mg/l	9.8	6.2
TDS	mg/l	260	190
MW-1010P			
Conductivity(Field)	umhos	295	303
pH(Field)	S.U.	7.25	7.03
Alkalinity	mg/l	130	140
Copper	mg/l	0.048	0.03
Hardness	mg/l	140	140
Iron	mg/l	0.001	0.001
Manganese	mg/l	0.026	0.029
Sulfate	mg/l	7	5.1
TDS	mg/l	170	170

Prepared By: SGL Checked By: JBHI

Table 1B

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Total Samples	# Of Samples Included In Trend Test(*)	Total Detections	Mann-Kendall S	p-Level	Inc./Dec. Trend
MW-1000P-R							
Conductivity(Field)	umhos	26	26	26	-180	0	-
pH(Field)	S.U.	26	26	26	36	0.445	
Alkalinity	mg/l	26	26	26	-195	0	-
Copper	mg/l	26	26	20	176	0	+
Hardness	mg/l	26	26	26	-173	0	-
Iron	mg/l	26	26	25	-214	0	-
Manganese	mg/l	26	26	26	-231	0	-
Sulfate	mg/l	26	26	23	-51	0.274	
TDS	mg/l	26	26	26	-86	0.061	
MW-1002							
Conductivity(Field)	umhos	26	26	26	-82	0.074	
pH(Field)	S.U.	26	26	26	-13	0.794	
Alkalinity	mg/l	26	26	26	-145	0.002	-
Copper	mg/l	26	12	10	-1	0.973	
Hardness	mg/l	26	26	26	-143	0.002	-
Iron	mg/l	26	16	15	-32	0.166	
Manganese	mg/l	26	16	15	-36	0.116	
Sulfate	mg/l	26	26	21	22	0.647	
TDS	mg/l	26	26	26	-66	0.153	
MW-1002G							
Conductivity(Field)	umhos	26	26	26	-9	0.862	
pH(Field)	S.U.	26	26	26	-48	0.304	
Alkalinity	mg/l	26	26	26	28	0.555	
Copper	mg/l	26	12	5	24	0.116	
Hardness	mg/l	26	26	26	-102	0.025	
Iron	mg/l	26	13	11	-18	0.306	
Manganese	mg/l	26	11	7	5	0.762	
Sulfate	mg/l	26	26	25	-33	0.484	
TDS	mg/l	26	26	26	34	0.471	
MW-1004P							
Conductivity(Field)	umhos	26	26	26	-29	0.54	
pH(Field)	S.U.	26	26	26	-30	0.526	
Alkalinity	mg/l	26	26	26	-108	0.017	
Copper	mg/l	26	14	13	28	0.142	
Hardness	mg/l	26	26	26	-181	0	-
Iron	mg/l	26	26	24	-193	0	-
Manganese	mg/l	26	26	25	-174	0	-
Sulfate	mg/l	26	26	19	196	0	+
TDS	mg/l	26	26	26	-6	0.913	
MW-1004S							
Conductivity(Field)	umhos	26	26	26	42	0.37	
pH(Field)	S.U.	26	26	26	-146	0.001	-
Alkalinity	mg/l	26	26	26	52	0.264	
Copper	mg/l	26	14	13	-24	0.213	
Hardness	mg/l	26	26	26	-33	0.484	
Iron	mg/l	26	19	13	-36	0.224	
Manganese	mg/l	26	13	12	-11	0.55	
Sulfate	mg/l	26	26	22	-21	0.662	
TDS	mg/l	26	26	26	15	0.76	

Table 1B

Groundwater Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Well/Parameter	Units	Total Samples	# Of Samples Included In Trend Test(*)	Total Detections	Mann-Kendall S	p-Level	Inc./Dec. Trend
MW-1005							
Conductivity(Field)	umhos	26	26	26	-84	0.067	
pH(Field)	S.U.	26	26	26	-78	0.09	
Alkalinity	mg/l	26	26	26	-180	0	-
Copper	mg/l	26	12	6	30	0.044	
Hardness	mg/l	26	26	26	-201	0	-
Iron	mg/l	26	26	26	88	0.055	
Manganese	mg/l	26	26	26	100	0.028	
Sulfate	mg/l	26	26	26	-98	0.032	
TDS	mg/l	26	26	26	-43	0.358	
MW-1005P							
Conductivity(Field)	umhos	26	26	26	25	0.6	
pH(Field)	S.U.	26	26	26	-54	0.245	
Alkalinity	mg/l	26	26	26	-91	0.046	
Copper	mg/l	26	12	10	-15	0.345	
Hardness	mg/l	26	26	26	-125	0.006	-
Iron	mg/l	26	26	26	-158	0	-
Manganese	mg/l	26	26	26	-160	0	-
Sulfate	mg/l	26	15	12	54	0.007	+
TDS	mg/l	26	26	26	-7	0.896	
MW-1005S							
Conductivity(Field)	umhos	26	26	26	-18	0.71	
pH(Field)	S.U.	26	26	26	-112	0.013	
Alkalinity	mg/l	26	26	26	-148	0	-
Copper	mg/l	26	12	5	37	0.011	
Hardness	mg/l	26	26	26	-194	0	-
Iron	mg/l	26	26	26	18	0.71	
Manganese	mg/l	26	26	26	-67	0.146	
Sulfate	mg/l	26	26	20	110	0.015	
TDS	mg/l	26	26	25	59	0.204	
MW-1010P							
Conductivity(Field)	umhos	26	26	26	-76	0.099	
pH(Field)	S.U.	26	26	26	-29	0.54	
Alkalinity	mg/l	26	26	26	-106	0.019	
Copper	mg/l	26	26	13	109	0.016	
Hardness	mg/l	26	26	26	-11	0.828	
Iron	mg/l	26	15	14	-54	0.007	-
Manganese	mg/l	26	26	26	-113	0.012	
Sulfate	mg/l	26	26	23	20	0.678	
TDS	mg/l	26	26	26	-118	0.009	-

+ : Implies Statistically Increasing Trend
- : Implies Statistically Decreasing Trend

(*) If the value of a sample is below the detection limit, three situations apply:
1) If the detection limit is equal to or less than the minimum detected value, the result is replaced with zero.
2) If the detection limit is greater than the minimum detected value, but less than or equal to two times the minimum detected value, the minimum detected value, the result is replaced with the minimum detected value.
3) If the detection limit is greater than two times the minimum detected value the result is omitted from the trend analysis.

Table 2A

Surface Water Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Station/Parameter	Units	Jul-91	Oct-91	Jan-92	Apr-92	Jul-92	Oct-92	Jan-93	Apr-93
SW-1									
Conductivity(Field)	umhos	112	102	84	74	86	134	136	84
pH(Field)	S.U.	7.43	7.92	6.95	6.71	6.75	7.23	6.71	7.07
Aluminum	mg/l	< 0.4	0.08	0.7	0.75	0.14	0.42	0.11	0.13
Arsenic	mg/l	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Beryllium	mg/l	< 0.2	< 0.2	< 0.2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	mg/l	< 0.0002	0.001	< 0.0002	< 0.0002	0.0006	< 0.0002	0.0007	< 0.0002
Chromium	mg/l	0.0027	< 0.002	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chromium IV	mg/l	0.01	< 0.02	0.009	< 0.02	< 0.018	< 0.02	< 0.005	< 0.005
Copper	mg/l	< 0.003	0.004	0.003	0.005	0.002	0.004	< 0.002	< 0.002
Diss O2	mg/l	6.2	11	12	11.2	7.4	9.9	11	6.8
Hardness	mg/l	100	46	50	34	23	52	52	40
Lead	mg/l	0.0012	< 0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001
Mercury	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Nickel	mg/l	< 0.05	< 0.016	< 0.05	< 0.02	< 0.018	< 0.02	< 0.02	< 0.02
Selenium	mg/l	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Silver	mg/l	< 0.0005	< 0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Sulfide	mg/l								
TDS	mg/l	140	98	90	86	90	90	100	66
TSS	mg/l	< 1	14	4	< 1	9	4	< 1	2
Zinc	mg/l	0.02	24	0.008	0.011	0.006	< 0.003	0.007	< 0.003
SW-2									
Conductivity(Field)	umhos	120	104	144	69	85	117	158	85
pH(Field)	S.U.	7.92	8.01	7.09	6.19	7.1	7.11	7.05	7.25
Aluminum	mg/l	< 0.4	0.06	0.42	0.72	0.14	0.54	0.07	0.11
Arsenic	mg/l	< 0.001	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Beryllium	mg/l	< 0.2	< 0.2	< 0.2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cadmium	mg/l	< 0.0002	0.0005	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	mg/l	0.0012	< 0.002	0.002	< 0.001	0.001	< 0.001	< 0.001	< 0.001
Chromium IV	mg/l	0.009	< 0.02	0.007	< 0.02	< 0.013	< 0.02	< 0.005	< 0.005
Copper	mg/l	0.0042	< 0.002	0.004	< 0.002	< 0.002	0.004	0.004	0.002
Diss O2	mg/l	6.5	10	12	11.5	7.6	10	12	11
Hardness	mg/l	48	47	50	34	28	68	52	40
Lead	mg/l	0.0012	< 0.003	0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001
Mercury	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Nickel	mg/l	< 0.05	< 0.016	< 0.05	< 0.02	< 0.018	< 0.02	< 0.02	< 0.02
Selenium	mg/l	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Silver	mg/l	< 0.0005	< 0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Sulfide	mg/l								
TDS	mg/l	140	85	87	120	120	96	110	74
TSS	mg/l	< 1	4	< 1	< 1	7	5	< 1	1
Zinc	mg/l	0.02	< 3	0.004	0.009	0.008	< 0.003	0.008	< 0.003

Prepared By: SGL Checked By: JBH1

Table 2A

Surface Water Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Station/Parameter	Units	Jul-93	Nov-93	Jan-94	Apr-94	Jul-94	Oct-94	Jan-95	Apr-95
SW-1									
Conductivity(Field)	umhos	87	118.9	203	118	117	78	128.5	78.1
pH(Field)	S.U.	7.29	8.59	7.8	8	7.4	7.2	8.14	7.7
Aluminum	mg/l	0.18	0.047	0.12	0.29	0.07	0.2	0.059	0.093
Arsenic	mg/l	0.0028	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0014	< 0.0014
Beryllium	mg/l	< 0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.00028	< 0.00028
Cadmium	mg/l	< 0.0008	< 0.0006	< 0.0002	0.00038	< 0.0002	< 0.0008	< 0.00052	0.00022
Chromium	mg/l	< 0.002	0.004	< 0.001	0.0018	0.0018	0.0025	< 0.00055	0.0043
Chromium IV	mg/l	< 0.005		< 0.005	< 0.005	< 0.005	< 0.0015	< 0.0015	< 0.0015
Copper	mg/l	< 0.012	< 0.002	0.0044	< 0.002	0.0027	0.002	0.0078	< 0.0038
Diss O2	mg/l	10	9	11.9	5.8	8.5	10.1	9	9.3
Hardness	mg/l	44	56	64	43	48	36	48	36
Lead	mg/l	< 0.005	< 0.001	< 0.001	0.01	0.0025	0.0011	< 0.00078	0.0045
Mercury	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 9.5E-05	< 9.5E-05
Nickel	mg/l	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.0059	< 0.0059
Selenium	mg/l	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0015	< 0.0015
Silver	mg/l	< 0.002	< 0.0015	< 0.0005	< 0.0005	< 0.0005	< 0.0025	0.0016	0.0013
Sulfide	mg/l		< 2			< 2	< 2	< 2	< 2
TDS	mg/l	66	91	93	84	96	100	120	100
TSS	mg/l	5	< 1	1	3	< 1	8	8	10
Zinc	mg/l	< 0.003	< 0.003	0.007	0.009	0.011	0.017	0.016	< 0.012
SW-2									
Conductivity(Field)	umhos	100	132.6	151	124	119	82	158	86
pH(Field)	S.U.	7.14	7.93	8.1	8	7.6	7.1	8.19	7.7
Aluminum	mg/l	0.36	0.072	0.036	0.31	0.14	0.22	0.26	0.12
Arsenic	mg/l	0.0027	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0014	< 0.0014
Beryllium	mg/l	< 0.0004	< 0.001	< 0.001	< 0.001	0.0012	0.0012	0.0012	0.0006
Cadmium	mg/l	< 0.0008	< 0.0006	< 0.0002	< 0.0002	0.00022	< 0.0008	< 0.00052	< 0.0016
Chromium	mg/l	0.0021	0.004	< 0.001	0.0019	0.0023	0.0037	< 0.00055	0.0044
Chromium IV	mg/l	< 0.005		< 0.005	< 0.005	< 0.005	< 0.0015	< 0.0015	< 0.0015
Copper	mg/l	< 0.012	0.0032	< 0.002	0.0051	0.0036	0.0057	0.011	< 0.0038
Diss O2	mg/l	9.7	8.5	11.6	6.6	8.8	9.3	8.6	10.8
Hardness	mg/l	76	60	60	40	48	38	55	36
Lead	mg/l	< 0.005	< 0.001	< 0.001	< 0.001	0.0014	0.0015	0.0097	0.0061
Mercury	mg/l	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 9.5E-05	< 9.5E-05
Nickel	mg/l	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.0059	< 0.0059
Selenium	mg/l	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0015	< 0.0015
Silver	mg/l	< 0.002	< 0.0015	< 0.0005	< 0.0005	< 0.0005	< 0.0025	< 0.00085	0.0018
Sulfide	mg/l		< 2			< 2	< 2	< 2	< 2
TDS	mg/l	100	88	83	82	100	92	150	81
TSS	mg/l	11	< 1	< 1	13	10	8	6	< 1
Zinc	mg/l	0.009	0.04	0.05	0.007	0.009	0.023	0.021	< 0.012

Prepared By: SGL Checked By: JBH1

Table 2A

Surface Water Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Station/Parameter	Units	Jul-95	Oct-95	Jan-96	Apr-96	Jul-96	Oct-96	Jan-97	Apr-97
SW-1									
Conductivity(Field)	umhos	105.5	112.5	150.5	124	94.5	153.5	113.3	58.9
pH(Field)	S.U.	7.18	7.74	7.15	6.5	7.53	7.95	7.57	6.82
Aluminum	mg/l	0.06	0.096	< 0.025	0.037	0.14	0.046	0.064	0.26
Arsenic	mg/l	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018
Beryllium	mg/l	< 8.3E-05	0.00011	< 8.3E-05	< 8.3E-05	0.00022	< 8.3E-05	< 8.3E-05	< 8.3E-05
Cadmium	mg/l	< 0.00016	0.00019	0.00035	< 0.00016	0.00017	0.00031	< 0.00016	< 0.00016
Chromium	mg/l	< 0.00061	0.0014	0.0013	< 9.3E-06	0.0014	< 0.00061	0.0025	0.00082
Chromium IV	mg/l	< 0.0015	< 0.006	0.003	< 0.0015	< 0.029	0.004	< 0.0036	< 0.018
Copper	mg/l	< 0.0017	0.0037	< 0.0017	0.0033	0.0021	0.0019	< 0.0017	0.0018
Diss O2	mg/l	9.1	8.2	10.7	9.1	5.3	8.5	9.6	12.1
Hardness	mg/l	43	40	46	44	34	40	44	20
Lead	mg/l	< 0.002	0.0082	0.01	< 0.002	0.0027	< 0.002	0.0023	< 0.002
Mercury	mg/l	< 9.5E-05	< 9.5E-05	< 9.5E-05	< 9.5E-05	0.00066	< 6.7E-05	< 6.7E-05	< 6.7E-05
Nickel	mg/l	< 0.00075	0.0026	< 0.00075	< 0.00075	0.00081	< 0.00075	< 0.00075	0.00076
Selenium	mg/l	< 0.0015	< 0.0015	< 0.0015	< 0.0015	0.0017	0.0025	0.0018	< 0.0015
Silver	mg/l	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0015	< 0.0011	< 0.0011
Sulfide	mg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
TDS	mg/l	80	120	86	120	120	16	100	98
TSS	mg/l	7	< 1	4	< 1	< 1	< 1	1	8
Zinc	mg/l	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	0.021	0.013
SW-2									
Conductivity(Field)	umhos	170	126	120.2	153.1	106.8	274	132	89.6
pH(Field)	S.U.	7.38	7.95	7.01	6.76	7.41	7.86	7.61	6.51
Aluminum	mg/l	0.043	0.12	< 0.025	0.071	0.091	0.047	0.058	0.24
Arsenic	mg/l	< 0.0018	< 0.0018	< 0.0018	< 0.0018	< 0.0018	0.002	< 0.0018	< 0.0018
Beryllium	mg/l	< 8.3E-05	0.00012	< 8.3E-05	< 8.3E-05	0.00011	< 8.3E-05	< 8.3E-05	< 8.3E-05
Cadmium	mg/l	< 0.00016	0.00027	< 0.00016	< 0.00016	< 0.00016	0.00028	< 0.00016	0.00018
Chromium	mg/l	< 0.00061	0.002	0.0014	< 9.3E-06	0.0012	< 0.00061	0.0021	0.0012
Chromium IV	mg/l	< 0.0015	< 0.006	0.003	< 0.0015	< 0.029	< 0.0036	< 0.0036	< 0.018
Copper	mg/l	< 0.0017	0.0043	< 0.0017	< 0.0017	< 0.0017	0.0043	< 0.0017	0.0026
Diss O2	mg/l	10.2	8.5	10.7	11.7	7.5	8.7	11.1	12.9
Hardness	mg/l	46	46	45	53	36	69	52	21
Lead	mg/l	< 0.002	0.0083	0.0096	< 0.002	0.0026	0.0022	0.0021	< 0.002
Mercury	mg/l	< 9.5E-05	< 9.5E-05	< 9.5E-05	< 9.5E-05	< 9.5E-05	< 6.7E-05	< 6.7E-05	< 6.7E-05
Nickel	mg/l	< 0.00075	0.0008	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075	< 0.00075
Selenium	mg/l	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015	< 0.0015
Silver	mg/l	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0013	< 0.0011	0.0016
Sulfide	mg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
TDS	mg/l	63	110	95	110	120	98	84	100
TSS	mg/l	6	3	< 1	< 1	< 1	1	3	4
Zinc	mg/l	< 0.012	0.013	< 0.012	< 0.012	< 0.012	0.023	< 0.012	0.017

Table 2A

Surface Water Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Station/Parameter	Units	Jul-97	Oct-97
SW-1			
Conductivity(Field)	umhos	96.1	107.6
pH(Field)	S.U.	7.25	7.27
Aluminum	mg/l	0.085	0.11
Arsenic	mg/l	< 0.0014	< 0.0014
Beryllium	mg/l	0.00011	< 8.3E-05
Cadmium	mg/l	< 0.00016	< 0.00016
Chromium	mg/l	0.0011	< 0.00061
Chromium IV	mg/l	< 0.0036	< 0.0036
Copper	mg/l	< 0.0017	0.0022
Diss O2	mg/l	6	6.9
Hardness	mg/l	35	39
Lead	mg/l	< 0.002	< 0.002
Mercury	mg/l	< 5E-05	< 5E-05
Nickel	mg/l	< 0.00075	< 0.00075
Selenium	mg/l	< 0.0016	< 0.0016
Silver	mg/l	< 0.0011	0.0011
Sulfide	mg/l	< 2	< 2
TDS	mg/l	94	72
TSS	mg/l	4	5
Zinc	mg/l	< 0.012	< 0.012
SW-2			
Conductivity(Field)	umhos	106.8	113.8
pH(Field)	S.U.	7.25	7.44
Aluminum	mg/l	0.08	0.072
Arsenic	mg/l	< 0.0014	< 0.0014
Beryllium	mg/l	0.00023	< 8.3E-05
Cadmium	mg/l	< 0.00016	< 0.00016
Chromium	mg/l	0.0012	0.0014
Chromium IV	mg/l	< 0.0036	< 0.0036
Copper	mg/l	< 0.0017	< 0.0017
Diss O2	mg/l	6.1	8.1
Hardness	mg/l	37	40
Lead	mg/l	< 0.002	< 0.002
Mercury	mg/l	< 5E-05	< 5E-05
Nickel	mg/l	0.0011	< 0.00075
Selenium	mg/l	< 0.0016	< 0.0016
Silver	mg/l	< 0.0011	< 0.0011
Sulfide	mg/l	< 2	< 2
TDS	mg/l	99	80
TSS	mg/l	3	< 1
Zinc	mg/l	< 0.012	< 0.012

Table 2B

Surface Water Quality Results, Summary Statistics and Trend Analysis
July 1991 Through October 1997

Station/Parameter	Units	Total Samples	# Of Samples Included In Trend Test(*)	Total Detections	Mann-Kendall S	p-Level	Inc./Dec. Trend
SW-1							
Conductivity(Field)	umhos	26	26	26	20	0.678	
pH(Field)	S.U.	26	26	26	18	0.71	
Aluminum	mg/l	26	25	24	-88	0.042	
Arsenic	mg/l	26	26	1	15	0.76	
Beryllium	mg/l	26	10	3	-1	1	
Cadmium	mg/l	26	22	9	-73	0.042	
Chromium	mg/l	26	14	13	-42	0.023	
Chromium IV	mg/l	25	9	4	-6	0.612	
Copper	mg/l	26	24	15	-58	0.158	
Diss O2	mg/l	26	26	26	-55	0.236	
Hardness	mg/l	26	26	26	-105	0.02	
Lead	mg/l	26	18	10	55	0.04	
Mercury	mg/l	26	12	1	-17	0.28	
Nickel	mg/l	26	10	3	-6	0.664	
Selenium	mg/l	26	26	3	-32	0.498	
Silver	mg/l	26	14	4	36	0.055	
Sulfide	mg/l	15	15	0	0	1	
TDS	mg/l	26	26	26	15	0.76	
TSS	mg/l	26	26	16	-10	0.845	
Zinc	mg/l	26	17	13	18	0.49	
SW-2							
Conductivity(Field)	umhos	26	26	26	41	0.382	
pH(Field)	S.U.	26	26	26	3	0.966	
Aluminum	mg/l	26	25	24	-85	0.049	
Arsenic	mg/l	26	26	2	30	0.526	
Beryllium	mg/l	26	14	7	-43	0.02	
Cadmium	mg/l	26	21	5	-62	0.064	
Chromium	mg/l	26	17	16	-18	0.49	
Chromium IV	mg/l	25	8	3	-10	0.276	
Copper	mg/l	26	24	13	-61	0.138	
Diss O2	mg/l	26	26	26	-24	0.616	
Hardness	mg/l	26	26	26	-43	0.358	
Lead	mg/l	26	24	12	58	0.158	
Mercury	mg/l	26	12	0	-20	0.196	
Nickel	mg/l	26	10	2	1	1	
Selenium	mg/l	26	26	0	-120	0.008	-
Silver	mg/l	26	14	3	42	0.023	
Sulfide	mg/l	15	15	0	0	1	
TDS	mg/l	26	26	26	-34	0.471	
TSS	mg/l	26	26	14	-20	0.678	
Zinc	mg/l	26	17	15	42	0.092	

+ : Implies Statistically Increasing Trend
- : Implies Statistically Decreasing Trend

(*) If the value of a sample is below the detection limit, three situations apply:
1) If the detection limit is equal to or less than the minimum detected value, the result is replaced with zero.
2) If the detection limit is greater than the minimum detected value, but less than or equal to two times the minimum detected value, the minimum detected value, the result is replaced with the minimum detected value.
3) If the detection limit is greater than two times the minimum detected value the result is omitted from the trend analysis.

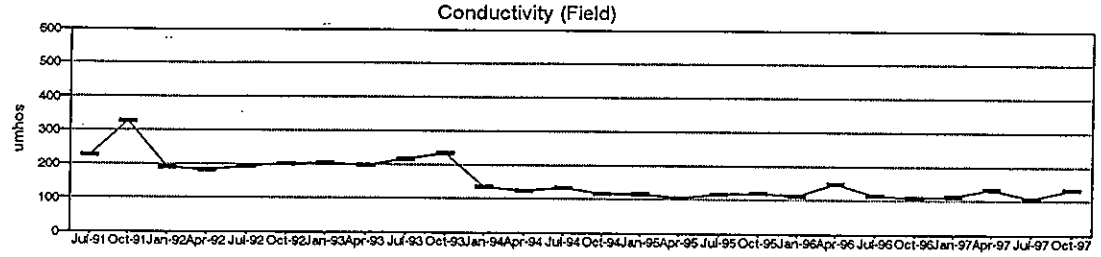
Attachment 1

Historical Trend Plots
Groundwater

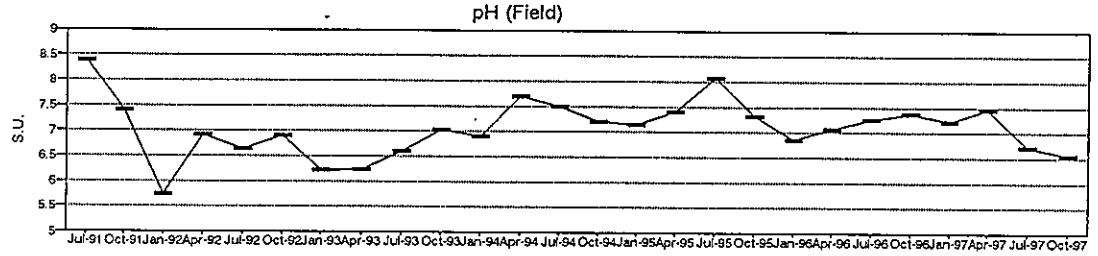
Flambeau Mining Company
Groundwater Quality Results

MW-1000P-R

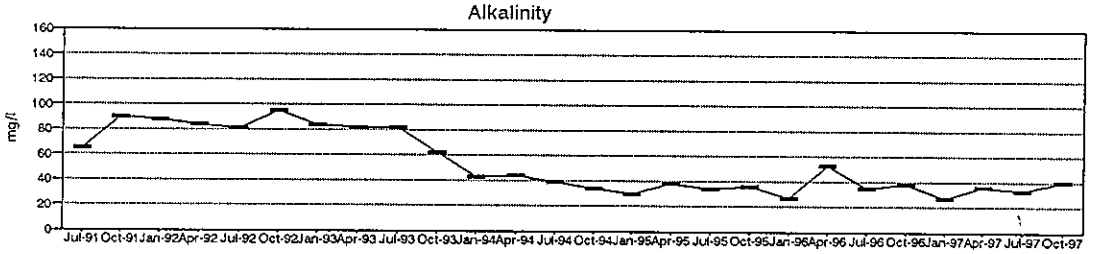
Conductivity (Field)



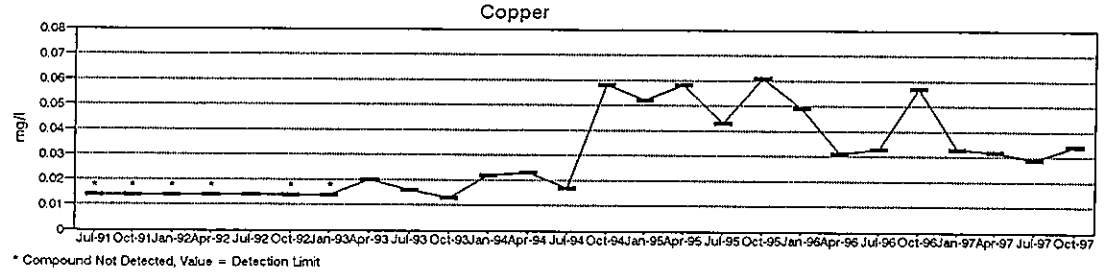
pH (Field)



Alkalinity

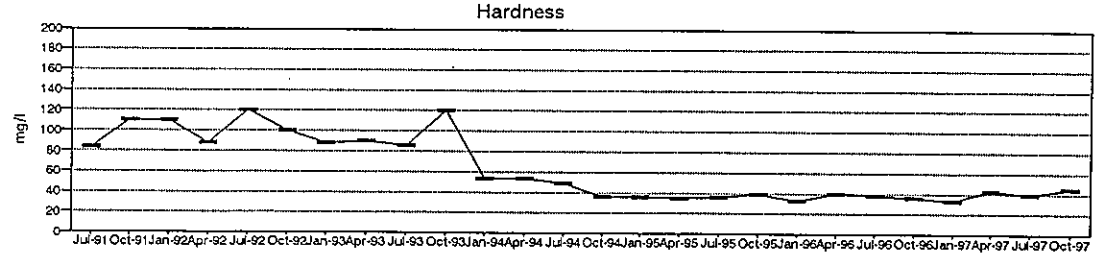


Copper



* Compound Not Detected, Value = Detection Limit

Hardness

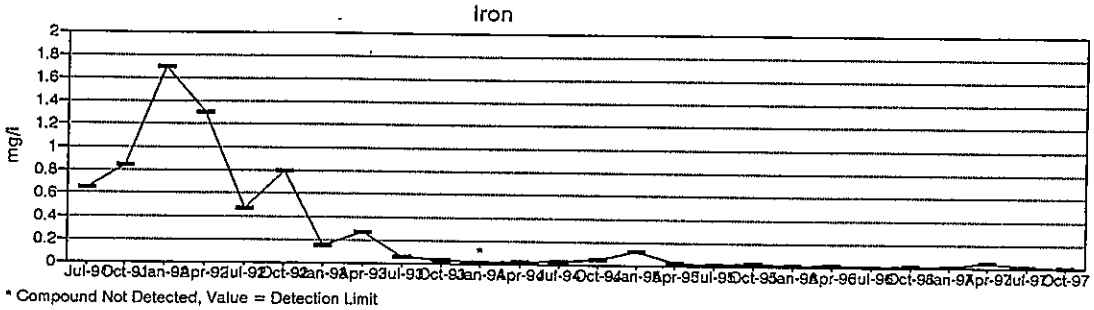


Prepared By: SGL Checked By: JBH1

Flambeau Mining Company
Groundwater Quality Results

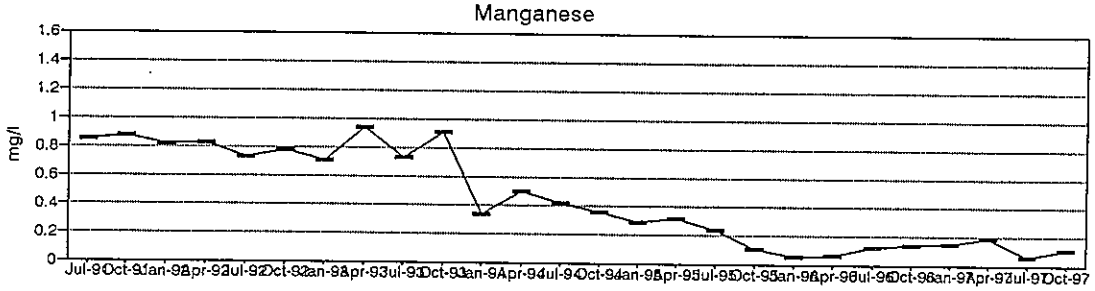
MW-1000P-R

Iron

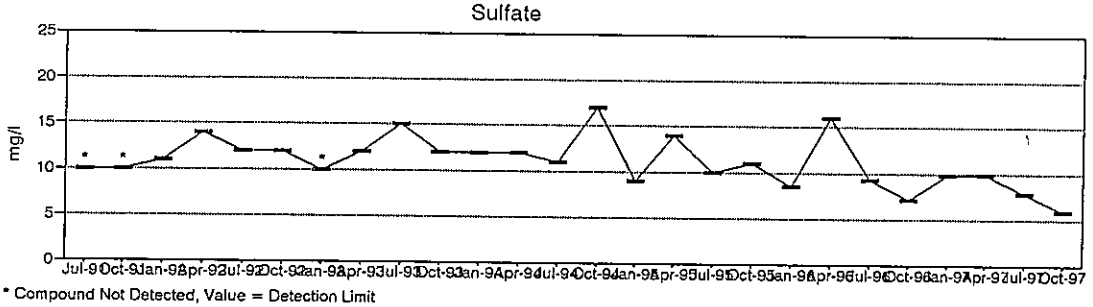


* Compound Not Detected, Value = Detection Limit

Manganese

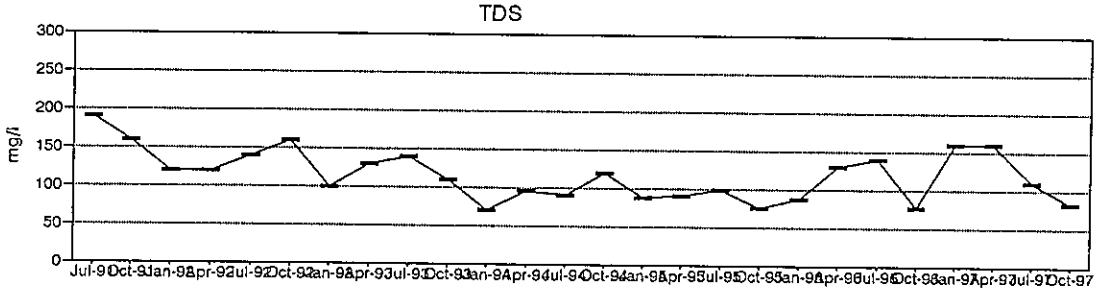


Sulfate



* Compound Not Detected, Value = Detection Limit

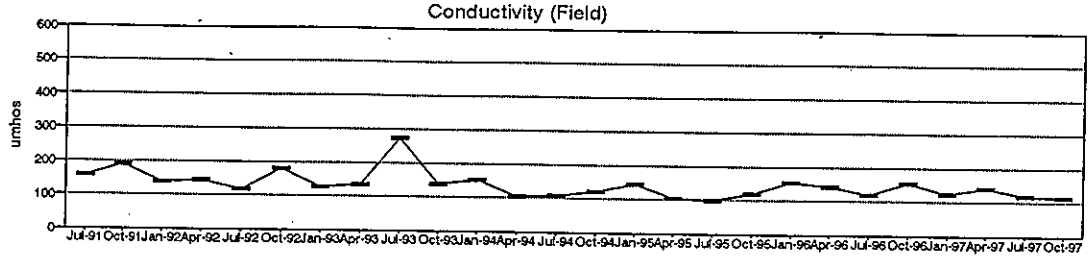
TDS



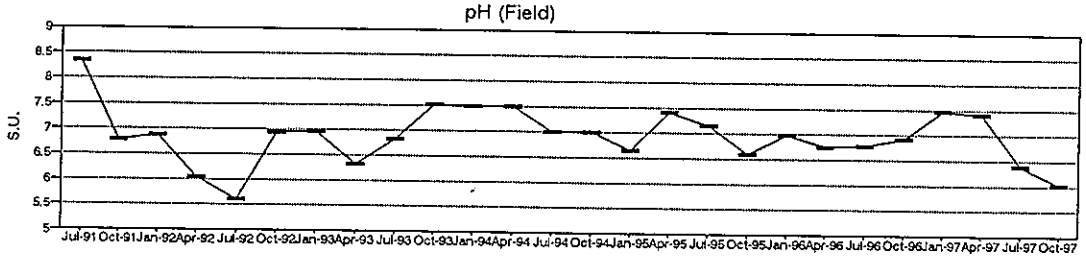
Flambeau Mining Company
Groundwater Quality Results

MW-1002

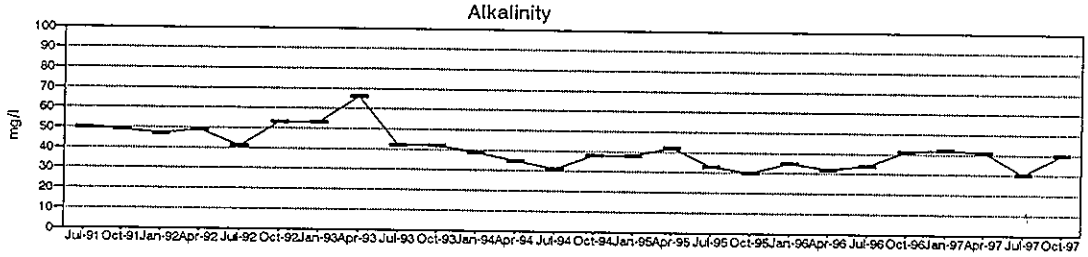
Conductivity (Field)



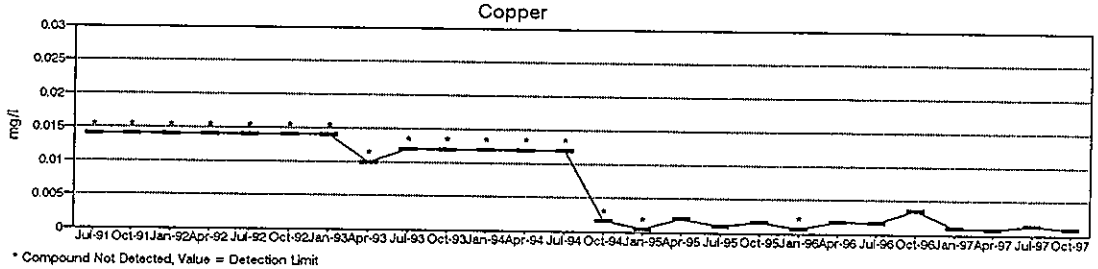
pH (Field)



Alkalinity

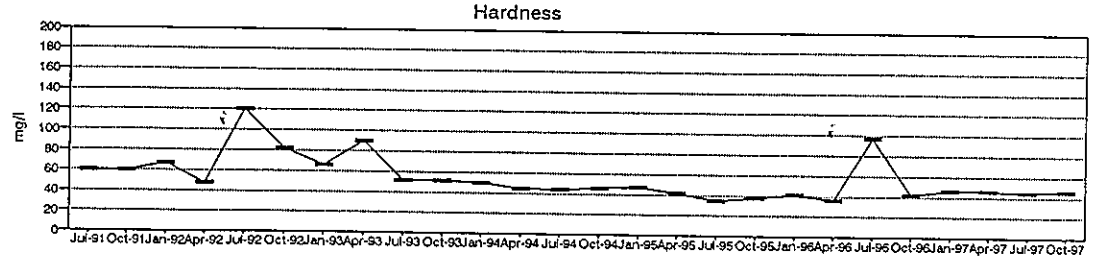


Copper



* Compound Not Detected, Value = Detection Limit

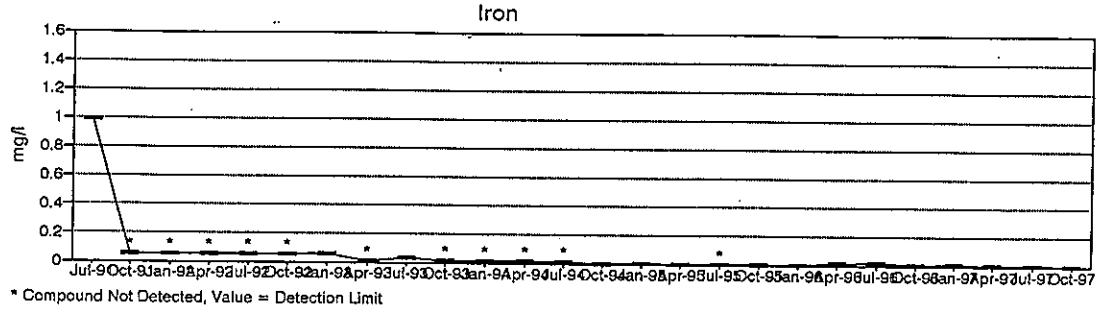
Hardness



Flambeau Mining Company
Groundwater Quality Results

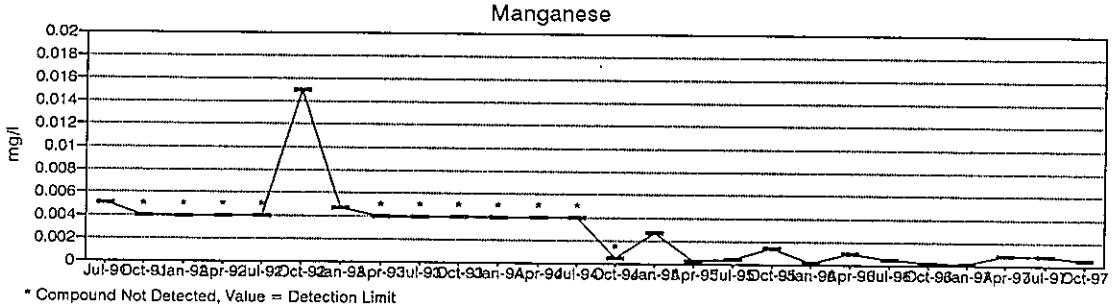
MW-1002

Iron



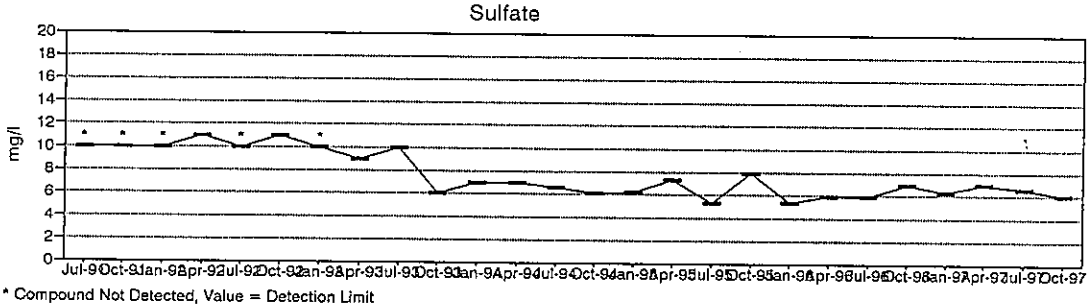
* Compound Not Detected, Value = Detection Limit

Manganese



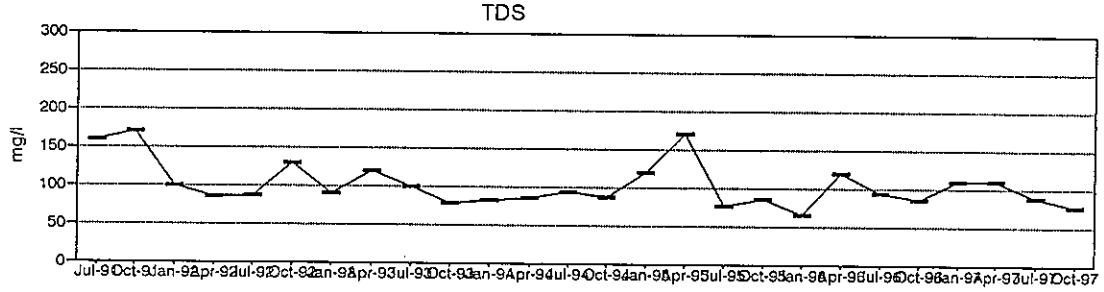
* Compound Not Detected, Value = Detection Limit

Sulfate



* Compound Not Detected, Value = Detection Limit

TDS

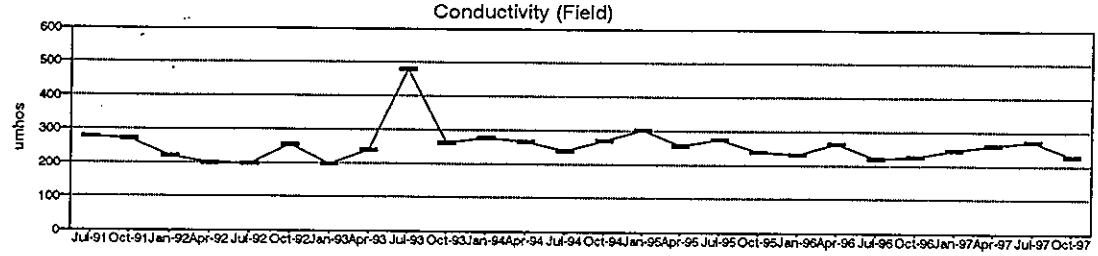


Prepared By: SGL Checked By: JBH1

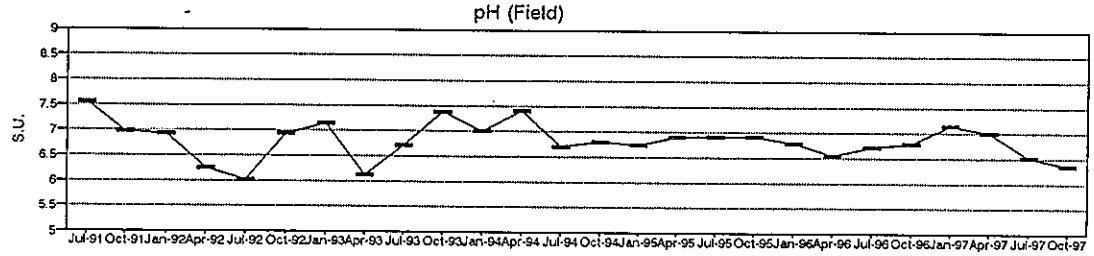
Flambeau Mining Company
Groundwater Quality Results

MW-1002G

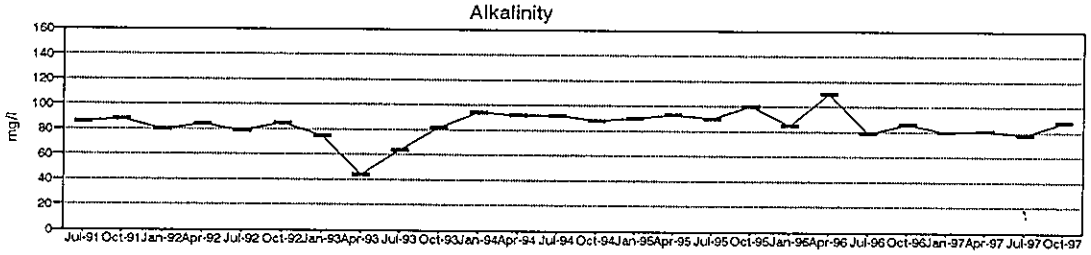
Conductivity (Field)



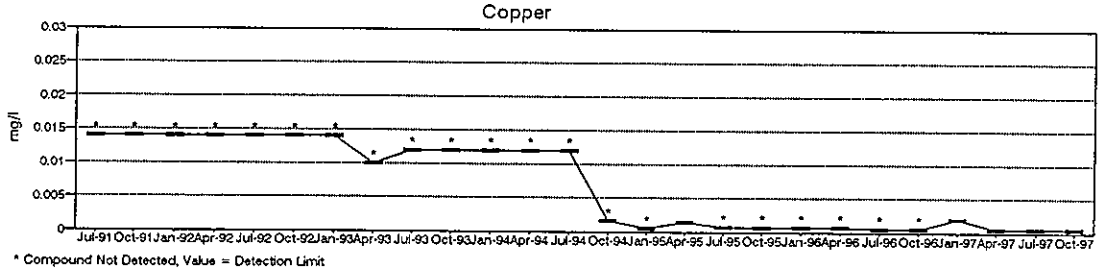
pH (Field)



Alkalinity

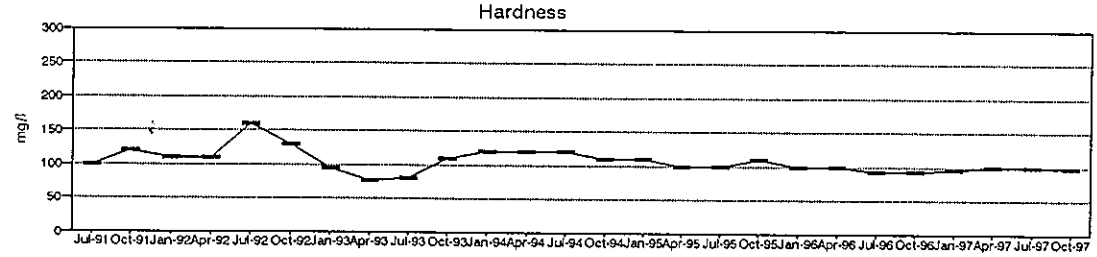


Copper



* Compound Not Detected, Value = Detection Limit

Hardness



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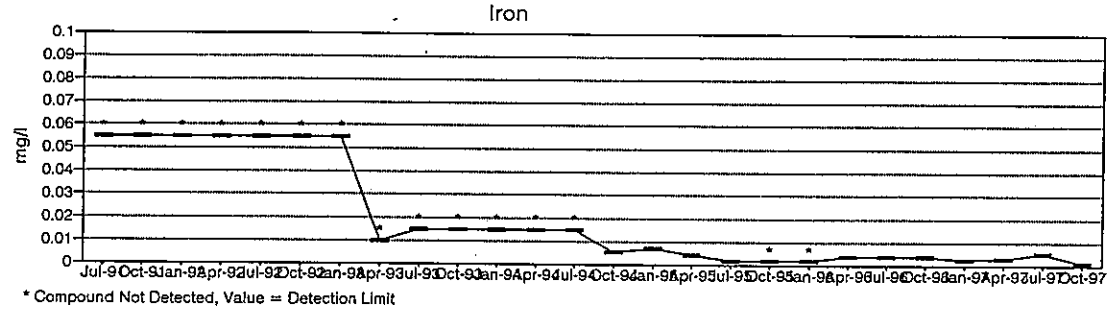
Flambeau Mining Company
Groundwater Quality Results

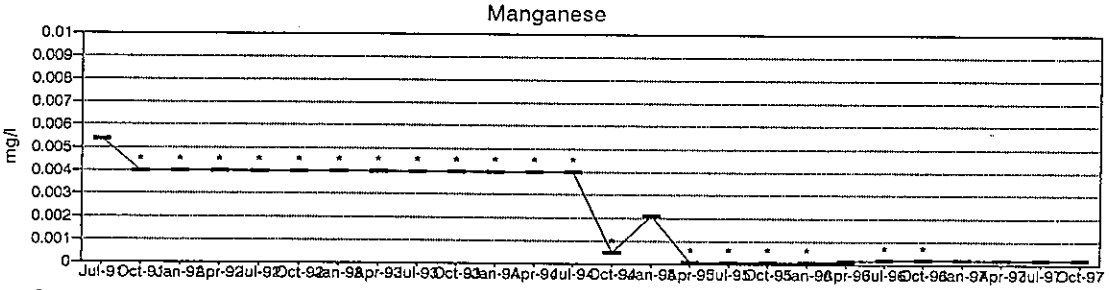
MW-1002G

Iron



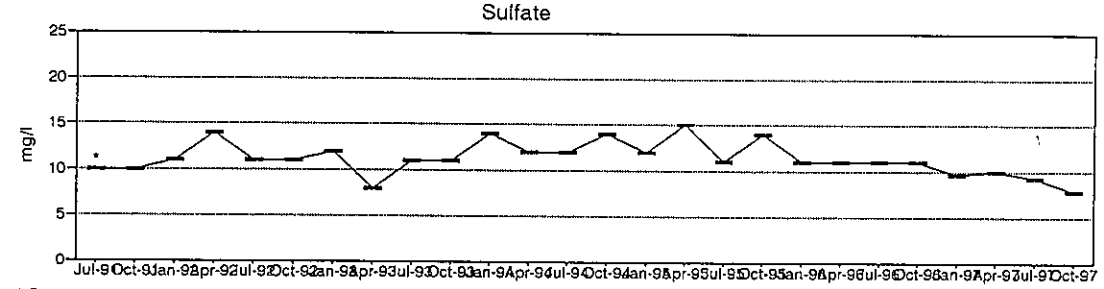
* Compound Not Detected, Value = Detection Limit

Manganese



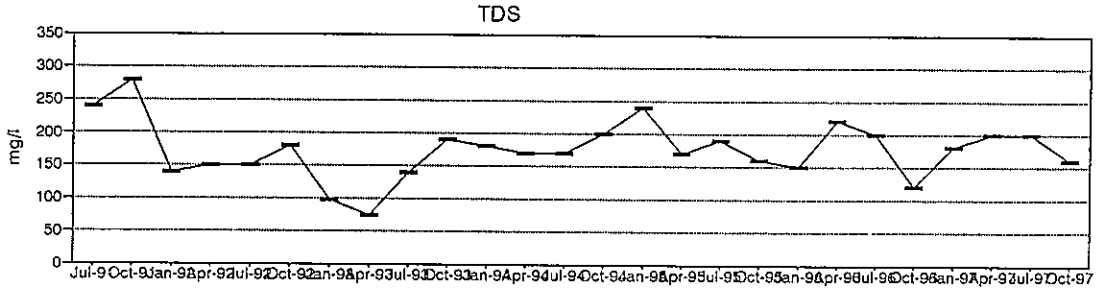
* Compound Not Detected, Value = Detection Limit

Sulfate



* Compound Not Detected, Value = Detection Limit

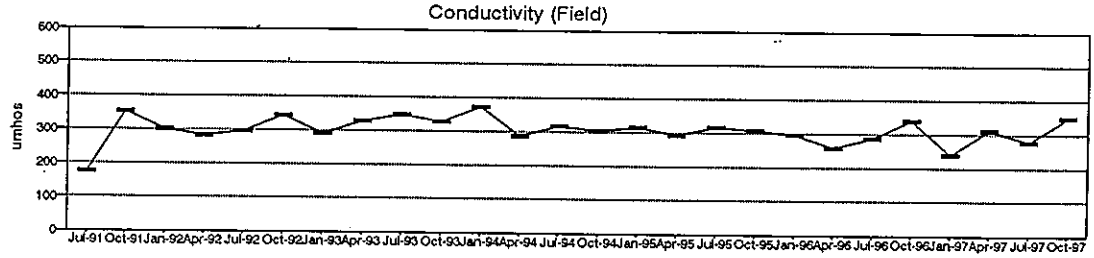
TDS



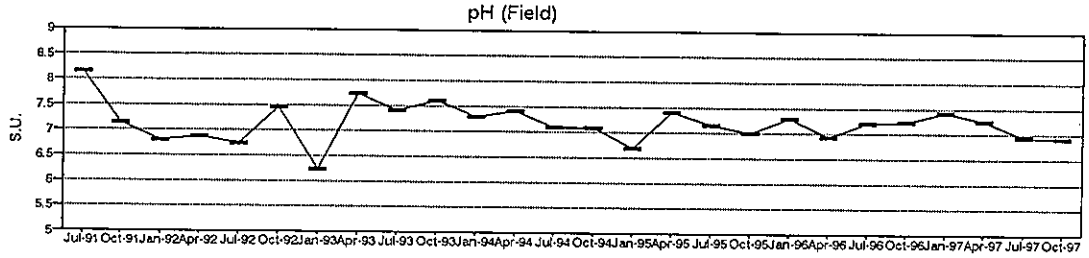
Flambeau Mining Company
Groundwater Quality Results

MW-1004P

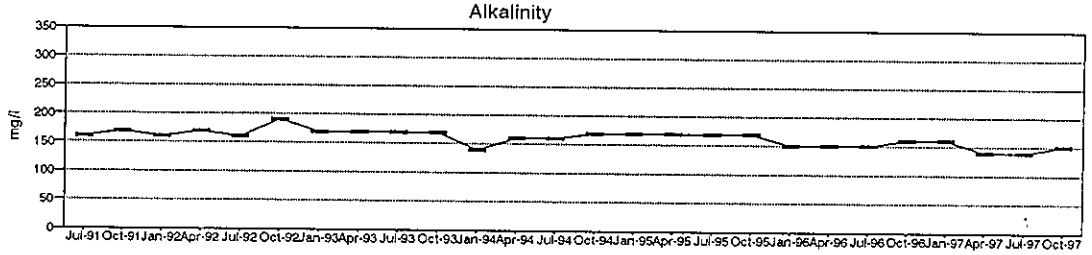
Conductivity (Field)



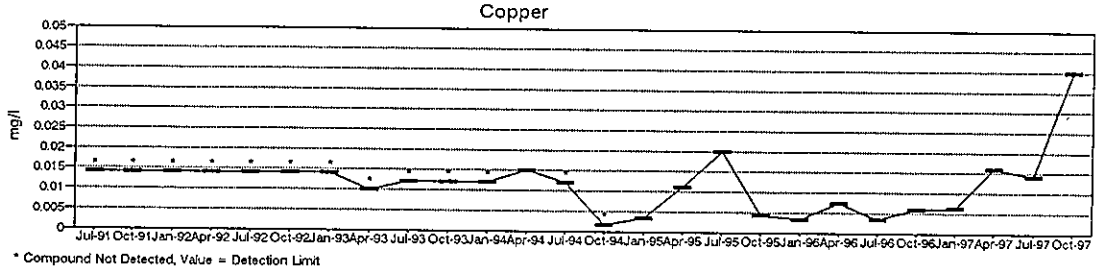
pH (Field)



Alkalinity

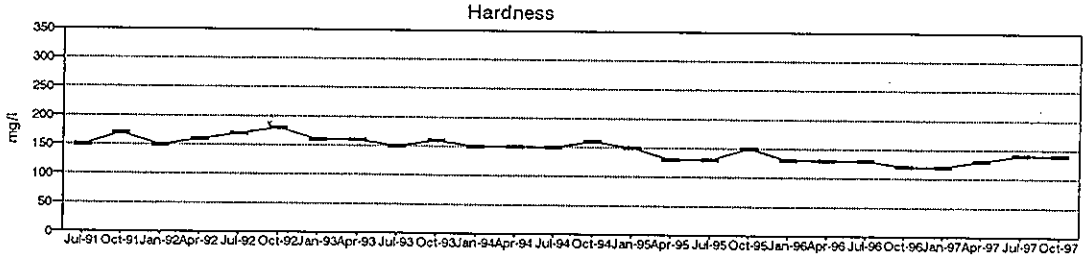


Copper



* Compound Not Detected, Value = Detection Limit

Hardness



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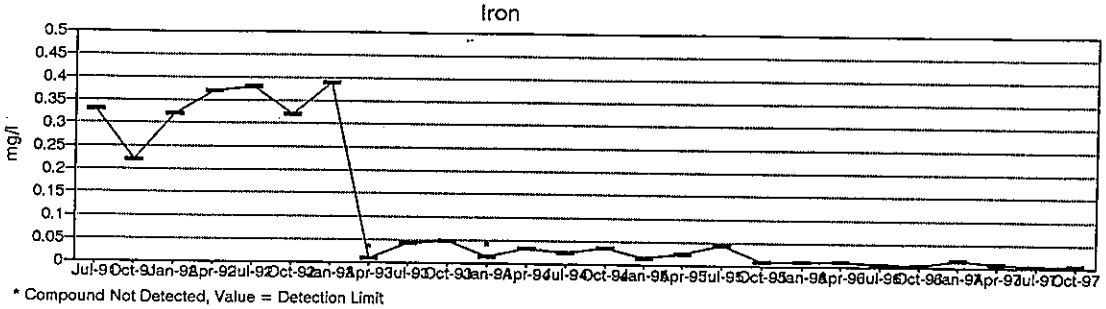
Flambeau Mining Company
Groundwater Quality Results

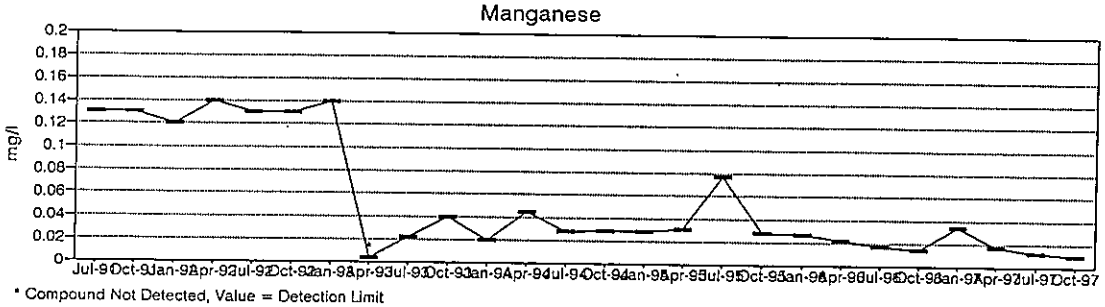
MW-1004P

Iron



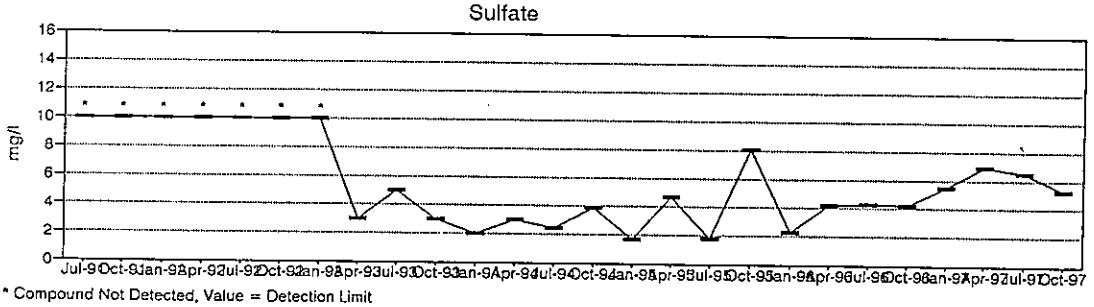
* Compound Not Detected, Value = Detection Limit

Manganese



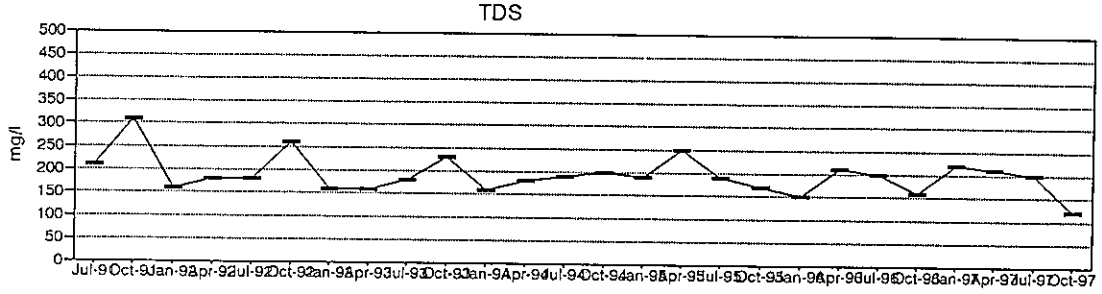
* Compound Not Detected, Value = Detection Limit

Sulfate



* Compound Not Detected, Value = Detection Limit

TDS



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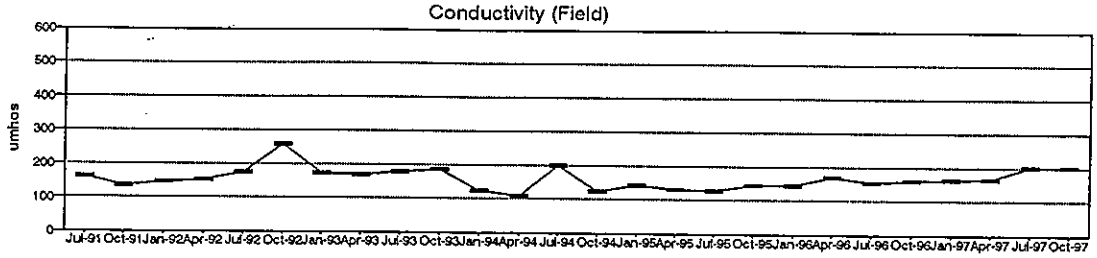
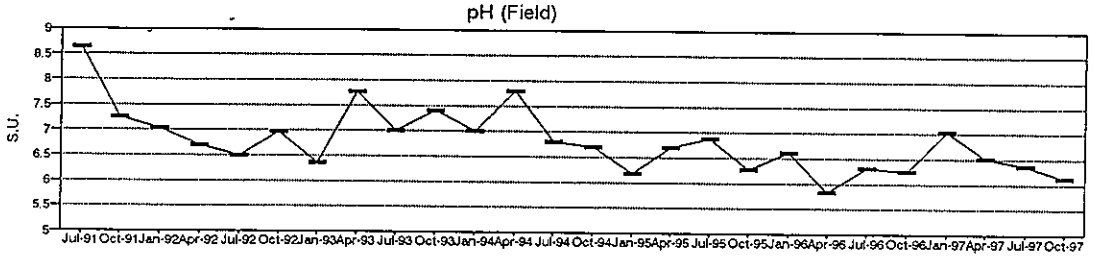
Flambeau Mining Company
Groundwater Quality Results

MW-1004S

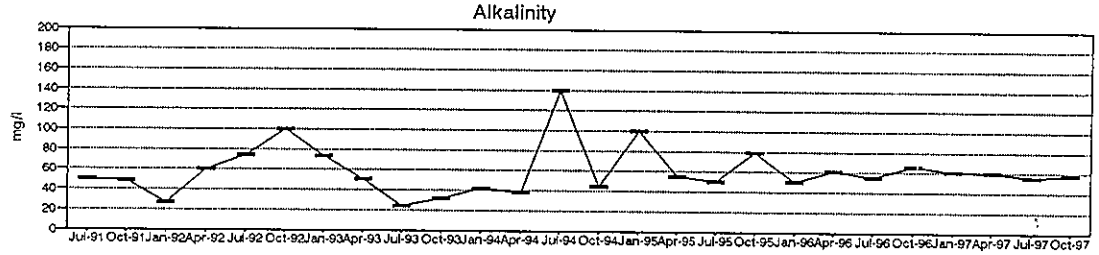
Conductivity (Field)



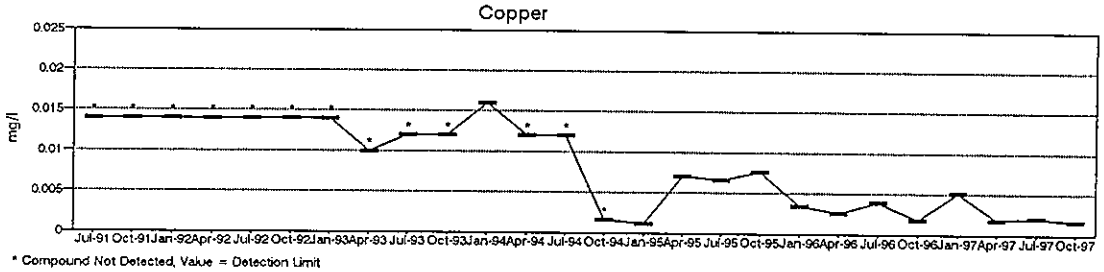
pH (Field)



Alkalinity

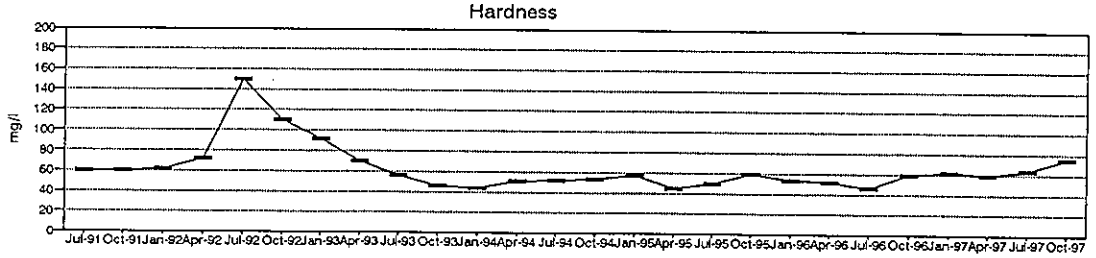


Copper



* Compound Not Detected, Value = Detection Limit

Hardness

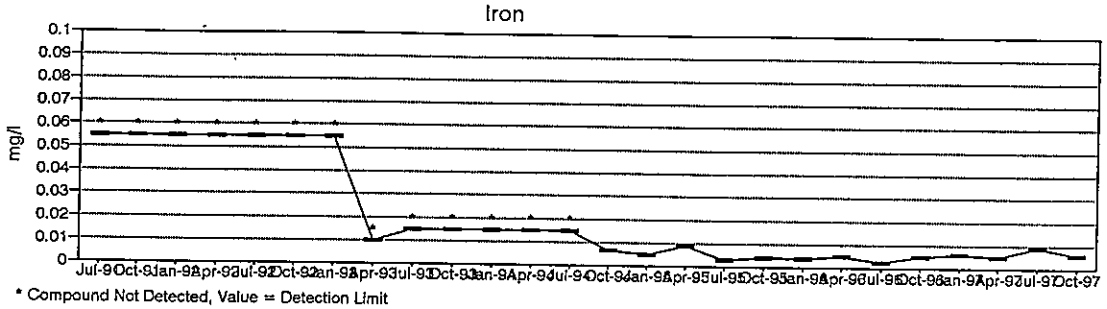


Prepared By: SGL Checked By: JBH1

Flambeau Mining Company
Groundwater Quality Results

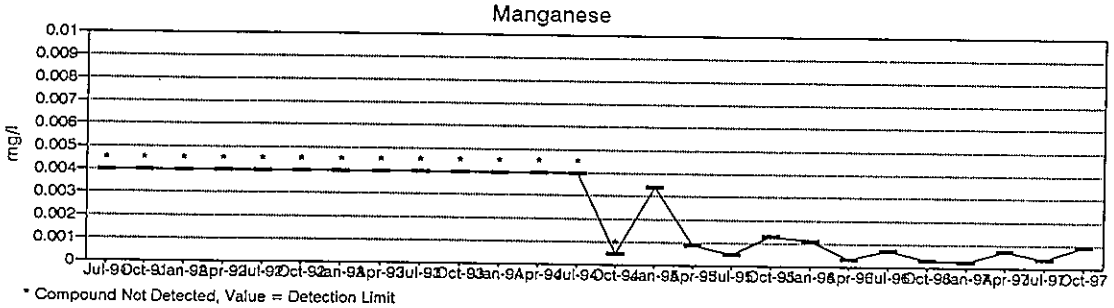
MW-1004S

Iron



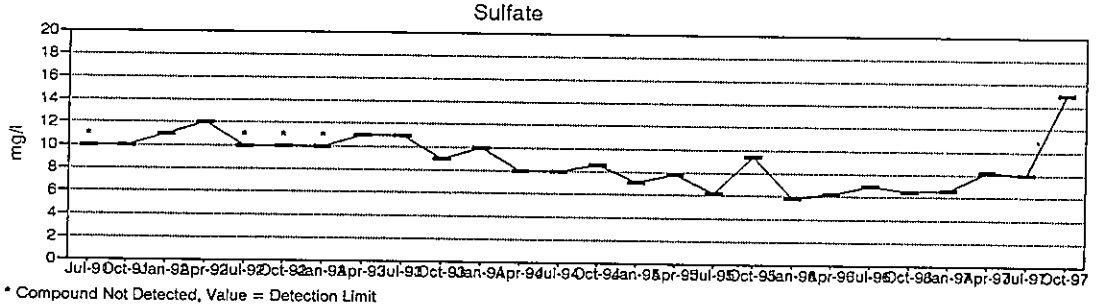
* Compound Not Detected, Value = Detection Limit

Manganese



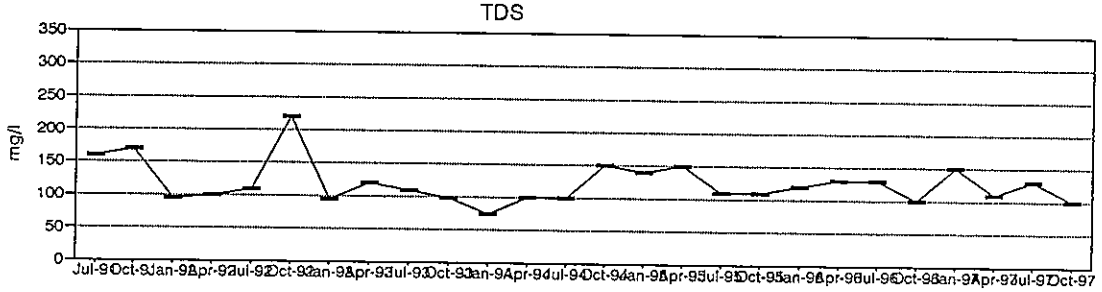
* Compound Not Detected, Value = Detection Limit

Sulfate



* Compound Not Detected, Value = Detection Limit

TDS

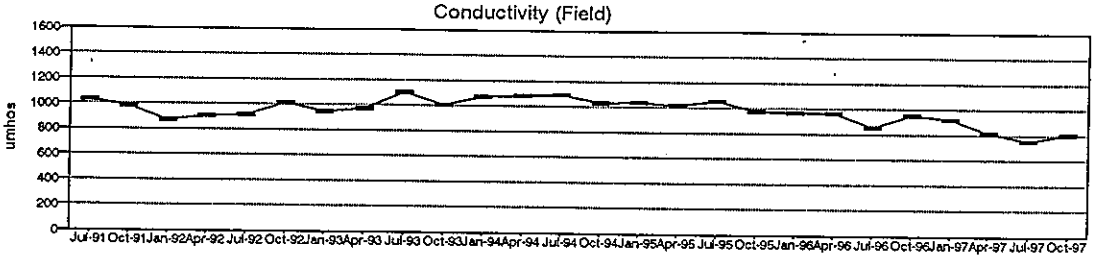


Prepared By: SGL Checked By: JBH1

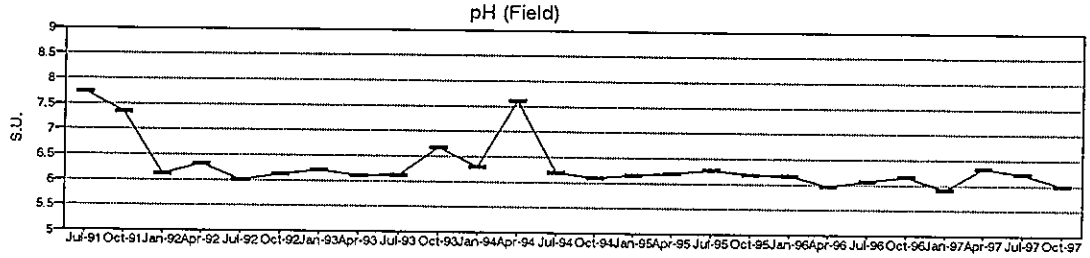
Flambeau Mining Company
Groundwater Quality Results

MW-1005

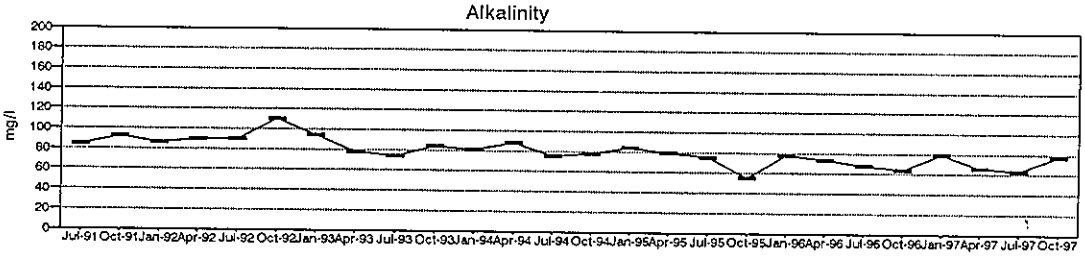
Conductivity (Field)



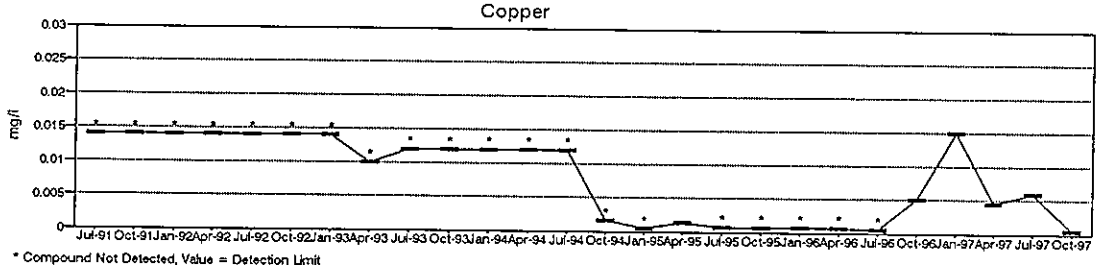
pH (Field)



Alkalinity

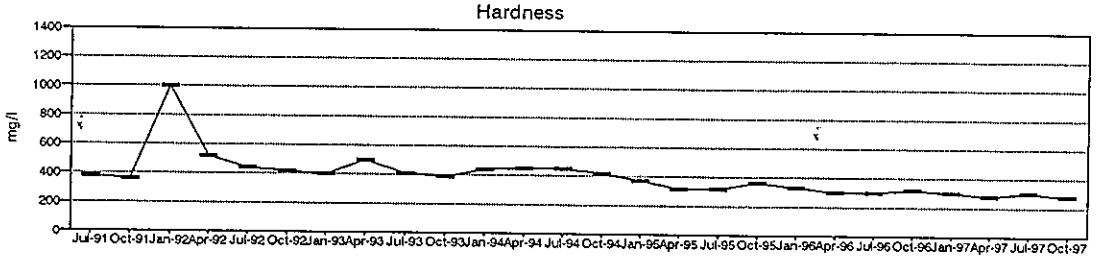


Copper



* Compound Not Detected, Value = Detection Limit

Hardness

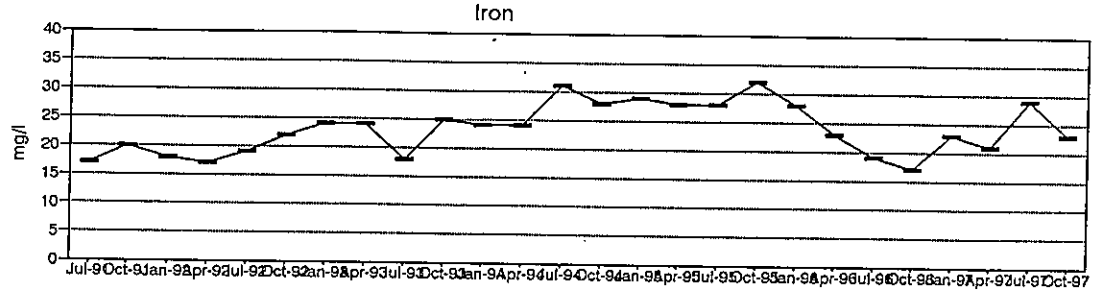


Prepared By: SGL Checked By: JBH1

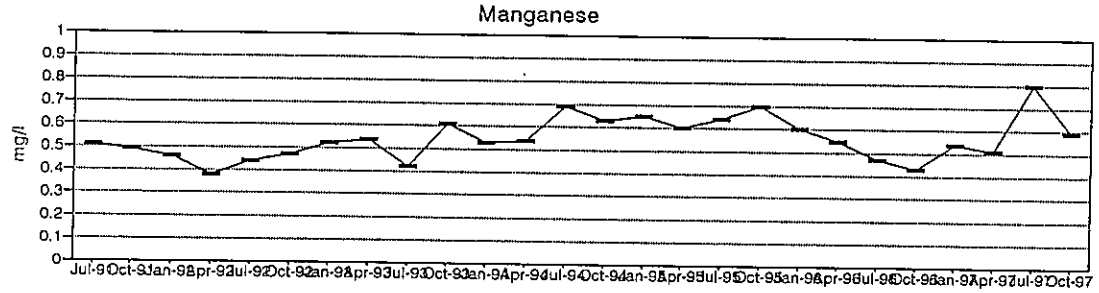
Flambeau Mining Company
Groundwater Quality Results

MW-1005

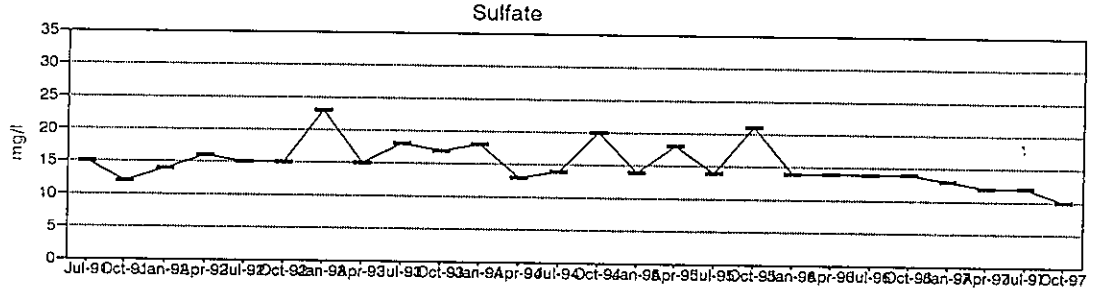
Iron



Manganese



Sulfate



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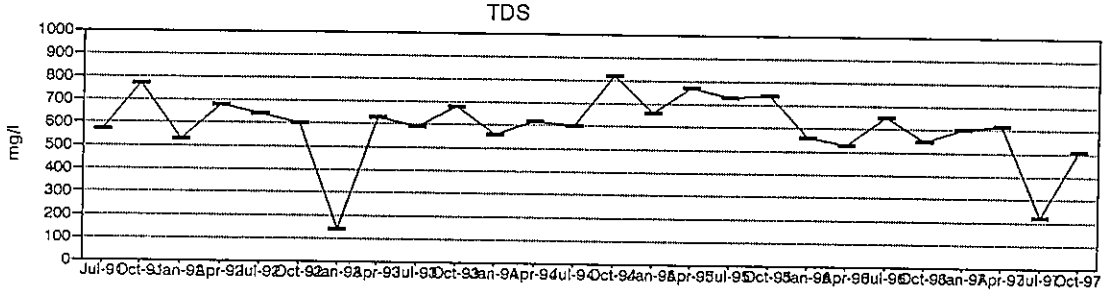
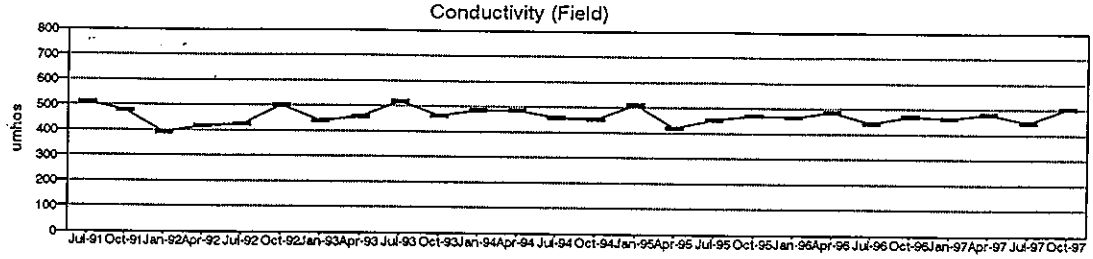


Prepared By: SGL Checked By: JBH1

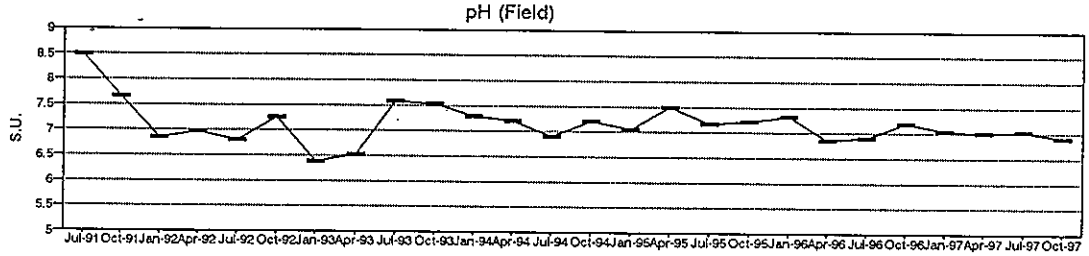
Flambeau Mining Company
Groundwater Quality Results

MW-1005P

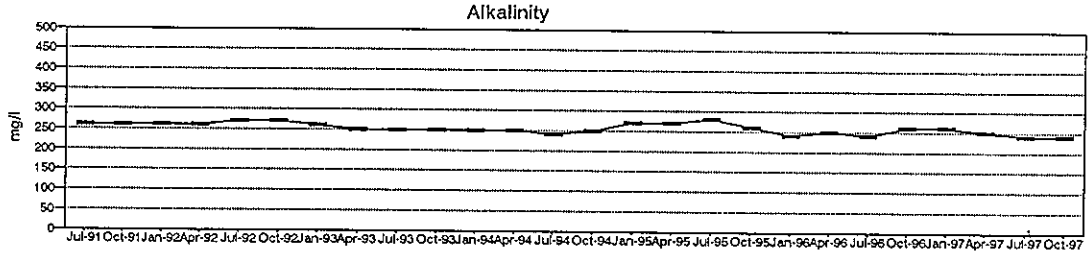
Conductivity (Field)



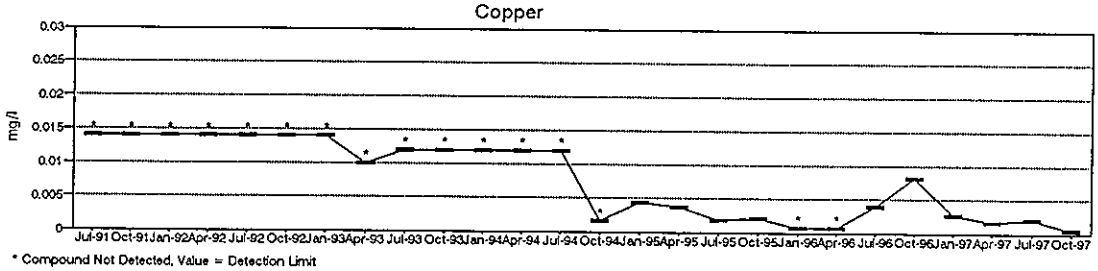
pH (Field)



Alkalinity

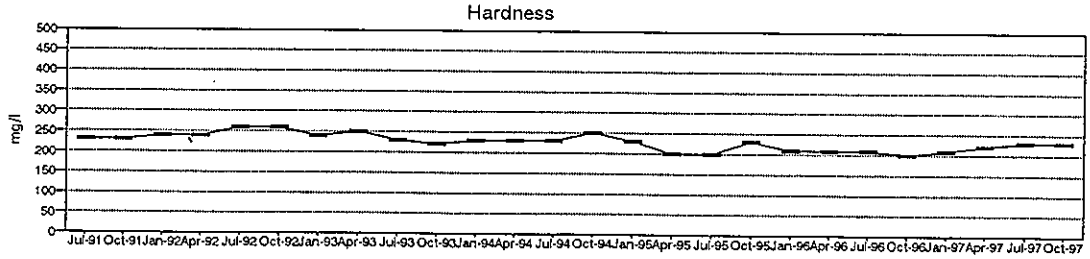


Copper



* Compound Not Detected, Value = Detection Limit

Hardness



Prepared By: SGL Checked By: JBH1

APPENDIX D

SEDIMENT SAMPLING

ENVIRONMENTAL COMPLIANCE CONSULTANTS, INC.

P.O. BOX 11417 • GREEN BAY, WI 54307-1417 • 920-434-6380 (VOICE) • 920-434-6381 (FAX)

Environmental Compliance Consultants, Inc.
Memorandum

October 27, 1997

TO: Jana Murphy, Flambeau Mining Company

CC: Jeff Earnshaw, Flambeau Mining Company

FR: Bill West, ECCI

RE: Report on Activities Associated with 1997 Sediment Sampling , Flambeau River, Ladysmith, Wisconsin

Introduction

On June 17, 1997, Bill West of Environmental Compliance Consultants, Inc., was accompanied by Jack Christman of Flambeau Mining Company (Flambeau) for the purpose of installing sediment traps in the Flambeau River. This activity is part of routine site monitoring required of the Flambeau Mining Permit.

Four individual sampling containers were positioned in two locations in the Flambeau River. One location was above the Flambeau discharge Outfall 001 (Site S-1) at the Blackberry Lane access. The second location was downstream of mining site Outfall 001 near the Sister's Farm (Site S-3). Sample Site S-2 was replaced by Site S-3 in 1993 and succeeding years. The sampling locations for 1997 were the same locations sampled in 1993 through 1996.

Sediment sample jars were retrieved from the Flambeau River on August 18, 1997 after an approximate two month exposure window.

Methodology

Sediment traps were installed upstream and downstream of the Flambeau discharge locations as illustrated in Figure 1. Sample containers consisted of one-quart wide mouth mason jars which were acid washed prior to installation.

At each sampling location, a set of four sample jars were placed in the river, each surrounded by a concrete half block secured by rebar. Rebar was driven into the substrate to the point of being flush with the top of the block. Sinking the rebar flush with the block discourages the collection of debris which may cover the jar opening. Observations of sediment traps at the time of trap removal from the river in previous years indicated that this technique was successful in keeping debris from accumulating on and around the traps.

Quart jars inserted into the submerged half block opening were positioned so that the top of the jar was either flush with the top of the block or slightly below the top of the block. This positioning was designed to reduce the potential for breakage due to an encounter with water-borne debris.

With every four jar set, the outer most jar (most distal to the shore) was positioned approximately ten feet and 45 degrees upstream of the second jar. The second, third, and fourth jars were similarly placed at 45 degrees and downstream of the previously placed jar. When placing jars in the block, the upstream jar was positioned first followed by the second, third and fourth descending downstream. In this manner, the chance of impacting downstream jars while placing the upstream jars was eliminated.

As in previous years, a nitex screen with ½-inch mesh was fitted over each of the jars and secured with plastic ties.

This technique was used to prevent the colonization of the traps by crayfish and/or fish.

Sample containers were retrieved on August 18, 1997. At each site, the container furthest downstream of the four sample set was collected first followed by the next upstream sample and so on until each of the four was collected. Collecting samples in this manner prevented the downstream samples from being contaminated by activity from upstream sample collection, had the upstream sample been collected first.

During sample collection, the plastic tie and mesh screen were removed prior to removing the sample from the water. After screen removal, a sheet of parafilm was placed over the jar opening. After placement of the parafilm, the jars were fitted with a lid and ring seal. Samples were placed on ice and taken directly to Northern Lake Service in Crandon, Wisconsin for analysis. At the laboratory, samples collected at each site were composited into a single sample, S-1 for the upstream sample and S-3 for the downstream sample. As in previous years, these samples were analyzed for metals and a sieve analysis was conducted on these samples.

Observations

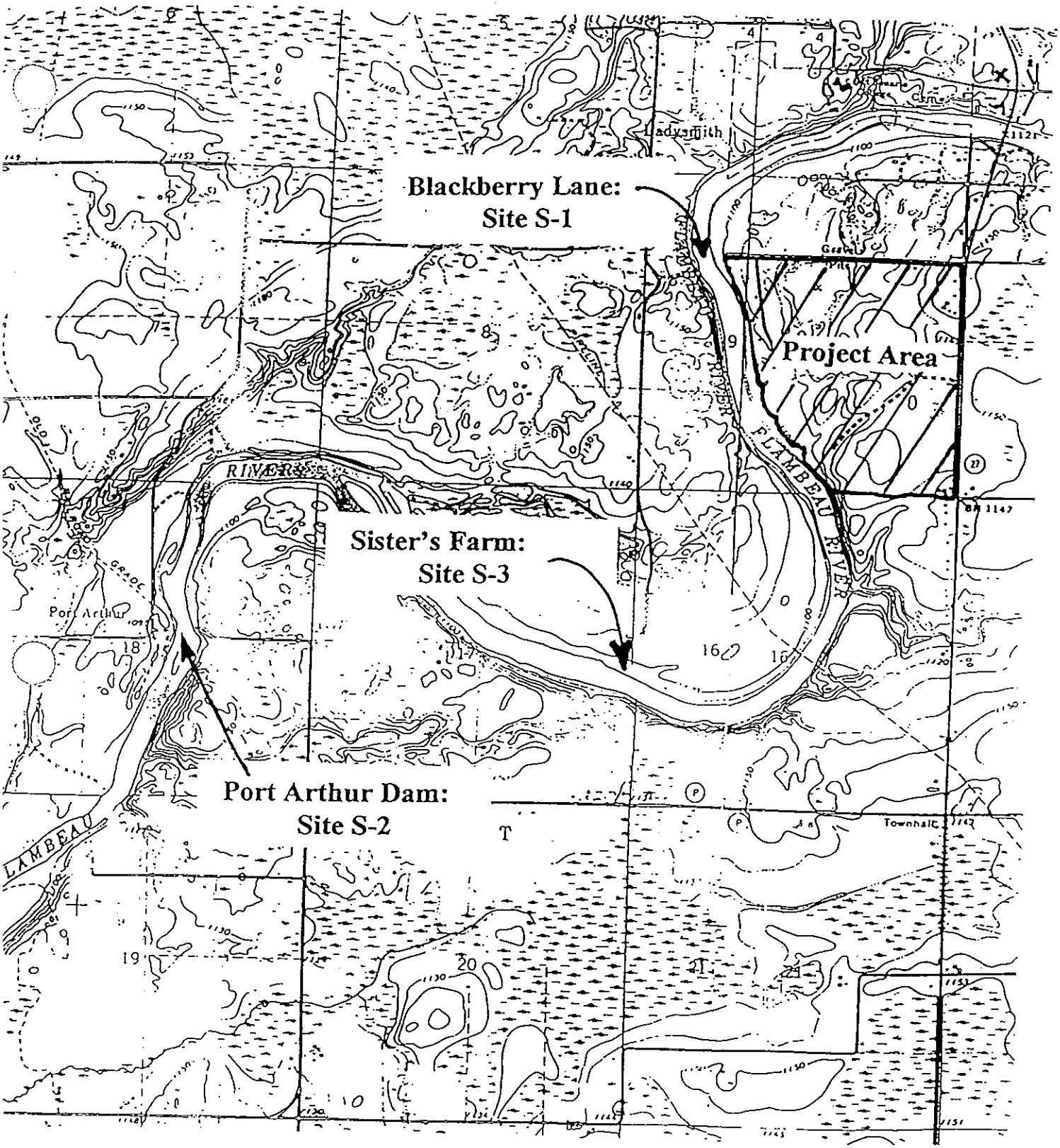
Samples from Blackberry Lane appeared to contain more granular material (sand and gravel) than the sample from Sister's Farm. The Sister's Farm sample appeared to contain more sediment which is typical of samples collected in previous years. One trap of the four trap set was lost in the river during the exposure period, the first such loss during the seven years of sampling. Therefore, only three samples from the Sister's Farm were combined for the purposes of conducting the metals analysis and sieve analysis.

Results

A summary of results of the laboratory anaylsis of the sediment samples from the two sampling sites is shown in Table 1. Individual sample analytical data and sieve analysis are provided in Appendix 1.

Discussion

Data from the first seven years of sediment analysis indicate that, in general, no increase or decrease in parameter concentration in sediments is occurring. Moreover, downstream samples continue to compare favorably with upstream sediment samples indicating no impacts due to mine activities.



Flambeau Mining Company	
Figure 1 Flambeau River Sediment Sample Collection Locations	
Scale: None	Date: 10/96

Table 1
Flambeau River Sediment Sampling Results
1991 - 1997

Parameter (mg/kg)	Sample Location/Number: Blackberry Lane (S-1) S-1-01 (1991)	S-1-02 (1992)	S-1-03 (1993)	S-1-04 (1994	S-1-05 (1995)	S-1-06 (1996)	S-1-07 (1997)	Port Arthur Dam (S-2) Sister's Farm(S-3) S-2-01 (1991)	S-2-02 (1992)	S-2-03 (1993)	S-3-03 (1993)	S-3-04 (1994)	S-3-05 (1995)	S-3-06 (1996)	S-3-07 (1997)
Silver	<1.2	<1.1	0.057	<0.21	<0.05	<0.57	<0.70	<1.1	<2.6	0.086	0.58	<0.08	0.04	<0.56	<0.40
Aluminum	3800	3300	4000	3900	2900	1900	2100	4000	12000	1500.0	4400	4000 -	3600	2500	2400
Arsenic	2.2	2.2	1.4	<4.2	<0.41	1.6	<0.87	1.5	4.1	<0.55	0.71	<1.6	1.5	<0.45	<0.71
Cadmuim	<0.7	<0.6	<0.06	<0.42	<0.03	0.72	1.2	0.6	<1.4	<0.055	0.11	0.13	0.085	0.64	0.70
Chromium	11.0	10.0	11	10	4.4	4.1	5.6	13.0	24.0	23.8	9.6	10	6.6	6.3	6.1
Copper	7.3	6.0	7.0	5.8	6.4	5.8	5.3	7.2	24.0	2.1	6.7	7.1	7.0	8.2	6.7
Iron	18000	16000	15000	11000	4800	6800	6500	16000	25000	3100	8200	7700	7300	6700	7900
Mercury	0.1	<0.1	<0.045	<0.04	<0.02	<0.02	<0.024>	0.1	<0.3	<0.057	<0.07	<0.03	<0.06	<0.02	<0.059>
Manganese	1900	1000	1300	1500	600	510	700	1600	570	610	830	860	780	840	910
Nickel	5.8	6.1	8.4	7.4	6.1	6.1	2.2	7.3	12.0	1.7	6.5	6.2	5.0	5.7	3.0
Lead	6.0	5.8	8.5	3.3	3.3	<2.2	<5.1>	6.9	20.0	2.6	8.3	7.8	7.5	9.0	6.4
Selenium	0.4	<0.4	<0.32	4.2	<0.44	<0.28	<1.0	0.4	<0.9	<0.28	<0.26	<1.6	<0.27	1.4	<0.95>
Zinc	47.0	33.0	38	34	18	19	20	45.0	79.0	9.6	33	46	26	28	24
Total Solids%	73.0	78.6	79.2	NA	76.7	74.9	72.6	76.8	35.0	32	56	NA	44.8	49.8	30.6
Total Vol. Solids %	1.8	1.6	0.77	NA	<2	<2	<2	2.5	12.0	5.8	6.24	NA	6.9	5.5	11
Field Temp. C	25.0	16.2	15.0	NA	25.0	27.0	18.9	25.0	15.8	15.5	15.5	NA	25.0	27.0	19.4

NA = Data Not Available
Data from Site S-1 is referenced by Sample ID#146004, Site S-3 is represented by Sample ID#146005
Data appearing in brackets (<>) was reported as observed between the level of detection (LOD) and level of quantitation (LOQ)

Prepared by: WMW
Checked by: AKM

Appendix 1

Laboratory Data for Sediment Analysis
Flambeau Mining Project, 1997

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998

NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: FMCA-1-4 Blackberry Lane Sediment Composite NLS#: 146004

Ref. Line 1 of COC 28078 Description: FMCA-1-4
Collected: 08/18/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	2100	mg/Kg WWB	0.56	1.9	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.87	3.0	EPA 206.2	09/12/97	721026460
Cadmium, tot. as Cd	1.2	mg/Kg WWB	0.11	0.40	EPA 200.7	09/17/97	721026460
Chromium, tot. as Cr	5.6	mg/Kg WWB	0.26	0.94	EPA 200.7	09/17/97	721026460
Copper, tot. as Cu	5.3	mg/Kg WWB	0.10	0.37	EPA 200.7	09/17/97	721026460
Iron, tot. as Fe	6500	mg/Kg WWB	0.52	1.8	EPA 200.7	09/19/97	721026460
Lead, tot. as Pb	< 5.1 >	mg/Kg WWB	1.9	6.7	EPA 200.7	09/17/97	721026460
Manganese, tot. as Mn	700	mg/Kg WWB	0.080	0.27	EPA 200.7	10/29/97	721026460
Mercury (Tissue) by CVAA	< 0.024 >	mg/Kg WWB	0.018	0.064	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	2.2	mg/Kg WWB	0.52	1.8	EPA 200.7	09/17/97	721026460
Selenium, tot. as Se by furnace	ND	mg/Kg WWB	1.0	3.6	EPA 270.2	09/17/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.70	2.5	EPA 200.7	09/18/97	721026460
Solids, total on solids	72.6	%	0.10		ASTM D2216	09/10/97	721026460
Solids, tot. volatile	ND	% DWB	2.0		EPA 160.4	09/10/97	721026460
Zinc, tot. as Zn	20	mg/Kg WWB	0.56	0.56	EPA 200.7	09/17/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/10/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/10/97	721026460
Particle Size	see attached				EPA	09/25/97	NA

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998

NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: FMCB-1-4 Sisters Farm Sediment Composite NLS#: 146005
Ref. Line 2 of COC 28078 Description: FMCB-1-4
Collected: 08/18/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	2400	mg/Kg WWB	0.32	1.1	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.71	2.4	EPA 206.2	09/12/97	721026460
Cadmium, tot. as Cd	0.70	mg/Kg WWB	0.064	0.23	EPA 200.7	09/17/97	721026460
Chromium, tot. as Cr	6.1	mg/Kg WWB	0.15	0.54	EPA 200.7	09/17/97	721026460
Copper, tot. as Cu	6.7	mg/Kg WWB	0.059	0.21	EPA 200.7	09/17/97	721026460
Iron, tot. as Fe	7900	mg/Kg WWB	2.9	10	EPA 200.7	09/19/97	721026460
Lead, tot. as Pb	6.4	mg/Kg WWB	1.1	3.8	EPA 200.7	09/17/97	721026460
Manganese, tot. as Mn	910	mg/Kg WWB	0.46	1.5	EPA 200.7	11/14/97	721026460
Mercury (Tissue) by CVAA	< 0.059 >	mg/Kg WWB	0.033	0.12	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	3.0	mg/Kg WWB	0.29	1.0	EPA 200.7	09/17/97	721026460
Selenium, tot. as Se by furnace	< 0.95 >	mg/Kg WWB	0.83	2.9	EPA 270.2	09/17/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.40	1.4	EPA 200.7	09/18/97	721026460
Solids, total on solids	30.6	%	0.10		ASTM D2216	09/10/97	721026460
Solids, tot. volatile	11	% DWB	2.0		EPA 160.4	09/10/97	721026460
Zinc, tot. as Zn	24	mg/Kg WWB	0.32	0.32	EPA 200.7	09/17/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/10/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/10/97	721026460
Particle Size	see attached				EPA	09/25/97	NA

GRADATION ANALYSIS

CLIENT: Northern Lakes Service
PROJECT: NLS Project #35998

JOB NO.: 13755MZ11

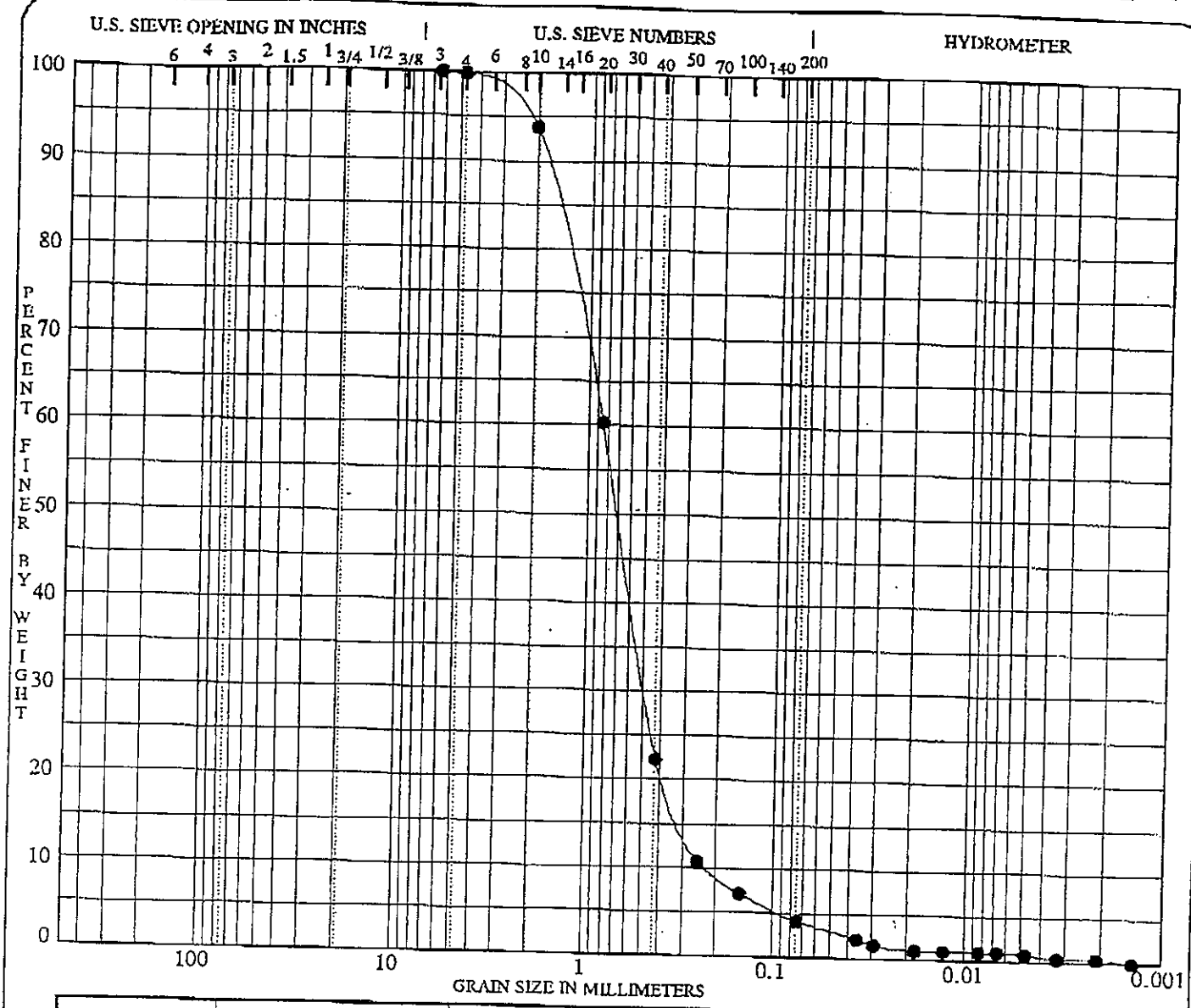
SPECIFICATION:
SOURCE: Northern Lake
SAMPLED BY: FMCA-11A-4
SAMPLE NO: 146004
Blackberry Lane Sediment Composite
TOTAL WEIGHT OF SAMPLE (g): 128.15

TEST DATE: 09/25/97
TESTED BY: TMO
REVIEWED BY: MRZ
DEPTH OF SAMPLE: 0.0

SIEVE TEST ANALYSIS (ASTM D422)

SIEVE # (in)	%FINER	REQUIRED SPECS	
		MIN	MAX
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
1/4	100.0		
SIEVE #			
4	99.8		
8			
10	93.8		
16			
20	60.3		
30			
40	22.2		
50			
60	10.7		
100	7.2		
200	4.1		

MILLER
ENGINEERS
SCIENTISTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 146004 0.0	POORLY GRADED SAND SP					1.26	3.7
Blackberry Ln.							
Sediment Comp.							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 146004 0.0	6.35	0.85	0.490	0.2257	0.2	95.7	3.3	0.8

CLIENT : Northern Lakes Service
PROJECT: NLS Project #35998

JOB NO.: 13755MZ11
TEST DATE: 09/25/97

MILLER ENGINEERS SCIENTISTS

INDEX TEST RESULTS
ASTM D422

SOURCE: Northern Lake
SAMPLED BY: FMCA-11A-4
TESTED BY: TMO
REVIEWED BY: MRZ

GRADATION ANALYSIS

CLIENT: Northern Lakes Service
PROJECT: NLS Project #35998

JOB NO.: 13755MZ11

SPECIFICATION:
SOURCE: Northern Lake
SAMPLED BY: FMCB-11B-4
SAMPLE NO: 146005
Sisters Farm Sediment Composite

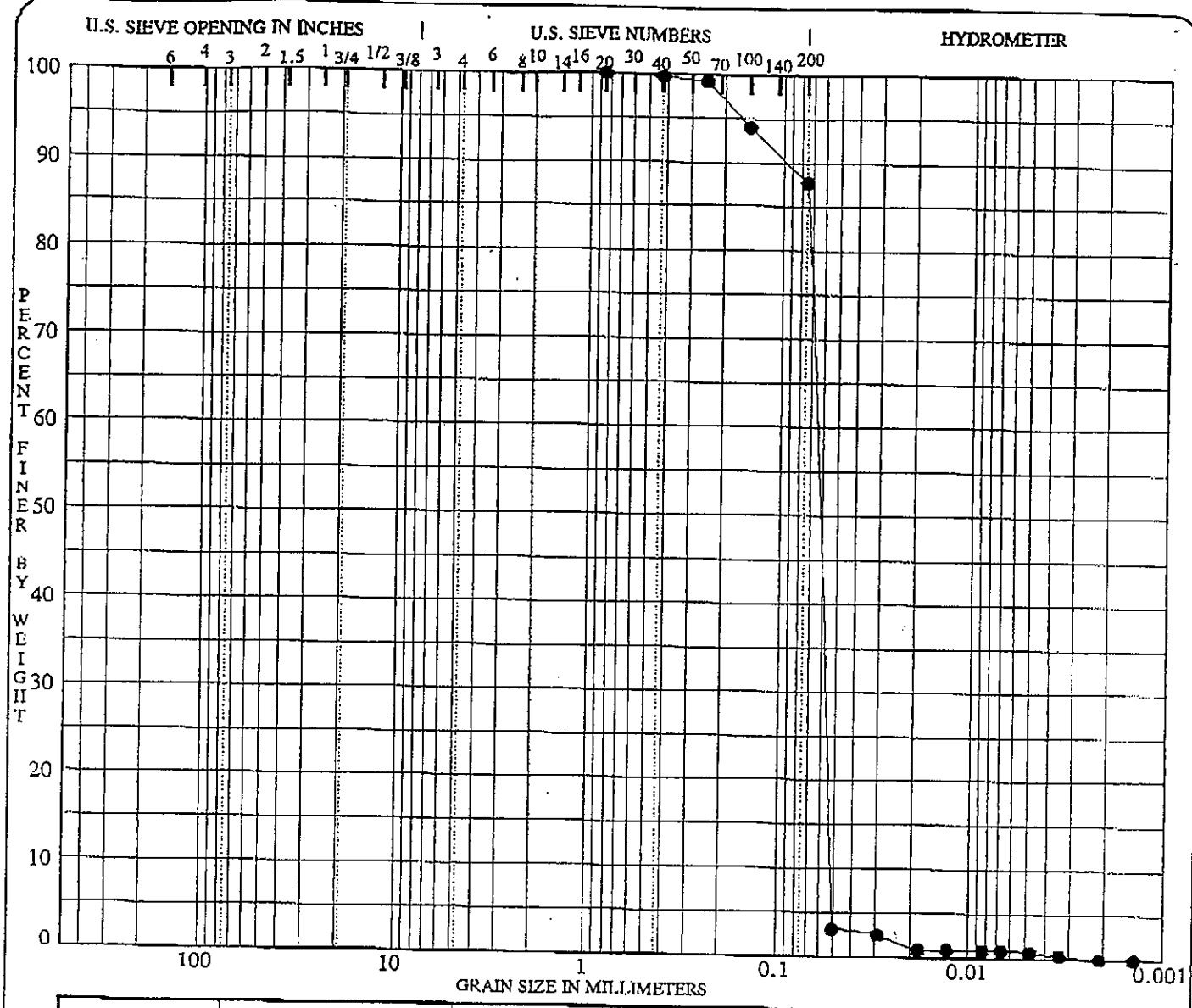
TEST DATE: 09/25/97
TESTED BY: TMO
REVIEWED BY: MRZ
DEPTH OF SAMPLE: 0.0

TOTAL WEIGHT OF SAMPLE (g): 145.10

SIEVE TEST ANALYSIS (ASTM D422)

SIEVE # (in)	%FINER	REQUIRED SPECS	
		MIN	MAX
3	100.0		
1 1/2	100.0		
1	100.0		
3/4	100.0		
1/2	100.0		
3/8	100.0		
1/4	100.0		
SIEVE #			
4	100.0		
8	100.0		
10	100.0		
16	100.0		
20	100.0		
30			
40	99.7		
50			
60	99.2		
100	94.0		
200	87.7		

MILLER
ENGINEERS
SCIENTISTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● 146005	0.0							
Sisters Farm								
Sediment Comp.								

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 146005	0.0	0.85	0.07	0.057	0.0523	0.0	12.3	87.0	0.7

CLIENT: Northern Lakes Service
PROJECT: NLS Project #35998

JOB NO.: 13755MZ11
TEST DATE: 09/25/97

MILLER ENGINEERS SCIENTISTS

INDEX TEST RESULTS
ASTM D422

SOURCE: Northern Lake
SAMPLED BY: FMCB-11B-4
TESTED BY: TMO
REVIEWED BY: MRZ

APPENDIX E

FISH SAMPLING

ENVIRONMENTAL COMPLIANCE CONSULTANTS, INC.

P.O. BOX 11417 • GREEN BAY, WI 54307-1417 • 920-434-6380 (VOICE) • 920-434-6381 (FAX)

Environmental Compliance Consultants, Inc.
Memorandum

October 27, 1997

TO: Jana Murphy, Flambeau Mining Company

CC: Jeff Earnshaw, Flambeau Mining Company

FR: Bill West, ECCI

RE: Report on Activities Associated with 1997 Fish Sampling
Flambeau River, Ladysmith, Wisconsin

Introduction

On August 19 and 20, 1997, representatives of EA Associates, Deerfield, Illinois and Environmental Compliance Consultants, Inc., (ECCI) electroshocked two impoundments on the Flambeau River located above and below the Flambeau Mining Site. These impoundments included the flowage above the Ladysmith Dam, Ladysmith, Wisconsin (upstream sample location) and above the Thornapple Dam (downstream location). The purpose of this activity was to fulfill requirements of the Flambeau Mining Permit which requires Flambeau Mining Company (Flambeau) to conduct metals analysis of fish (walleye) tissue at specified sites above and below the mining outfall. In addition to tissue analysis, captured fish are required to be aged, sexed, lengths recorded, and stomach contents evaluated. Relative abundance of all fish encountered was also to be recorded for each flowage.

Methods

Acceptable sampling methods for fish collection include hook and line, electrofishing, and fyke netting. As in previous years, electrofishing was used for the collection of walleye. Per the mining permit, walleye in the following size ranges were targeted for collection:

- 10 to 12 inches - one fish
- 12 to 15 inches - two fish
- 15 to 18 inches - three fish
- 18 to 22 inches - two fish
- > 22 inches - one fish

Electrofishing was conducted on the Thornapple Flowage on August 19, 1997 and on the Ladysmith Flowage on August 20, 1997. Approximately 40% of the workable shoreline of the Thornapple Flowage was sampled (4.3 hours of energized time), however; several shoreline areas were sampled with multiple passes with the boat electrofisher. Weather conditions at the initiation of the collection period included an overcast sky giving way to steady light rain later in the evening. Initial water conditions included a temperature of 19.2 °C, dissolved oxygen of 6.4 mg/L, and conductivity of 222 umhs/cm (all measurements taken near the boat ramp prior to sampling).

Approximately 50% of the workable shoreline of the Ladysmith Flowage was sampled (5.2 hours of energized time). Weather conditions at the initiation of the collection period included a partly cloudy sky, cool, and moderately foggy. Initial water conditions included a temperature of 20.3 °C, dissolved oxygen of 7.3 mg/L, and conductivity of 184 umhs/cm (all measurements taken at the boat ramp prior to sampling).

During each of the collection efforts, observed fish species were recorded. As in previous years, fish in the largest walleye size class were not obtained. Therefore, fish collected in the next lower size class were substituted for the largest size. Walleyes which met the criteria for length were set aside in tubs of ice water for further processing. Walleyes were measured for length, filleted, and certain organs were extracted for analysis. Scales of each walleye were extracted for aging and on the largest walleye, dorsal spines were also taken. Paired walleye fillets were bagged separately for analysis. The livers from each of the nine walleyes from a single flowage were composited into a single sample for analysis. Individual walleye stomachs were extracted and preserved in formalin, the contents of which to be analyzed on an individual basis. Walleye fillets and livers once processed were placed on ice for transport to Northern Lake Service, Crandon, Wisconsin, for analysis. Walleye stomachs were delivered to ECCI for analysis.

Results and Discussion

The physical data of the walleye collected for analysis is provided in Table 1. Total species of fish observed and their relative abundance are provided in Table 2. An analysis of the stomach contents of the walleye is provided in Table 3. Analytical results of fish tissue and liver are provided in Tables 4 and 5 respectively. A copy of the analytical results relative to this report is provided in Appendix 1.

Data which is provided in Tables 1 through 5 is consistent with the data which was obtained in previous years.

A review of the historical information (data from 1991 to 1997) suggests that relative values for

copper in walleye liver from the Thornapple Flowage and from the Ladysmith Flowage are consistent. Moreover, it is observed that year-to-year increases and decreases in concentrations of copper in the liver of walleye are comparable from the upstream flowage to the downstream flowage.

ECCI has reviewed other data for the Flambeau River for this time period including crayfish tissue analysis, surface water data and sediment deposition data. None of these data sets show other than consistent copper or other metals concentrations in the ecosystm for the time period of 1991 to 1997. It is concluded that the operation of the mine has had no impact on the concentrations of metals which are observed in the liver of walleye.

Table 1

Physical Data of Walleye
Flambeau River, Ladysmith, Wisconsin
August 1997

ID No.	Length (mm)	Weight (g)	Sex	Age
		Thornapple Flowage		
WE-TA-01	285	180	F	2+
WE-TA-02	347	400	F	3+
WE-TA-03	353	380	F	3+
WE-TA-04	353	380	M	3+
WE-TA-05	347	400	M	3+
WE-TA-06	369	450	F	3+
WE-TA-07	388	520	F	3+
WE-TA-08	423	680	F	4+
WE-TA-09	448	820	M	4+
		Ladysmith Flowage		
WE-LS-01	268	180	M	2+
WE-LS-02	364	390	M	3+
WE-LS-03	343	370	F	3+
WE-LS-04	348	360	F	3+
WE-LS-05	348	405	M	4+
WE-LS-06	361	500	F	3+
WE-LS-07	358	485	M	3+
WE-LS-08	391	580	F	3+
WE-LS-09	394	580	F	3+

Prepared by: WMW
Checked by: AKM

Table 2

Fish Species Observed
Flambeau River, Ladysmith, Wisconsin
August 1997

Fish Species	Thornapple* Flowage	Ladysmith* Flowage
Northern pike	C	P
Muskellunge	P	---
Silver redhorse	C/A	C
Golden redhorse	C/A	---
Walleye	C	A
White sucker	P	P
Trout-perch	P	---
Rock bass	C	C
Smallmouth bass	C	C
Yellow perch	C	P
Shorthead redhorse	P	C
Logperch	P	P
Golden Shiner	P	P
Lake sturgeon	P	---

* A=Abundant
C=Common
P=Present

Prepared by: WMW
Checked by: AKM

Table 3

Stomach Analaysis of Walleye
Flambeau River, Ladysmith, Wisconsin
August 1997

Sample ID	Percent Full	Type of Content	General Comment
		Thornapple Flowage	
WE-TA-01	Empty	None	None
WE-TA-02	Empty	None	None
WE-TA-03	Empty	None	None
WE-TA-04	Empty	None	None
WE-TA-05	10%	Undiscernable matter, possible crayfish, color and texture similar to TA-07	Nearly all digested
WE-TA-06	70%	1 crayfish, 5.0 cm	Partially digested
WE-TA-07	5%	Undiscernable matter	Mostly digested
WE-TA-08	Empty	None	None
WE-TA-09	70%	1 large crayfish, 6.5 cm	Partially digested
		Ladysmith Flowage	
WE-LS-01	Empty	None	None
WE-LS-02	100%	1 minnow, 5.5 cm	Partially digested
WE-LS-03	Empty	None	None
WE-LS-04	10%	1 crayfish	Mostly digested
WE-LS-05	Empty	None	None
WE-LS-06	70%	1 crayfish, 4.8 cm; some plant material (*Valisneria*)	Partially digested
WE-LS-07	Empty	None	None
WE-LS-08	Empty	None	None
WE-LS-09	Empty	None	None

Prepared by: WMW

Table 4

Fish Tissue Analysis
Flambeau River, Ladysmith, Wisconsin
Mercury 1991 - 1997 (mg/kg)

Fish ID No.	Year						
	1991	1992	1993	1994	1995	1996	1997
			Thornapple Flowage				
WE-TA-01	0.09	0.78	0.40	0.10	0.08	0.12	0.16
WE-TA-02	1.00	0.55	0.40	0.18	0.10	0.09	0.13
WE-TA-03	0.60	0.59	0.20	0.19	0.09	0.19	0.15
WE-TA-04	0.80	0.52	0.48	0.21	0.13	0.13	0.66
WE-TA-05	0.40	0.68	0.39	0.37	0.12	0.16	<0.072>
WE-TA-06	0.70	0.76	0.33	0.88	0.12	0.19	0.14
WE-TA-07	0.60	0.44	1.10	0.59	0.14	0.35	0.14
WE-TA-08	0.80	0.47	0.63	0.29	0.13	0.23	0.14
WE-TA-09	0.60	0.38	0.91	0.32	0.13	0.19	0.52
Average Concentration	0.71	0.57	0.54	0.35	0.12	0.17	0.20
			Ladysmith Flowage				
WE-LS-01	0.90	0.99	0.68	0.35	0.19	0.17	<0.079>
WE-LS-02	0.80	0.94	0.67	0.45	0.12	0.23	0.25
WE-LS-03	0.80	0.79	0.55	0.31	0.18	0.44	0.34
WE-LS-04	0.70	0.85	0.44	0.25	0.16	0.27	0.16
WE-LS-05	0.90	0.81	0.81	0.53	0.15	0.30	0.12
WE-LS-06	0.60	0.91	0.66	0.35	0.15	0.50	0.34
WE-LS-07	0.80	0.82	0.71	0.25	0.29	0.40	0.32
WE-LS-08	0.60	0.96	0.76	0.18	0.25	0.38	0.22
WE-LS-09	0.60	0.55	0.77	0.31	0.29	0.38	0.26
Average Concentration	0.67	0.84	0.67	0.33	0.20	0.34	0.20

Data appearing in brackets (< >) were observed in concentrations between the level of detection (LOD) and the level of quantitation (LOQ)

Prepared by: WMW
Checked by: AKM

Table 5

Metals Analysis of Walleye Liver
Flambeau River, Ladysmith, Wisconsin
1991 - 1997 (mg/kg)

Sample ID	Cd	Cr	Cu	Ni	Pb	Zn	Al	Hg	As	Se	Ag	Fe	Mn
Thornapple Flowage													
WE-TA-1-9 1991	0.1	0.2	1.5	0.4	1.3	17	1.1	0.3	0.02	0.51	0.2	73	1.5
WE-TA-1-9 1992	<0.1	<0.1	1.6	<0.2	<0.1	33	15	0.2	<0.04	0.6	<0.1	96	1.6
WE-TA-1-9 1993	0.10	<0.10	4.3	<0.2	<0.05	21	1.6	0.45	<0.09	0.70	0.03	110	1.6
WE-TA-1-9 1994	<0.27	<0.63	1.2	<0.72	<3.9	16	7.9	0.12	<1.3	<1.3	<0.45	140	1.4
WE-TA-1-9 1995	<0.9	<1.2	3.6	0.34	<1.1	14	1.8	0.07	<0.60	<0.65	<0.30	99	1.6
WE-TA-1-9 1996	0.10	0.31	45(40*)	0.64	<1.1	29	2.3	<0.01	<0.26	0.97	<0.29	72	1.1
WE-TA-1-9 1997	<0.21>	<0.45>	45(43*)	<0.77	<1.3	30	1.9	0.13	<0.86	<1.2>	<0.48>	110	1.3
Ladysmith Flowage													
WE-LS-1-9 1991	0.1	0.3	6.0	0.5	1.2	18	2.9	0.3	0.02	0.48	0.2	67	1.4
WE-LS-1-9 1992	0.2	0.2	9.6	<0.2	<0.1	37	14	0.4	<0.05	0.6	<0.1	59	2.0
WE-LS-1-9 1993	0.19	<0.08	17	0.17	<0.04	22	1.6	0.28	<0.09	0.64	0.07	63	1.3
WE-LS-1-9 1994	0.32	<0.58	3.1	<0.67	<3.7	19	4.0	0.19	<1.4	<1.4	<0.42	76	1.6
WE-LS-1-9 1995	<0.10	<0.13	13	0.47	<1.2	18	1.5	0.26	<0.54	1.2	<0.33	56	1.3
WE-LS-1-9 1996	0.18	0.30	26(45*)	0.96	<1.3	22	2.2	0.22	<0.27	0.76	<0.34	68	1.3
WE-LS-1-9 1997	0.48	<0.46>	33(33*)	<0.33>	<1.1	27	5.2	0.22	<0.90	<1.0	<0.41	90	1.8

Data for the Thornapple Flowage have sample ID#146018,Data for the Ladysmith Flowage have sample ID#146028
Data in appearing brackets (< >) were observed in concentrations between the level of detection (LOD) and level of quantitation (LOQ)

Prepared by: WMW
Checked by: AKM

*Values in parentheses were derived from re-digestion and re-run of laboratory analytical process and which are believed to be representative of the copper concentrations present in the walleye liver.

Appendix 1

Analytical Data - Fish Tissue Analysis
1997

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998
NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-TA-01 Thornapple Walleye Tissue NLS#: 146009
Ref. Line 6 of COC 28078 Description: WE-TA-01
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.16	mg/Kg WWB	0.045	0.16	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-02 Thornapple Walleye Tissue NLS#: 146010
Ref. Line 7 of COC 28078 Description: WE-TA-02
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.13	mg/Kg WWB	0.025	0.091	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-03 Thornapple Walleye Tissue NLS#: 146011
Ref. Line 8 of COC 28078 Description: WE-TA-03
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.15	mg/Kg WWB	0.042	0.15	EPA 245.1	09/18/97	721026460

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Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-TA-04 Thornapple Walleye Tissue NLS#: 146012
Ref. Line 9 of COC 28078 Description: WE-TA-04
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.66	mg/Kg WWB	0.12	0.44	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-05 Thornapple Walleye Tissue NLS#: 146013
Ref. Line 10 of COC 28078 Description: WE-TA-05
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	< 0.072 >	mg/Kg WWB	0.022	0.080	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-06 Thornapple Walleye Tissue NLS#: 146014
Ref. Line 11 of COC 28078 Description: WE-TA-06
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.14	mg/Kg WWB	0.039	0.14	EPA 245.1	09/18/97	721026460

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Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-TA-07 Thornapple Walleye Tissue NLS#: 146015
Ref. Line 12 of COC 28078 Description: WE-TA-07
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.14	mg/Kg WWB	0.039	0.14	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-08 Thornapple Walleye Tissue NLS#: 146016
Ref. Line 13 of COC 28078 Description: WE-TA-08
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.14	mg/Kg WWB	0.031	0.11	EPA 245.1	09/18/97	721026460

Sample ID: WE-TA-09 Thornapple Walleye Tissue NLS#: 146017
Ref. Line 14 of COC 28078 Description: WE-TA-09
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.52	mg/Kg WWB	0.064	0.23	EPA 245.1	09/18/97	721026460

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Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-TA-(1-9) Thornapple Liver Composite NLS#: 146018
Ref. Line 15 of COC 28078 Description: WE-TA-(1-9) Livers
Collected: 08/19/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	1.9	mg/Kg WWB	0.38	1.3	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.86	3.0	EPA 206.2	09/09/97	721026460
Cadmium, tot. as Cd	< 0.21 >	mg/Kg WWB	0.077	0.28	EPA 200.7	09/09/97	721026460
Chromium, tot. as Cr	< 0.45 >	mg/Kg WWB	0.18	0.64	EPA 200.7	09/09/97	721026460
Copper, tot. as Cu	45	mg/Kg WWB	0.071	0.25	EPA 200.7	09/09/97	721026460
Iron, tot. as Fe	110	mg/Kg WWB	0.35	1.2	EPA 200.7	09/09/97	721026460
Lead, tot. as Pb	ND	mg/Kg WWB	1.3	4.6	EPA 200.7	09/08/97	721026460
Manganese, tot. as Mn	1.3	mg/Kg WWB	0.054	0.18	EPA 200.7	09/09/97	721026460
Mercury (Tissue) by CVAA	0.13	mg/Kg WWB	0.028	0.10	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	< 0.77 >	mg/Kg WWB	0.35	1.2	EPA 200.7	09/09/97	721026460
Selenium, tot. as Se by furnace	< 1.2 >	mg/Kg WWB	1.0	3.6	EPA 270.2	09/08/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.48	1.7	EPA 200.7	09/08/97	721026460
Zinc, tot. as Zn	30	mg/Kg WWB	0.38	0.38	EPA 200.7	09/09/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/05/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/05/97	721026460

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Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-LS-01 Ladysmith Tissue NLS#: 146019
Ref. Line 16 of COC 28078 Description: WE-LS-01
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	< 0.079 >	mg/Kg WWB	0.025	0.089	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-02 Ladysmith Tissue NLS#: 146020
Ref. Line 17 of COC 28078 Description: WE-LS-02
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.25	mg/Kg WWB	0.030	0.11	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-03 Ladysmith Tissue NLS#: 146021
Ref. Line 18 of COC 28078 Description: WE-LS-03
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.34	mg/Kg WWB	0.067	0.24	EPA 245.1	09/18/97	721026460

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Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-LS-04 Ladysmith Tissue NLS#: 146022
Ref. Line 19 of COC 28078 Description: WE-LS-04
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.16	mg/Kg WWB	0.023	0.081	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-05 Ladysmith Tissue NLS#: 146023
Ref. Line 20 of COC 28078 Description: WE-LS-05
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.12	mg/Kg WWB	0.024	0.087	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-06 Ladysmith Tissue NLS#: 146024
Ref. Line 21 of COC 28078 Description: WE-LS-06
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.34	mg/Kg WWB	0.035	0.12	EPA 245.1	09/18/97	721026460

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Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-LS-07 Ladysmith Tissue NLS#: 146025
Ref. Line 22 of COC 28078 Description: WE-LS-07
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.32	mg/Kg WWB	0.042	0.15	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-08 Ladysmith Tissue NLS#: 146026
Ref. Line 23 of COC 28078 Description: WE-LS-08
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.22	mg/Kg WWB	0.048	0.17	EPA 245.1	09/18/97	721026460

Sample ID: WE-LS-09 Ladysmith Tissue NLS#: 146027
Ref. Line 24 of COC 28078 Description: WE-LS-09
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Mercury (Tissue) by CVAA	0.26	mg/Kg WWB	0.043	0.16	EPA 245.1	09/18/97	721026460

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

 NLS PROJECT# 35998
NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: WE-LS-(1-9) Ladysmith Liver Composite NLS#: 146028
Ref. Line 25 of COC 28078 Description: WE-LS-(1-9) Livers
Collected: 08/20/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	5.2	mg/Kg WWB	0.33	1.1	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.90	3.1	EPA 206.2	09/09/97	721026460
Cadmium, tot. as Cd	0.48	mg/Kg WWB	0.066	0.24	EPA 200.7	09/09/97	721026460
Chromium, tot. as Cr	< 0.46 >	mg/Kg WWB	0.15	0.55	EPA 200.7	09/09/97	721026460
Copper, tot. as Cu	33	mg/Kg WWB	0.060	0.22	EPA 200.7	09/09/97	721026460
Iron, tot. as Fe	90	mg/Kg WWB	0.30	1.0	EPA 200.7	09/09/97	721026460
Lead, tot. as Pb	ND	mg/Kg WWB	1.1	3.9	EPA 200.7	09/08/97	721026460
Manganese, tot. as Mn	1.8	mg/Kg WWB	0.046	0.16	EPA 200.7	09/09/97	721026460
Mercury (Tissue) by CVAA	0.22	mg/Kg WWB	0.014	0.052	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	< 0.33 >	mg/Kg WWB	0.30	1.1	EPA 200.7	09/09/97	721026460
Selenium, tot. as Se by furnace	ND	mg/Kg WWB	1.0	3.7	EPA 270.2	09/08/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.41	1.5	EPA 200.7	09/08/97	721026460
Zinc, tot. as Zn	27	mg/Kg WWB	0.33	0.33	EPA 200.7	09/09/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/05/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/05/97	721026460

Values in brackets represent results greater than the LOD but less than the LOQ and are within a region of "Less-Certain Quantitation". Results greater than the LOQ are considered to be in the region of "Certain Quantitation".

LOD = Limit of Detection
DWB = Dry Weight Basis
LOQ = Limit of Quantitation
NA = Not Applicable
ND = Not Detected
%DWB = (mg/kg DWB)/10000

Reviewed by: Steven R. Cupp

Authorized by:
R. T. Krueger
Laboratory Manager

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

PAGE: 1 NLS PROJECT# 38347
NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Liver Composite Copper Reanalysis

---

Sample ID: 146018 (TA Liver Comp.) **NLS#: 156104**
COC Description: 146018
Collected: 12/08/97 Received: 12/08/97 Reported: 12/12/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Copper, tot. as Cu	43	mg/Kg WWB	0.071	0.25	SW846 6010	12/11/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				SW846 3050	09/05/97	721026460

Sample ID: 146028 (LS Liver Comp.) **NLS#: 156105**
COC Description: 146028
Collected: 12/08/97 Received: 12/08/97 Reported: 12/12/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Copper, tot. as Cu	33	mg/Kg WWB	0.060	0.22	SW846 6010	12/11/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				SW846 3050	09/05/97	721026460

Values in brackets represent results greater than the LOD but less than the LOQ and are within a region of "Less-Certain Quantitation". Results greater than the LOQ are considered to be in the region of "Certain Quantitation".

LOD = Limit of Detection
DWB = Dry Weight Basis
LOQ = Limit of Quantitation
NA = Not Applicable
ND = Not Detected
%DWB = (mg/kg DWB) / 10000

Reviewed by: Thomas R Pucbo

Authorized by:
R. T. Krueger
Laboratory Manager

NORTHERN LAKE SERVICE, INC.

00 NORTH LAKE AVENUE
RANDON, WI 54520 (715)478-2777

ORDER OF ANALYSIS

TS ORDERED BY:

CHAIN OF CUSTODY RECORD NUMBER: 28079

QUOTATION NUMBER:

ANALYZE FOR DISSOLVED OR TOTAL PARAMETERS?

SEND RESULTS TO: Bill West ECCI GB

SEND INVOICE TO: Same

ote "L" for low level ICP analysis, and "F" for furnace analysis.

amples on line #s: 1-9 (9 samples - composite each bay first) to be analyzed for the parameters checked below:

☐ Alkalinity, total	☐ Cyanide, total	☐ Phenols	☐ Acid Extractables by 625/8270
☐ Alkalinity, bicarb.	☐ Amenable	☐ Phosphorus, total	☐ Base/Neutral Extractables by 625/8270
☐ Aluminum	☐ Fluoride	☐ Tot. reactive	☐ BNAs by 625/8270
☐ Antimony	☐ Hardness	☐ Dis. reactive	☐ Chlorinated Hydrocarbons by 612
☐ Arsenic	☐ Iron	☐ Potassium	☐ Haloethers by 611
☐ Barium	☐ Lead	☐ Selenium	☐ Nitrosamines by 607
☐ Beryllium	☐ Magnesium	☐ Silica	☐ Pesticides-Organochlorine by 608/8080
☐ B.O.D.-5	☐ Manganese	☐ Silver	☐ Pesticides-Organophosphate by 8141
☐ Boron	☒ Mercury	☐ Sodium	☐ PCBs by 608/8080
☐ Cadmium	☐ Molybdenum	☐ Solids, total	☐ Phenols by GC 604/8040
☐ [illegible]um	☐ Nickel	☐ Tot. dissolved	☐ Phenoxy Acid Herbicides by 8150
☐ [illegible]	☐ Nitrogen, total	☐ Tot. suspended	☐ TCLP-metals ☐ TCLP-VOCs ☐ TCLP-BNAs
☐ Chloride	☐ Ammonia	☐ Sulfate	☐ TCLP-pesticides/herbicides
☐ Chromium	☐ Nitrate	☐ Sulfide	☐ VOCs by EPA 601+602 or 8010+8020
☐ Chromium, hexavalent	☐ Nitrite	☐ Surfactants (MBAS)	☐ -by EPA 8021
☐ Cobalt	☐ Nitrate + Nitrite	☐ Thallium	☐ -by EPA 624/8240/8260
☐ Coliform, fecal	☐ Total Kjeldahl	☐ Tin	☐ -by EPA 524.2 (SDWA)
☐ Color	☐ Total Organic	☐ T.O.C.	☐ BTEX by 8020
☐ Conductivity	☐ Oil & Grease	☐ Turbidity	☐ PVOCs by 8020
☐ Copper	☐ pH	☐ Vanadium	☐ GRO-WI Modified ☐ GRO+PVOCs
☐ _____	☐ _____	☐ Zinc	☐ DRO-WI Modified
☐ _____	☐ _____	☐ Munic.Sludge,WI List	☐ PAHs by 610LC/8310

amples on line #s: 10 (1 sample - comp - all rivers first) to be analyzed for the parameters checked below:
(See C-O-C for metals list)

☐ Alkalinity, total	☐ Cyanide, total	☐ Phenols	☐ Acid Extractables by 625/8270
☐ Alkalinity, bicarb.	☐ Amenable	☐ Phosphorus, total	☐ Base/Neutral Extractables by 625/8270
☐ Aluminum	☐ Fluoride	☐ Tot. reactive	☐ BNAs by 625/8270
☐ Antimony	☐ Hardness	☐ Dis. reactive	☐ Chlorinated Hydrocarbons by 612
☐ Arsenic	☐ Iron	☐ Potassium	☐ Haloethers by 611
☐ Barium	☐ Lead	☐ Selenium	☐ Nitrosamines by 607
☐ Beryllium	☐ Magnesium	☐ Silica	☐ Pesticides-Organochlorine by 608/8080
☐ B.O.D.-5	☐ Manganese	☐ Silver	☐ Pesticides-Organophosphate by 8141
☐ Boron	☐ Mercury	☐ Sodium	☐ PCBs by 608/8080
☐ Cadmium	☐ Molybdenum	☐ Solids, total	☐ Phenols by GC 604/8040
☐ Calcium	☐ Nickel	☐ Tot. dissolved	☐ Phenoxy Acid Herbicides by 8150
☐ C.O.D.	☐ Nitrogen, total	☐ Tot. suspended	☐ TCLP-metals ☐ TCLR-VOCs ☐ TCLP-BNAs
☐ Chloride	☐ Ammonia	☐ Sulfate	☐ TCLP-pesticides/herbicides
☐ Chromium	☐ Nitrate	☐ Sulfide	☐ VOCs by EPA 601+602 or 8010+8020
☐ Chromium, hexavalent	☐ Nitrite	☐ Surfactants (MBAS)	☐ -by EPA 8021
☐ Cobalt	☐ Nitrate + Nitrite	☐ Thallium	☐ -by EPA 624/8240/8260
☐ [illegible]form, fecal	☐ Total Kjeldahl	☐ Tin	☐ -by EPA 524.2 (SDWA)
☐ [illegible]	☐ Total Organic	☐ T.O.C.	☐ BTEX by 8020
☐ [illegible]uctivity	☐ Oil & Grease	☐ Turbidity	☐ PVOCs by 8020
☐ Copper	☐ pH	☐ Vanadium	☐ GRO-WI Modified ☐ GRO+PVOCs
☐ _____	☐ _____	☐ Zinc	☐ DRO-WI Modified
☐ _____	☐ _____	☐ Munic.Sludge,WI List	☐ PAHs by 610LC/8310

PECIAL INSTRUCTIONS: _____

NORTHERN LAKE SERVICE, INC.

00 NORTH LAKE AVENUE
RANDON, WI 54520 (715)478-2777

ORDER OF ANALYSIS

TS ORDERED BY:

CHAIN OF CUSTODY RECORD NUMBER: 2880

QUOTATION NUMBER:

ANALYZE FOR DISSOLVED OR TOTAL PARAMETERS?

SEND RESULTS TO: Bill West ECCI GB

SEND INVOICE TO: Same

ote "L" for low level ICP analysis, and "F" for furnace analysis.

amples on line #s: 1-9 (9 samples) (comp - each sample first) to be analyzed for the parameters checked below:

-] Alkalinity, total
-] Alkalinity, bicarb.
-] Aluminum
-] Antimony
-] Arsenic
-] Barium
-] Beryllium
-] B.O.D.-5
-] Boron
-] Cadmium
-] Calcium
-] C.O.D.
-] Chloride
-] Chromium
-] Chromium, hexavalent
-] Cobalt
-] Coliform, fecal
-] Color
-] Conductivity
-] Copper
-] _____
-] _____

- ☐ Cyanide, total
- ☐ Amenable
- ☐ Fluoride
- ☐ Hardness
- ☐ Iron
- ☐ Lead
- ☐ Magnesium
- ☐ Manganese
- ☒ Mercury
- ☐ Molybdenum
- ☐ Nickel
- ☐ Nitrogen, total
- ☐ Ammonia
- ☐ Nitrate
- ☐ Nitrite
- ☐ Nitrate + Nitrite
- ☐ Total Kjeldahl
- ☐ Total Organic
- ☐ Oil & Grease
- ☐ pH
- ☐ _____
- ☐ _____

- ☐ Phenols
- ☐ Phosphorus, total
- ☐ Tot. reactive
- ☐ Dis. reactive
- ☐ Potassium
- ☐ Selenium
- ☐ Silica
- ☐ Silver
- ☐ Sodium
- ☐ Solids, total
- ☐ Tot. dissolved
- ☐ Tot. suspended
- ☐ Sulfate
- ☐ Sulfide
- ☐ Surfactants (MBAS)
- ☐ Thallium
- ☐ Tin
- ☐ T.O.C.
- ☐ Turbidity
- ☐ Vanadium
- ☐ Zinc
- ☐ Munic.Sludge,WI List

- ☐ Acid Extractables by 625/8270
- ☐ Base/Neutral Extractables by 625/8270
- ☐ BNAs by 625/8270
- ☐ Chlorinated Hydrocarbons by 612
- ☐ Haloethers by 611
- ☐ Nitrosamines by 607
- ☐ Pesticides-Organochlorine by 608/8080
- ☐ Pesticides-Organophosphate by 8141
- ☐ PCBs by 608/8080
- ☐ Phenols by GC 604/8040
- ☐ Phenoxy Acid Herbicides by 8150
- ☐ TCLP-metals ☐ TCLP-VOCs ☐ TCLP-BNAs
- ☐ TCLP-pesticides/herbicides
- ☐ VOCs by EPA 601+602 or 8010+8020
- ☐ -by EPA 8021
- ☐ -by EPA 624/8240/8260
- ☐ -by EPA 524.2 (SDWA)
- ☐ BTEX by 8020
- ☐ PVOCs by 8020
- ☐ GRO-WI Modified ☐ GRO+PVOCs
- ☐ DRO-WI Modified
- ☐ PAHs by 610LC/8310

amples on line #s: Composite liver first 2 (1 sample) See c-o-c for list to be analyzed for the parameters checked below:

-] Alkalinity, total
-] Alkalinity, bicarb.
-] Aluminum
-] Antimony
-] Arsenic
-] Barium
-] Beryllium
-] B.O.D.-5
-] Boron
-] Cadmium
-] Calcium
-] C.O.D.
-] Chloride
-] Chromium
-] Chromium, hexavalent
-] Cobalt
-] Coliform, fecal
-] Conductivity
-] Copper
-] _____
-] _____

- ☐ Cyanide, total
- ☐ Amenable
- ☐ Fluoride
- ☐ Hardness
- ☐ Iron
- ☐ Lead
- ☐ Magnesium
- ☐ Manganese
- ☐ Mercury
- ☐ Molybdenum
- ☐ Nickel
- ☐ Nitrogen, total
- ☐ Ammonia
- ☐ Nitrate
- ☐ Nitrite
- ☐ Nitrate + Nitrite
- ☐ Total Kjeldahl
- ☐ Total Organic
- ☐ Oil & Grease
- ☐ pH
- ☐ _____
- ☐ _____

- ☐ Phenols
- ☐ Phosphorus, total
- ☐ Tot. reactive
- ☐ Dis. reactive
- ☐ Potassium
- ☐ Selenium
- ☐ Silica
- ☐ Silver
- ☐ Sodium
- ☐ Solids, total
- ☐ Tot. dissolved
- ☐ Tot. suspended
- ☐ Sulfate
- ☐ Sulfide
- ☐ Surfactants (MBAS)
- ☐ Thallium
- ☐ Tin
- ☐ T.O.C.
- ☐ Turbidity
- ☐ Vanadium
- ☐ Zinc
- ☐ Munic.Sludge,WI List

- ☐ Acid Extractables by 625/8270
- ☐ Base/Neutral Extractables by 625/8270
- ☐ BNAs by 625/8270
- ☐ Chlorinated Hydrocarbons by 612
- ☐ Haloethers by 611
- ☐ Nitrosamines by 607
- ☐ Pesticides-Organochlorine by 608/8080
- ☐ Pesticides-Organophosphate by 8141
- ☐ PCBs by 608/8080
- ☐ Phenols by GC 604/8040
- ☐ Phenoxy Acid Herbicides by 8150
- ☐ TCLP-metals ☐ TCLP-VOCs ☐ TCLP-BNAs
- ☐ TCLP-pesticides/herbicides
- ☐ VOCs by EPA 601+602 or 8010+8020
- ☐ -by EPA 8021
- ☐ -by EPA 624/8240/8260
- ☐ -by EPA 524.2 (SDWA)
- ☐ BTEX by 8020
- ☐ PVOCs by 8020
- ☐ GRO-WI Modified ☐ GRO+PVOCs
- ☐ DRO-WI Modified
- ☐ PAHs by 610LC/8310

PECIAL INSTRUCTIONS: _____

APPENDIX F

MACROINVERTEBRATE SAMPLING

ENVIRONMENTAL COMPLIANCE CONSULTANTS, INC.

P.O. BOX 11417 • GREEN BAY, WI 54307-1417 • 920-434-6380 (VOICE) • 920-434-6381 (FAX)

Environmental Compliance Consultants, Inc.
Memorandum

October 27, 1997

TO: Jana Murphy

CC: Jeff Earnshaw, Flambeau Mining Company

FR: Bill West, ECCI

RE: Report of Activities Conducted in 1997 Associated with Collection and Analysis of Crayfish from the Flambeau River, Ladysmith, Wisconsin

Introduction

On August 18, 1997, Bill West of Environmental Compliance Consultants, Inc. (ECCI), completed crayfish collection activities at three sites on the Flambeau River downstream of Ladysmith, Wisconsin. The purpose of this activity was to fulfill requirements of the Flambeau Mining Permit which requires Flambeau Mining Company (Flambeau) to conduct metals analysis of crayfish at selected sites upstream and downstream of the mining discharge point (Outfall 001). The permit requires that a minimum of 25 crayfish be collected at the following sites:

- The Flambeau River at the Blackberry Lane access (upstream site)
- The Flambeau River at Meadowbrook Creek (downstream site)
- The Flambeau River at the site of the former Port Arthur Dam (downstream site)

The time of year of collection is not defined, however, from past experience, the best time to collect appears to be mid to late summer when crayfish are active and easily obtained. This is also the time to obtain larger size crayfish which would provide better information on metals uptake in macroinvertebrates over time.

Methodology

All samples were collected using an 8 by 18-inch rectangular net with 800 to 900 micron mesh size. Crayfish were collected by using a kick seine method.

Crayfish were collected during the following time windows:

Site Location	Time of Collection	Number of Crayfish
Blackberry Lane	9:00 - 10:00 a.m.	26
Port Arthur Dam	10:00 - 11:30 a.m.	25
Meadowbrook Creek	11:30 - 1:30 a.m.	27

Specimens were composited for each site in a Ziploc bag and placed on ice. Specimens were transported to Northern Lake Service, Crandon, Wisconsin for metals analysis.

Results and Discussion

The results of the analysis of the crayfish appear in Table 1. Raw laboratory results are provided in Appendix 1. The results represent a composite from all crayfish collected per site. Whole bodies were used for analysis. A review of the data indicates that no relative difference in parameter concentrations from upstream locations to downstream locations is evident.

There appears to be some cycling of the aluminum results, i.e., the results of the first year in all samples were low followed by an increase in all samples. The third year witnessed another low set of results in all sites followed by two successive years of increases. The 1996 results were approximately one-half the concentration of the 1995 results for aluminum, while 1997 results show continued declines except for the sample at Meadowbrook Creek. These results do not coincide with similar fluctuations in sediment analyses or, for that matter, other metal results in fish tissue. Fluctuating data may be the result of instrumental analysis and the ability to maintain the same levels of detection (instrument noise suppression) from year to year. There may also be matrix interference which could cause one year's data to be higher or lower than previous year's data. One would expect this situation to be consistent for all samples for a given year. A review of the historical data presented in Table 1 for aluminum suggests that all data for a given year is consistently higher or lower than an average aluminum value. There appears to be no significance to these fluctuations as there is no trend upward or downward in the crayfish data.

In 1997, the laboratory conducting the crayfish analysis inadvertently completed analysis on two parameters which had not been conducted in previous years. Results for manganese and iron appear in the data set. Because these parameters are not required by permit to be analyzed in crayfish, no attempt will be made to evaluate these three sets of data herein, except that it is observed that there is no particular significance in the concentrations of these parameters as reported as they appear to be consistent and comparable from upstream to downstream locations.

Table 1
Metals Analysis of Crayfish
Flambeau River, Ladysmith, Wisconsin
Results in mg/kg
1991 - 1997

Sample ID	Cadmium	Chromium	Copper	Nickel	Lead	Zinc	Aluminum	Mercury	Arsenic	Selenium	Silver
Blackberry Lane											
1991	0.1	1.0	17	0.4	1.2	23	36	0.1	0.24	0.14	0.2
1992	<0.1	0.4	16	<0.2	0.1	43	46	0.1	0.30	0.13	<0.1
1993	0.03	<0.09	15	0.2	<0.05	16	28	<0.2	<0.09	<0.19	0.06
1994	0.02	0.92	9.9	<0.22	<0.05	12	17	<0.02	<0.75	<1.93	<0.09
1995	<0.04	0.96	21	<0.19	<0.23	21	48	<0.05	<0.41	<0.44	<0.05
1996	<0.06	<0.16	20	0.40	<0.97	16	24	<0.02	0.33	<0.13	<0.25
1997	<0.070	0.67	18	<0.41>	<1.2	20	17	<0.025>	<0.82	<0.95	<0.44
Meadowbrook Creek											
1991	0.1	1.6	20	0.5	1.3	27	36	0.1	0.29	0.15	0.2
1992	<0.1	0.5	19	<0.2	0.2	39	82	0.11	0.4	0.12	<001
1993	0.04	<0.09	15	0.2	<0.04	15	18	<0.20	<0.08	<0.35	0.08
1994	0.02	0.74	22	<0.29	<0.09	17	31	<0.03	<0.66	<1.64	<0.08
1995	<0.05	0.71	27	<0.23	<0.33	19	69	<0.06	<0.60	<0.64	<0.07
1996	<0.08	<0.22	28	0.74	<1.3	16	30	<0.02	<0.26	<0.14	<0.35
1997	<0.066	<0.49>	24	<0.55>	<1.1	17	42	<0.029	<0.78	<0.91	<0.41

Sample ID	Cadmium	Chromium	Copper	Nickel	Lead	Zinc	Aluminum	Mercury	Arsenic	Selenium	Silver
Port Arthur											
1991	0.1	1.6	20	0.5	1.2	21	27	0.3	0.28	0.15	0.2
1992	<0.1	0.4	14	1.5	0.2	33	430	0.1	0.34	0.14	<0.1
1993	0.03	<0.09	12	<0.15	<0.04	11	22	<0.2	<0.1	<0.36	0.09
1994	0.04	0.92	18	<1.4	<0.10	15	28	<0.02	<0.76	<1.88	<0.09
1995	<0.04	4.5	24	0.05	<0.25	16	130	<0.06	<0.45	<0.48	<0.05
1996	<0.07	0.17	28	0.44	<1.1	16	68	<0.02	<0.28	<0.42	<0.28
1997	<0.049	<0.26>	22	<0.53>	<0.81	16	11	0.065	<0.74	<0.86	<0.30

Data for Blackberry Lane is represented by Sample ID#146006, Meadowbrook Creek by ID#146007, and Port Arthur Dam by ID#146008
Data appearing in brackets (< >) fall between the level of detection (LOD) and level of quantitation (LOQ)

Prepared by: WMW
Checked by: AKM

Appendix 1

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998

NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: FMC-CR-PAD Port Arthur Dam Crayfish NLS#: 146008
Ref. Line 5 of COC 28078 Description: FMC-CR-PAD
Collected: 08/18/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	11	mg/Kg WWB	0.24	0.81	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.74	2.5	EPA 206.2	09/09/97	721026460
Cadmium, tot. as Cd	ND	mg/Kg WWB	0.049	0.17	EPA 200.7	09/09/97	721026460
Chromium, tot. as Cr	< 0.26 >	mg/Kg WWB	0.11	0.41	EPA 200.7	09/09/97	721026460
Copper, tot. as Cu	22	mg/Kg WWB	0.045	0.16	EPA 200.7	09/09/97	721026460
Iron, tot. as Fe	53	mg/Kg WWB	0.22	0.77	EPA 200.7	09/09/97	721026460
Lead, tot. as Pb	ND	mg/Kg WWB	0.81	2.9	EPA 200.7	09/08/97	721026460
Manganese, tot. as Mn	67	mg/Kg WWB	0.035	0.12	EPA 200.7	09/09/97	721026460
Mercury (Tissue) by CVAA	0.065	mg/Kg WWB	0.036	0.029	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	< 0.53 >	mg/Kg WWB	0.22	0.79	EPA 200.7	09/09/97	721026460
Selenium, tot. as Se by furnace	ND	mg/Kg WWB	0.86	3.1	EPA 270.2	09/08/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.30	1.1	EPA 200.7	09/08/97	721026460
Solids, total on solids	30.4	%	0.10		ASTM D2216	08/27/97	721026460
Zinc, tot. as Zn	16	mg/Kg WWB	0.24	0.24	EPA 200.7	09/09/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/05/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/05/97	721026460

NORTHERN LAKE SERVICE, INC.
Analytical Laboratory and Environmental Services
400 North Lake Avenue - Crandon, WI 54520
Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998

NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: FMC-CR-BBL Blackberry Lane Crayfish NLS#: 146006
Ref. Line 3 of COC 28078 Description: FMC-CR-BBL
Collected: 08/18/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	17	mg/Kg WWB	0.35	1.2	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.82	2.8	EPA 206.2	09/09/97	721026460
Cadmium, tot. as Cd	ND	mg/Kg WWB	0.070	0.25	EPA 200.7	09/09/97	721026460
Chromium, tot. as Cr	0.67	mg/Kg WWB	0.16	0.58	EPA 200.7	09/09/97	721026460
Copper, tot. as Cu	18	mg/Kg WWB	0.064	0.23	EPA 200.7	09/09/97	721026460
Iron, tot. as Fe	85	mg/Kg WWB	0.32	1.1	EPA 200.7	09/09/97	721026460
Lead, tot. as Pb	ND	mg/Kg WWB	1.2	4.2	EPA 200.7	09/08/97	721026460
Manganese, tot. as Mn	85	mg/Kg WWB	0.050	0.17	EPA 200.7	09/09/97	721026460
Mercury (Tissue) by CVAA	< 0.025 >	mg/Kg WWB	0.019	0.068	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	< 0.41 >	mg/Kg WWB	0.32	1.1	EPA 200.7	09/09/97	721026460
Selenium, tot. as Se by furnace	ND	mg/Kg WWB	0.95	3.4	EPA 270.2	09/08/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.44	1.6	EPA 200.7	09/08/97	721026460
Solids, total on solids	28.0	%	0.10		ASTM D2216	09/04/97	721026460
Zinc, tot. as Zn	20	mg/Kg WWB	0.35	0.35	EPA 200.7	09/09/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/05/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/05/97	721026460

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Tel:(715)478-2777 Fax:(715)478-3060

WIS. LAB CERT. NO. 721026460

ANALYTICAL REPORT

NLS PROJECT# 35998

NLS CUST# 10513

Client: E.C.C.I. (GB)
Attn: Bill West
PO Box 12114
2637 Tulip Ln
Green Bay, WI 54307

Project Description: Flambeau Mining Co.-Sediment, Fish, Crayfish, & Livers

Sample ID: FMC-CR-MBC Meadow Brook Creek Crayfish NLS#: 146007
Ref. Line 4 of COC 28078 Description: FMC-CR-MBC
Collected: 08/18/97 Received: 08/21/97 Reported: 11/14/97

Parameter	Result	Units	LOD	LOQ	Method	Analyzed	Lab
Aluminum, tot. as Al	42	mg/Kg WWB	0.33	1.1	EPA 200.7	09/16/97	721026460
Arsenic, tot. as As by furnace	ND	mg/Kg WWB	0.78	2.7	EPA 206.2	09/09/97	721026460
Cadmium, tot. as Cd	ND	mg/Kg WWB	0.066	0.24	EPA 200.7	09/09/97	721026460
Chromium, tot. as Cr	< 0.49 >	mg/Kg WWB	0.15	0.55	EPA 200.7	09/09/97	721026460
Copper, tot. as Cu	24	mg/Kg WWB	0.060	0.22	EPA 200.7	09/09/97	721026460
Iron, tot. as Fe	140	mg/Kg WWB	0.30	1.0	EPA 200.7	09/09/97	721026460
Lead, tot. as Pb	ND	mg/Kg WWB	1.1	3.9	EPA 200.7	09/08/97	721026460
Manganese, tot. as Mn	85	mg/Kg WWB	0.047	0.16	EPA 200.7	09/09/97	721026460
Mercury (Tissue) by CVAA	ND	mg/Kg WWB	0.029	0.10	EPA 245.1	09/18/97	721026460
Nickel, tot. as Ni	< 0.55 >	mg/Kg WWB	0.30	1.1	EPA 200.7	09/09/97	721026460
Selenium, tot. as Se by furnace	ND	mg/Kg WWB	0.91	3.2	EPA 270.2	09/08/97	721026460
Silver, tot. as Ag	ND	mg/Kg WWB	0.41	1.5	EPA 200.7	09/08/97	721026460
Solids, total on solids	27.0	%	0.10		ASTM D2216	08/27/97	721026460
Zinc, tot. as Zn	17	mg/Kg WWB	0.33	0.33	EPA 200.7	09/09/97	721026460
Metals digestion - total (soil/sludge) ICP	yes				EPA 200.0	09/05/97	721026460
Metals digestion - total (soil/sludge) furnace	yes				EPA 200.0	09/05/97	721026460

NO. 28078

NORTHERN LAKE SERVICE, INC.

Analytical Laboratory and Environmental Services

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SAMPLE COLLECTION AND CHAIN OF CUSTODY RECORD

Wisconsin Lab Cert. No. 721026460

RETURN THIS FORM WITH SAMPLES.

CLIENT	PROJECT TITLE	
Environmental Compliance Consultants Inc (ECCI)	Flambeau Mining Company	
ADDRESS: Box 11417	PROJECT NO.	P.O. NO.
CITY: Green Bay	STATE: WI ZIP: 54307	CONTACT: Bill West
		PHONE: 920-434-5036

ITEM NO.	NLS LAB. NO.	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	SAMPLE TYPE	GRAB/ COMP.	CONTAINER/PRESERVATIVE S/NP	S/NP				COLLECTION REMARKS
1.	14606	FMC A-1	8/18	6:00	SED	Comp	1					Filter save
2.		FMC A-2	8/18	6:00	Sed		1					Solids for Metals
3.		FMC A-3	8/18	6:00	Sed		1					+ Sieve Analysis
4.		FMC A-4	8/18	6:00	Sed		1					Compose 4 A's Four in the Single Sample
5.	14605	FMC B-1	8/18	6:15	Sed		1					Filter save Solids
6.		FMC B-2	8/18	6:15	Sed		1					for Metals + Sieve
7.		FMC B-4	8/18	6:15	Sed		1					Analysis, Compose
8.												three into Single
9												Sample
	14606	FMC-CR- [illegible]	8/18	9:00	TIS	Comp		1				per [illegible] grind for M
1.	14606	FMC-RR- MBC	8/18	10:00	TIS	Comp		1				" " grind for metals
2.	14606	FMC-[illegible] MAD	8/18	11:30	TIS	Comp		1				" " " "

SAMPLE TYPE:
SW = surface water; WW = wastewater; GW = groundwater; DW = drinking water; TIS = tissue; AIR = air; PROD = product; SOIL = soil; SED = sediment; describe others

CONTAINER: P = plastic; G = glass; V = glass vial; B = plastic bag; describe others

PRESERVATIVES & PREPARATION: NP = nothing added; S = sulfuric acid; N = nitric acid; Z = zinc acetate; OH = sodium hydroxide; HA = hydrochloric & ascorbic acid; H = hydrochloric acid; **F = field filtered**

COLLECTED BY (signatures): Bill West — CUSTODY SEAL NO. (IF ANY) — DATE/TIME

RELINQUISHED BY (signature): Bill West — RECEIVED BY (signature): [illegible] — DATE/TIME: 8/21/97 4 PM

RELINQUISHED BY (signature) — RECEIVED BY (signature) — DATE/TIME

DISPATCHED BY (signature) — METHOD OF TRANSPORT — DATE/TIME

RECEIVED AT NLS BY (signature): Alexander R. Cahnovsky — DATE/TIME: 8/21/97 1600 — CONDITION: [illegible] — TEMP: 2.6

SEAL INTACT? ☐ YES ☐ NO — SEAL # — REMARKS & OTHER INFORMATION

NOTE
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NO. 28079

SAMPLE COLLECTION AND CHAIN OF CUSTODY RECORD

Wisconsin Lab Cert. No. 721026460

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Environmental Compliance Consultants Inc (ECCI)	Flambeau Mining Company	
ADDRESS	PROJECT NO.	P.O. NO.
PO Box 11417		
CITY / STATE / ZIP	CONTACT	PHONE
Green Bay WI 54307	Bill Wait	920-434-5036

ITEM NO.	NLS LAB. NO.	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	SAMPLE TYPE	GRAB/ COMP.	CONTAINER/PRESERVATIVE B/NP	COLLECTION REMARKS
1.	146009	WE-TA-01	8/19		TIS	G	1	2 Fillets, Analyze as Composite
2.	146010	WE-TA-02	8/19				1	"
3.	146011	WE-TA-03	8/19				1	"
4.	146012	WE-TA-04	8/19				1	"
5.	146013	WE-TA-05	8/19				1	"
6.	146014	WE-TA-06	8/19				1	"
7.	146015	WE-TA-07	8/19				1	"
8.	146016	WE-TA-08	8/19				1	"
9.	146017	WE-TA-09	8/19				1	"
	146018	WE-TA-(1-9) Livers	8/19			Comp	1	9 Livers, Analyze as Composite
1.		Analyze Fillets for Mercury only						
2.		Analyze Livers for: Cr, Cu, Ni, Pb, Zn, Al, Hg, As, Se, Ag, Fe, + Mn						

SAMPLE TYPE:
SW = surface water; WW = wastewater; GW = groundwater; DW = drinking water; TIS = tissue; AIR = air; PROD = product; SOIL = soil; SED = sediment; describe others

CONTAINER: P = plastic; G = glass; V = glass vial; B = plastic bag; describe others

PRESERVATIVES & PREPARATION: NP = nothing added; S = sulfuric acid; N = nitric acid; Z = zinc acetate; OH = sodium hydroxide; HA = hydrochloric & ascorbic acid; H = hydrochloric acid; F = field filtered

COLLECTED BY (signatures)	CUSTODY SEAL NO. (IF ANY)	DATE/TIME
RELINQUISHED BY (signature)	RECEIVED BY (signature)	DATE/TIME
		8/21/97 9 p.m.
RELINQUISHED BY (signature)	RECEIVED BY (signature)	DATE/TIME
DISPATCHED BY (signature)	METHOD OF TRANSPORT	DATE/TIME

RECEIVED AT NLS BY (signature)	DATE/TIME	CONDITION	TEMP.
Steve R. Cupi	8/21/97 1600		
SEAL INTACT? ☐ YES ☐ NO	SEAL #	REMARKS & OTHER INFORMATION	

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NO. 28080

SAMPLE COLLECTION AND CHAIN OF CUSTODY RECORD

Wisconsin Lab Cert. No. 721026460

TURN THIS FORM WITH SAMPLES.

CLIENT	PROJECT TITLE	
Environmental Compliance Consultants Inc (ECCI)	Flambeau Mining Company	
ADDRESS: Box 1817	PROJECT NO.	P.O. NO.
CITY: Green Bay — STATE: WI — ZIP: 54307	CONTACT: Bill West	PHONE: 920-434-5036

SAM NO.	NLS LAB. NO.	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	SAMPLE TYPE	GRAB/ COMP.	CONTAINER/PRESERVATIVE B/NP					COLLECTION REMARKS
1.	146019	WE-LS-01	8/20		TIS	G	1			2		FILETS, Analyze as 1 sample
2.	146020	WE-LS-02	8/20				1					"
3.	146021	WE-LS-03	8/20				1					"
4.	146022	WE-LS-04	8/20				1					"
5.	146023	WE-LS-05	8/20				1					"
6.	146024	WE-LS-06	8/20				1					"
7.	146025	WE-LS-07	8/20				1					"
8.	146026	WE-LS-08	8/20				1					"
9.	146027	WE-LS-09	8/20				1					"
		WE-LS-06 Analyze Filets For			Mercury Only							
		WE-LS-09 Analyze Livers For:			Cd, Cr, Cu, Ni, Pb, Zn, Al, Hg, As, Se, Ag, Fe, etc.							
10.	146028	WE-LS-(1-9) Livers	8/20		TIS (Comp)	Comp	1			9 Livers		Analyze as 1 sample

SAMPLE TYPE:
SW = surface water; WW = wastewater; GW = groundwater; DW = drinking water; TIS = tissue; AIR = air; PROD = product; SOIL = soil; SED = sediment; describe others

CONTAINER: P = plastic; G = glass; V = glass vial; B = plastic bag; describe others

PRESERVATIVES & PREPARATION: NP = nothing added; S = sulfuric acid; N = nitric acid; Z = zinc acetate; OH = sodium hydroxide; HA = hydrochloric & ascorbic acid; H = hydrochloric acid; F = field filtered

COLLECTED BY (signatures)	CUSTODY SEAL NO. (IF ANY)	DATE/TIME
Bill West		
RELINQUISHED BY (signature): Bill West	RECEIVED BY (signature)	DATE/TIME: 8/21/97 9am
RELINQUISHED BY (signature)	RECEIVED BY (signature)	DATE/TIME
DISPATCHED BY (signature)	METHOD OF TRANSPORT	DATE/TIME

RECEIVED AT NLS BY (signature)	DATE/TIME	CONDITION	TEMP.
Steven R. Cain	8/21/97 1600		
SEAL INTACT? ☐ YES ☒ NO — SEAL #	REMARKS & OTHER INFORMATION		

INSTRUCTIONS:
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ENVIRONMENTAL COMPLIANCE CONSULTANTS, INC.

P.O. BOX 11417 • GREEN BAY, WI 54307-1417 • 920-434-6380 (VOICE) • 920-434-6381 (FAX)

Environmental Compliance Consultants, Inc.
Memorandum

November 24, 1997

TO: Jana Murphy, Flambeau Mining Company

CC: Jeff Earnshaw, Flambeau Mining Company

FR: Bill West, Environmental Compliance Consultants, Inc. (ECCI)

RE: Summary of Activities, 1997, Macroinvertebrate Collection
Flambeau River, Ladysmith, Wisconsin

Introduction

On September 26, 1997, Bill West of ECCI completed the 1997 macroinvertebrate collection activities for the Flambeau Mine Project. These activities are a requirement of the project's Mining Permit. Three locations, one upstream of the mine discharge locations and two downstream of the discharges, are required to be sampled annually. Sampling locations include the end of Blackberry Lane (upstream), the Flambeau River at the confluence with Meadowbrook Creek and at the site of the former Port Arthur Dam - the latter two sites being downstream sites. Sample site locations are identified in Figure 1. This report describes the collection activities and records observations noted on the day of collection.

Site Conditions

Flows in the river for the period of collection were considered normal, but river height was perhaps slightly below bank stage. Because of the slightly lower water level, collections from Blackberry Lane were, at the time of collection, assumed to collect fewer species which inhabit shoreline vegetation. Blackberry Lane is the only site of the three sites which contains a significant amount of overhanging vegetation. Because of the lower water, this habitat could not be sampled in 1997 at Blackberry Lane.

Methods

Macroinvertebrate samples were collected using a net with an 8 by 18-inch opening and a 800 to 900 micron mesh size. In-stream sampling methods consisted of kick seining.

At each of the three sites, in-stream sampling was conducted for two man-hours. This time window included sorting of collected specimens from debris. Specimens were preserved in 10% formalin.

Once collected and preserved, samples were sent to EA Engineering, Deerbrook, Illinois, for identification and enumeration.

Site-Specific Observations and Conditions

Blackberry Lane

Sampling was initiated at the end of Blackberry Lane at 7:35 a.m. and was terminated at 9:30 a.m. Water temperature at the time of collection was 64°F. Water stage was up to bank stage.

Bank vegetation downstream of the Blackberry Lane access is made up of grass/sedge with a significant amount of overhang at the water edge. This is an excellent habitat from which to collect macroinvertebrates particularly certain beetles, water scorpions, water striders, and damselflies. This habitat was not sampled in 1997 because of the lower water levels.

The substrate of Blackberry Lane is characterized as well washed rock and cobble with gravel filling the interstices.

Meadowbrook Creek

Sampling at Meadowbrook Creek was conducted between the hours of 11:30 and 1:10 p.m. Water temperature at the time of sample collection was 67°F. Water level was bank stage during the time of collection.

The substrate of the Meadowbrook Creek sampling site is characterized as rock/cobble with some boulder. Collections were concentrated in a portion of the Flambeau River immediately above the confluence of the Flambeau River with Meadowbrook Creek.

Port Arthur Dam

Sampling at Port Arthur Dam was conducted from 9:30 a.m. to 11:30. Water temperature at the time of sampling was 64°F. Water level was at bank stage during the time of collection.

The substrate of the Flambeau River at this site is characterized as rock in the four to twelve inch size category.

Results and Discussion

Containers with all collected specimens were sent to EA Engineering for enumeration and identification. Table 1 contains a list of organisms collected during the 1997 sampling event.

Populations of aquatic macroinvertebrates can be seen to vary from site to site and from year to year. In general, populations have remained relatively stable. Individual reports for the years 1994 and 1995 noted the occurrence of natural phenomena, such as severe flooding immediately prior to the sample collection event, which may have caused a decline in relative numbers of organisms collected. There is

no evidence at this time that discharges from the Flambeau Mine treatment facility are having any impact on the macroinvertebrate populations on the Flambeau River.

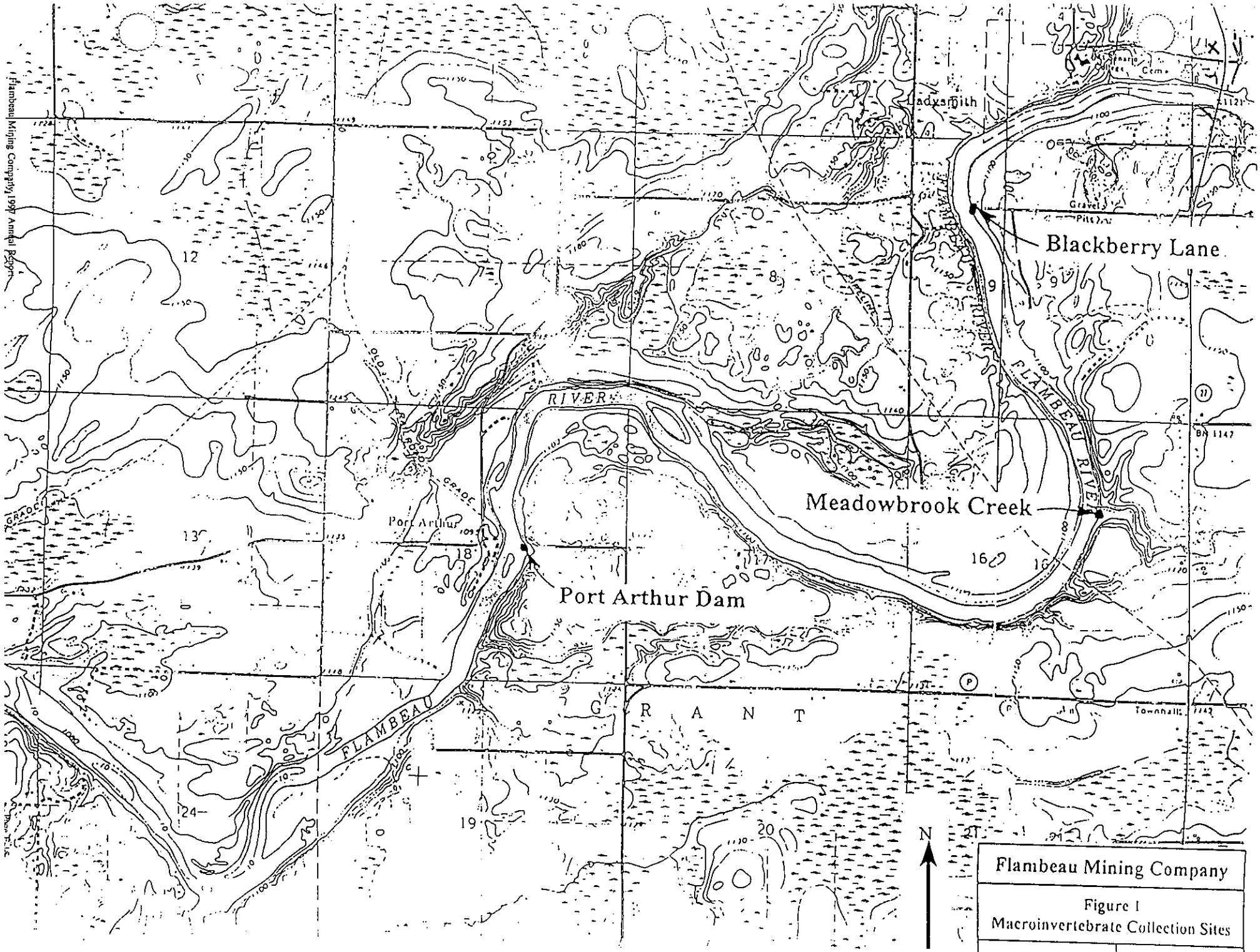


Table 1

Macroinvertebrates Collected From Three Locations Near the Flambeau River Mine Site September 1997

Taxa	Blackberry Lane	Meadowbrook Creek	Port Arthur Dam
Oligochaeta			
Tubificidae	1	4	1
Naididae	1	23	3
Decapoda			
Orconectes rusticus	4	4	5
Amphipoda			
Gammarus sp.	-	17	1
Gastropoda			
Ferrissia sp.	6	27	1
Physella sp.	1	-	-
Pelecypoda			
Elliptio dilatata	1	-	-
Pisidium sp.	-	2	4
Ephemeroptera			
Isonychia (Isonychia) sp.	4	-	1
Anthopotamus verticis	82	292	119
Stenonema sp.	-	-	1
Stenonema femoratum	-	9	6
Stenonema mediopunctatum	6	14	16
Stenonema terminatum	-	6	8
Stenonoma vicarium	2	98	117
Lecrocuta sp.	-	3	14
Baetis flavistriga	8	-	1
Baetis intercalaris	3	-	-

Table 1 (cont.)

Taxa	Blackberry Lane	Meadowbrook Creek	Port Arthur Dam
Ephemeroptera (cont.)			
Acerpenna pygmaea	1	-	-
Centroptilum sp.	-	1	-
Procloeon sp.	1	1	4
Ephemera simulans	-	23	42
Caenis sp.	-	1	-
Choroterpes sp.	-	2	1
Leptophlebia sp.	-	14	3
Odonata			
Argia sp.	-	-	1
Ophiogomphus sp.	4	-	1
Ophiogomphus rupinsulensis	2	-	1
Plecoptera			
Agnetina clymene	26	-	-
Neoperla clymene	30	8	7
Acroneuria abnormis	1	2	4
Perlinella drymo	-	3	2
Megaloptera			
Nigronia serricornis	1	7	12
Hemiptera			
Belostoma flumineum	-	1	-
Metrobates sp.	9	-	-
Rhagovelia sp.	1	-	-
Trepobates sp.	1	-	-
Coleoptera			
Ectopria nervosa	-	2	-
Optioservus fastiditus	-	1	-
Optioservus trivittatus	-	1	-

Table 1 (cont.)

Taxa	Blackberry Lane	Meadowbrook Creek	Port Arthur Dam
Coleoptera (cont.)			
Optioservus sp.	-	1	-
Stenelmis sp.	7	27	1
Tricoptera			
Chimarra obscura	5	1	-
Cheumatopsyche sp.	20	27	7
Ceratopsyche morosa	27	-	3
Macrostemum zebratum	4	-	-
Polycentropus sp.	-	4	3
Orthotrichia sp.	-	1	-
Diptera			
Atherix variegata	1	-	-
Chrysops sp.	-	1	-
Hexatoma sp.	1	6	2
Tipula sp.	-	1	-
Nilothauma sp.	1	-	-
Cricotopus bicinctus grp.	-	1	-
Micropsectra sp.	-	1	-
Epoicocladius sp.	-	2	-
Cricotopus tremulus grp.	-	2	-
Tanytarsus guerlus grp.	-	3	-
Psectrocladuis sp.	-	1	3
Stempellinella sp.	-	1	-
Phaenopsectra sp.	-	3	-
Djalmabatista sp.	1	2	1
Potthastia longimana grp.	-	1	-
Microtendipes pedellus grp.	-	30	3
Stictochironomus sp.	-	8	4
Dicrotendipes neomodestus	1	-	-

Table 1 (cont.)

Taxa	Blackberry Lane	Meadowbrook Creek	Port Arthur Dam
Coleoptera (cont.)			
Cladotanytarsus vandervulpi grp.	-	5	-
Cryptochironomus sp.	-	1	-
Total Taxa	32	48	34

Prepared by: WMW
Checked by: AKM

APPENDIX G

HABITAT CHARACTERIZATION

ENVIRONMENTAL COMPLIANCE CONSULTANTS, INC.
P.O. BOX 11417 • GREEN BAY, WI 54307-1417 • 920-434-6380 (VOICE) • 920-434-6381 (FAX)

Environmental Compliance Consultants, Inc.
Memorandum

November 4, 1997

TO: Jana Murphy, Flambeau Mining Company

CC: Jeff Earnshaw, Flambeau Mining Company

FR: Bill West, Environmental Compliance Consultants, Inc.

RE: Report on 1997 Habitat Characterization, Flambeau River, Ladysmith, Wisconsin

Introduction

On August 18, 1997, Bill West of Environmental Compliance Consultants, Inc.(ECCI), conducted a habitat characterization of the Flambeau River in an area adjacent to the Flambeau Mine site. The purpose of the characterization was to provide an assessment of the habitat in the Flambeau River above and below the mining site and to compare conditions in the river to those documented prior to the initiation of discharges from the mine wastewater treatment plant. Habitat characterization study requirements are described in the mining application (December 1989) and approved pursuant to Docket No. IH-89-14. This report describes the habitat/substrate along the east bank of the Flambeau River from a point 100 yards above Outfall 002 to a point 1000 yards downstream of discharge Outfall 001 (the approximate location of the pipeline crossing).

Methodology

On August 18, 1997, substrates along the east bank of the Flambeau River were noted and characterized. The area of study is identified in Figure 1.

The study was initiated at 2:30 p.m. at Meadowbrook Creek. Stream observations were conducted from Meadowbrook Creek upstream to a point adjacent to the mining site and immediately upstream of Outfall 002. Upon concluding the documentation for the upstream segment, a similar observation was then conducted from Meadowbrook Creek downstream to the pipeline crossing.

The stream assessment from above Outfall 002 to the pipeline crossing was conducted to physically evaluate the condition of the substrate, amount of deposition, if any, and the type of deposition, e.g., particle size of silt or larger.

Summary of Findings

Substrate descriptions were previously documented in a report submitted in January 1993 titled Flambeau Mining Company 1992 Annual Report (Appendix K). Conditions observed in 1997 were similar to the conditions noted in 1992 (Figure 2) except where noted below.

In 1996, a distinct deposit of sediment was observed at the foot of Outfall 002. This deposition was noted to be located at the water/shore interface and appeared to be caused solely by the action of the river. No depositional sediments were observed on the riprap throughout the entirety of Outfall 002 other than at the point where the river traversed the riprap. This condition is indicative of the type of erosional deposition which occurs along the east bank of the river and which has been noted in previous habitat assessments. In 1997, this deposition was less obvious. However, in 1997 there was noted a beginning of a gradual encroachment by indigenous plant communities onto the riprap in the area of the outfall. Therefore, the width of the riprap has noticeably narrowed. Photograph #1 shows the riprap which makes up the upper portion of the approach to Outfall 002. No sediment was observed along the riprap though encroachment by vegetation is shown. Photograph #2 shows the area of Outfall 002 at the point of confluence with the Flambeau River with obvious encroachment by vegetation.

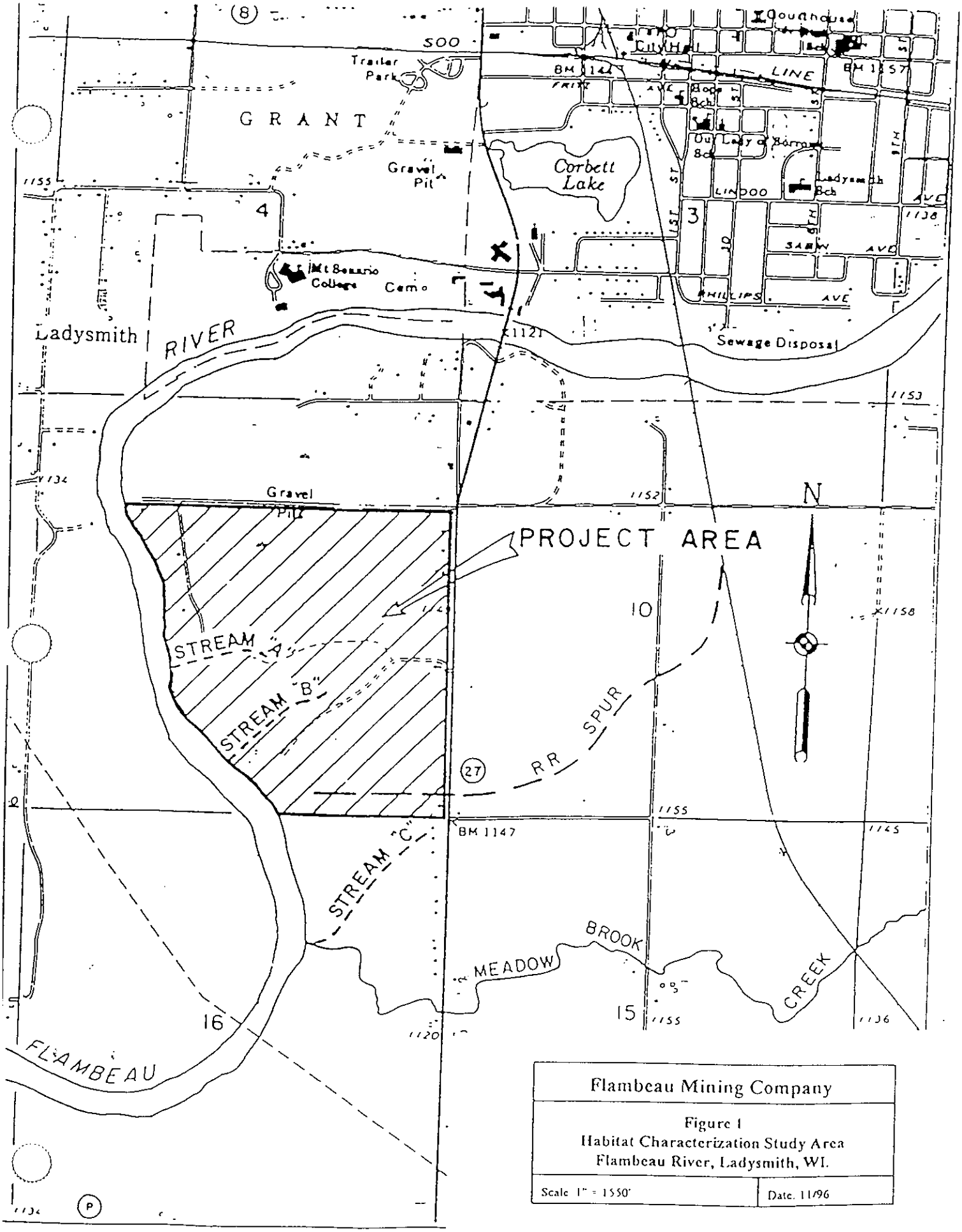
A similar though less amount of deposition was noted at the foot of Outfall 001 in 1996. Little if any deposition at Outfall 001 due to the river was noted in 1997. No deposition at all was observed on the riprap in 1997 from the point of mine effluent emergence at the top of the hill to the discharge point at the confluence with the river. In comparison to Outfall 002, there is more opportunity to keep Outfall 001 clean of river induced deposition because of the flow of treated mine effluent through this outfall.

Photograph #3 shows the point of mine effluent discharge at the top of the hill and a significant portion of the outfall discharge riprap structure. No deposition is obvious along any portion of the discharge route. Photograph #4 shows the submerged portion of the riprap at Outfall 001. No sediment is observed to be deposited in the area of Outfall 001.

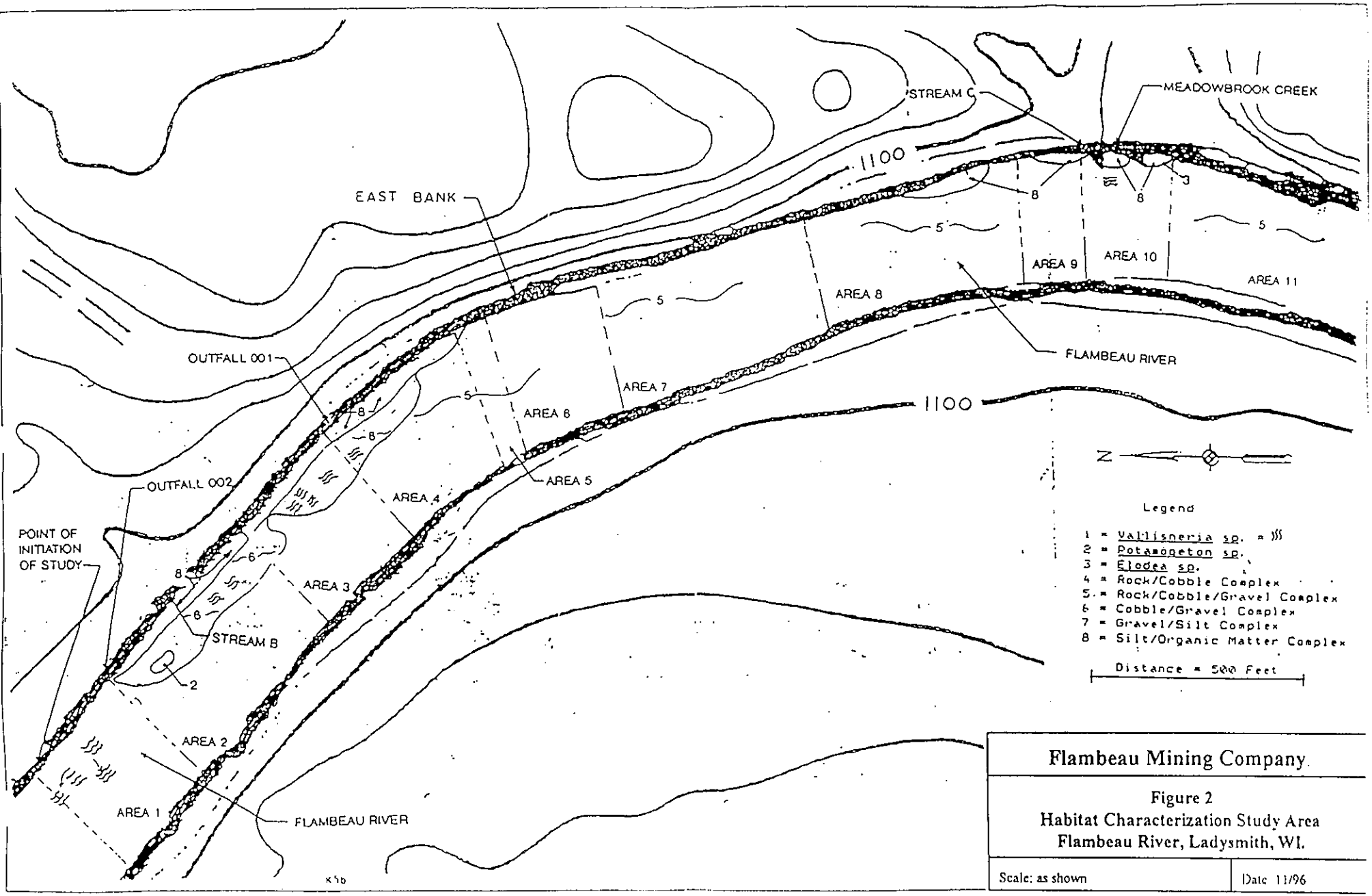
In contrast to previous years, in 1997 no debris or vegetation was observed on overhanging tree branches along the area of observation. This suggests that localized flooding which could impact the flora and fauna of this river had not occurred to the same extent as in the two previous years. Beaver activity is common along this stretch of the river. In 1997, such activity was noted about 100 yards above Meadowbrook Creek. Beaver activity usually results in areas of downed trees, bank erosion, and localized areas in which tree branches accumulate sometimes in association with a shoreline hut. These areas typically are characterized by an increase in sedimentation in and around the branches and hut. Photograph #5 shows the area where logs were dragged down to the river. These drag areas are typically characterized by a two-foot depression along the travel route followed by a depression and erosion area at the river edge. Photograph #6 shows a typical accumulation of tree branches deposited by beaver activity which is in turn becomes an accumulation point for sediment.

Stream C, which discharges at a location immediately upstream of Meadowbrook Creek was observed to be dry. Stream C, which is intermittent, drains an area through the woods from a point in the vicinity of the mine road entrance to Meadowbrook Creek. No sediments were observed along Stream C in an area some 50 yards upstream of the confluence with the Flambeau River.

The river segment from Meadowbrook Creek downstream to the pipeline appeared to be similar in nature as that which was described in the evaluation conducted in 1995 and 1996, with no changes noted.



Flambeau Mining Company	
Figure 1 Habitat Characterization Study Area Flambeau River, Ladysmith, WI.	
Scale 1" = 1550'	Date. 11/96



Flambeau Mining Company

Figure 2
Habitat Characterization Study Area
Flambeau River, Ladysmith, WI.

Scale: as shown | Date 11/96

Photograph 1: View of Upstream Portion of Outfall 002

Photograph 2: View of Outfall 002 at Flambeau River

Photograph 3: View of Outfall 001 Looking Upstream at Origin of Outfall

Photograph 4: View of Outfall 001 at Confluence with Flambeau River

Photograph 5: View of Bank and Erosion Damage Due to Beaver Activity

Photograph 6: View of Accumulation of Debris and Sedimentation Due to Beaver Activity

APPENDIX H

RESULTS OF WETLAND MONITORING EFFORTS FOR 1997

Foth & Van Dyke
engineers · architects · scientists

August 18, 1997

Ms. Jana Murphy
Flambeau Mining Company
N4100 Highway 27
Ladysmith, WI 54848

Dear Ms. Murphy:

Re: Flambeau Project - 1997 Wetland No. 1 Site Visit

On July 15, 1997, Foth & Van Dyke visited the Flambeau Mine site to evaluate the conditions within Wetland No. 1. The purpose of this letter is to document the results of our investigation.

As indicated in the 1995 and 1996 surveys, Wetland No. 1 continues to exhibit wetland characteristics. The site has not changed dramatically since the previous investigations. The soil in the interior portion of the wetland was saturated in the upper 18 inches. The soil moisture was higher than in previous years. However, this can be attributed to the recent rain events and the higher than average precipitation during the month of July. The soil in the outer fringes of the wetland is not fully saturated, and the vegetation remains relatively unchanged. As in previous years, the outer fringes are slowly being invaded by dryer upland species. With the exception of the recent heavy rain, it appears that the drying trend described in the 1995 and 1996 investigations will continue unless mitigation activities are initiated.

It is our opinion that measures be implemented within Wetland No. 1 to mitigate the diverted groundwater seep. A mitigation plan, as outlined in a letter dated August 24, 1995, to Flambeau Mining Company from Tim Weyenberg of Foth & Van Dyke, would supply supplementary water to the surface of the wetland and reverse the drying trend. In addition, the possibility of releasing water from a sedimentation basin to be constructed in the area of the hydric soil stockpile into Wetland No. 1 has been discussed. The use of this water, if feasible, would further mitigate Wetland No. 1, and may reduce the amount of off-site water needed.

BDH\MLD2\97F002\GBAPP\51862.61\5000

2737 South Ridge Road · P.O. Box 19012 · Green Bay, WI 54307-9012 · 414-497-2500 · Fax: 414-497-8516

If you have questions or comments about the mitigation plan or its objectives please call me at (414) 496-6821.

Sincerely,

Foth & Van Dyke

Bradley D. Helmandollar

Bradley D. Helmandollar
Project Biologist

BDH:mld2

cc: Mr. Jim Hutchinson, Foth & Van Dyke
Mr. Jerry Sevick, Foth & Van Dyke
Mr. Tim Weyenberg, Foth & Van Dyke

BDH\MLD2\97F002\GBAPP\51862.61\5000

APPENDIX I

LINER REPAIR DOCUMENTATION

Cooper Engineering Company, Inc.

310 WEST SOUTH STREET • RICE LAKE, WI 54868-2420
TELEPHONE (715) 234-7008 FAX (715) 234-1025

July 24, 1997

Ms. Jana Murphy
Flambeau Mining Company
N4100 Hwy. 27
P.O. Box 166
Ladysmith, WI 54848

Dear Ms. Murphy:

On June 27, 1997, maintenance repairs were made on the HDPE liner material in the surge pond. The repairs were made by GSI, Inc. and witnessed by Craig Walkey, Cooper Engineering Company, Inc. The repair is documented in the attached sketch, photographs, and narrative below:

Description and Repair

On June 26, 1997, six holes and one puncture were discovered at Location #1 at the toe of the first full panel on the west side in the northwest corner. The six holes were grouped within a one square foot area. Each hole was the approximate diameter of a pencil. The puncture was located approximately one foot from the holes.

The damage was located under a dense sand cover during the recent cleaning of the surge pond. The damage is believed to have occurred as a result of auger dredge cleaning of the pond during the summer of 1995.

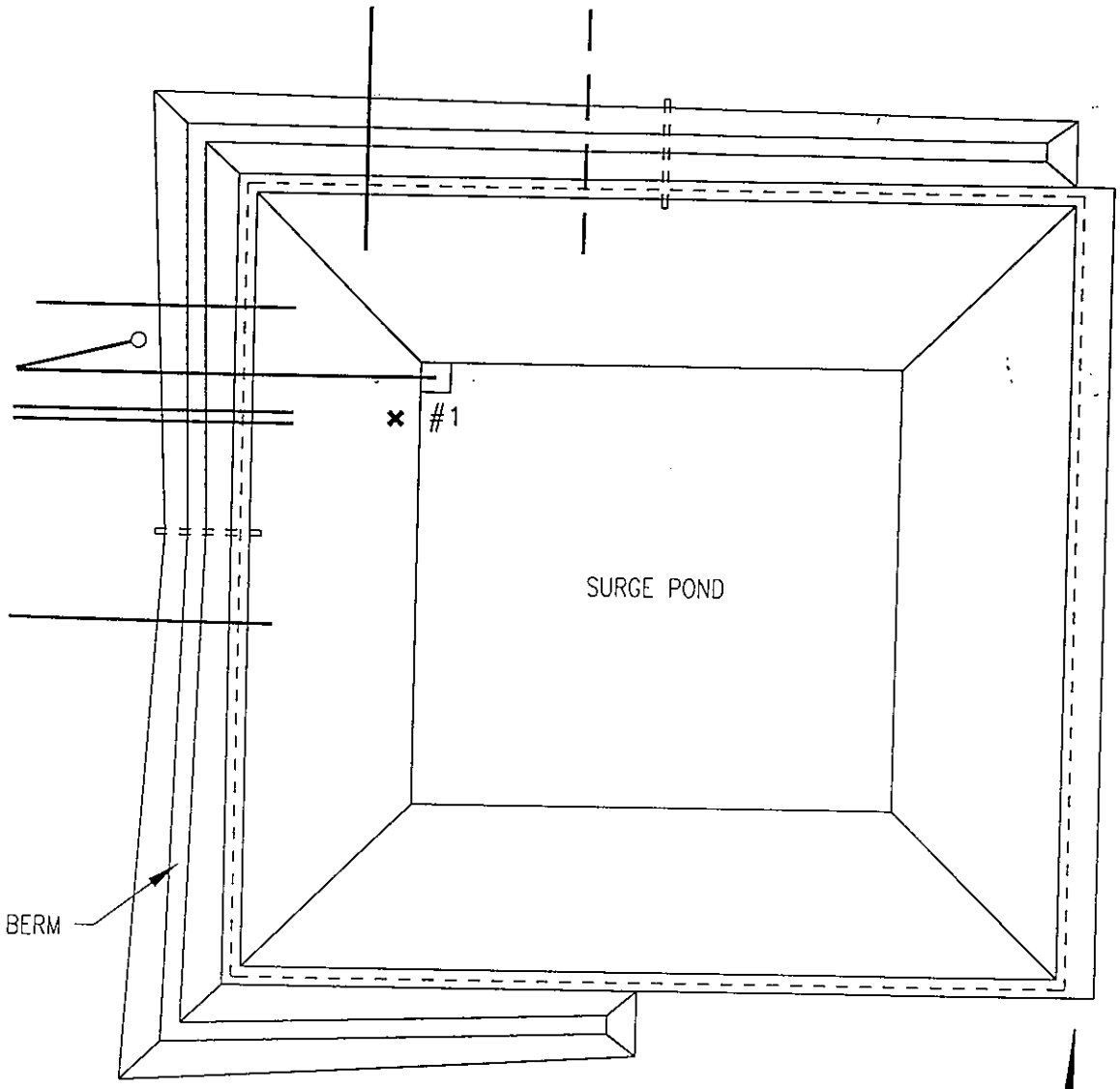
The damaged areas were covered with duct tape until repairs were completed on June 27, 1997.

The holes were prepared with an extrusion welded patch from surplus certified HDPE liner material stored in the building at H&H gate. The puncture was repaired with an extruded partial penetration weld.

Sincerely,

Craig Walkey, P.E.
Vice President

br:CS94081



LEGEND

× = REPAIR LOCATION

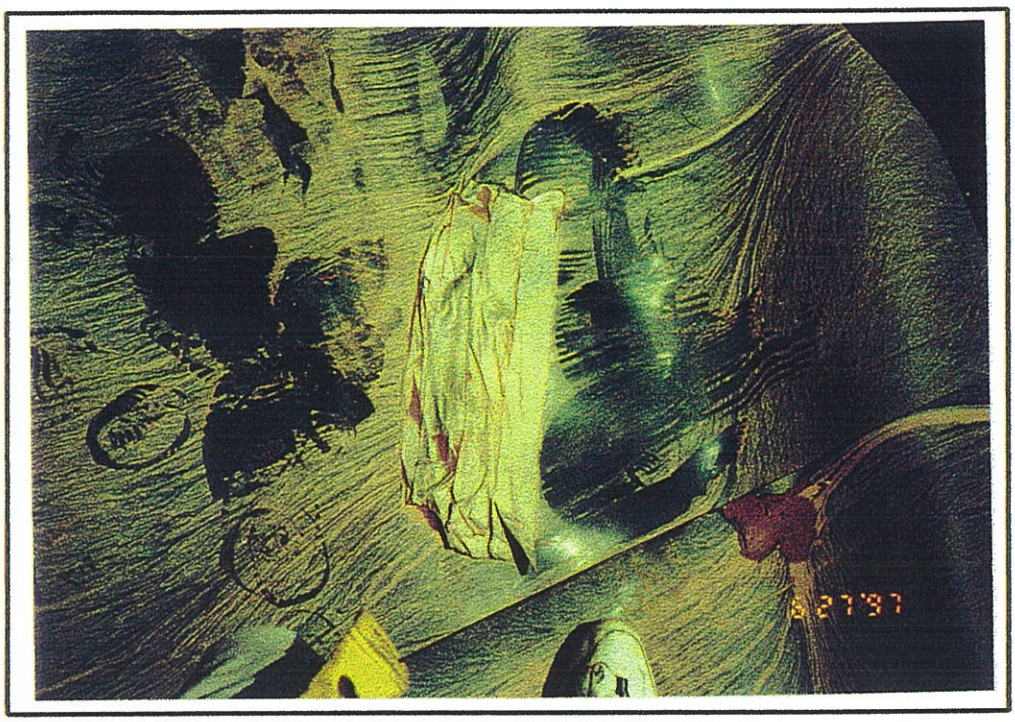
SCALE 1"=50'

SURGE POND INSPECTION
FLAMBEAU MINING COMPANY
JUNE 27, 1997

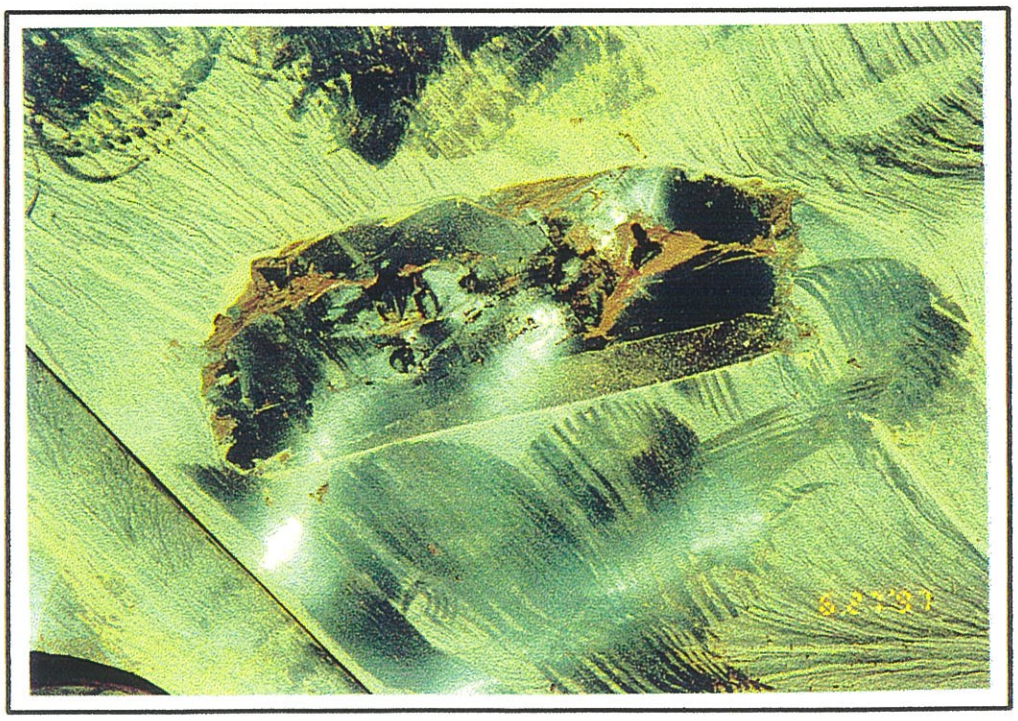
COOPER ENGINEERING COMPANY
310 WEST SOUTH STREET RICE LAKE, WISCONSIN
TELEPHONE 715-234-7006
C:\94-PROJ\94081\SURGE.DWG 7-22-97 MRE

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

SURGE POND LINER REPAIR
JUNE 27, 1997



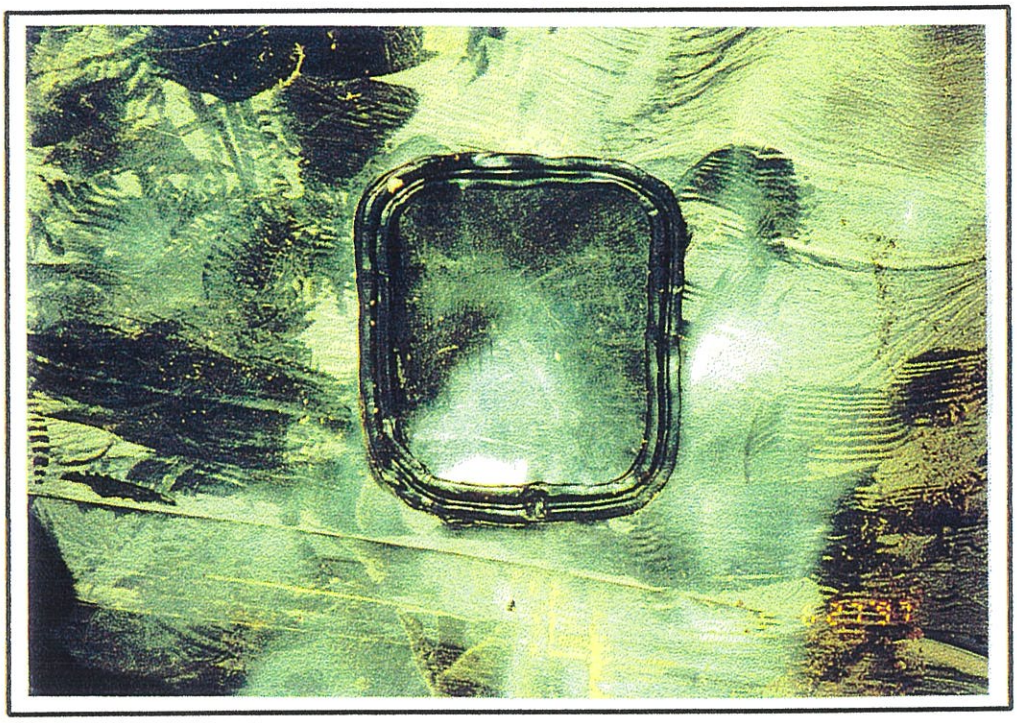
REPAIR LOCATION



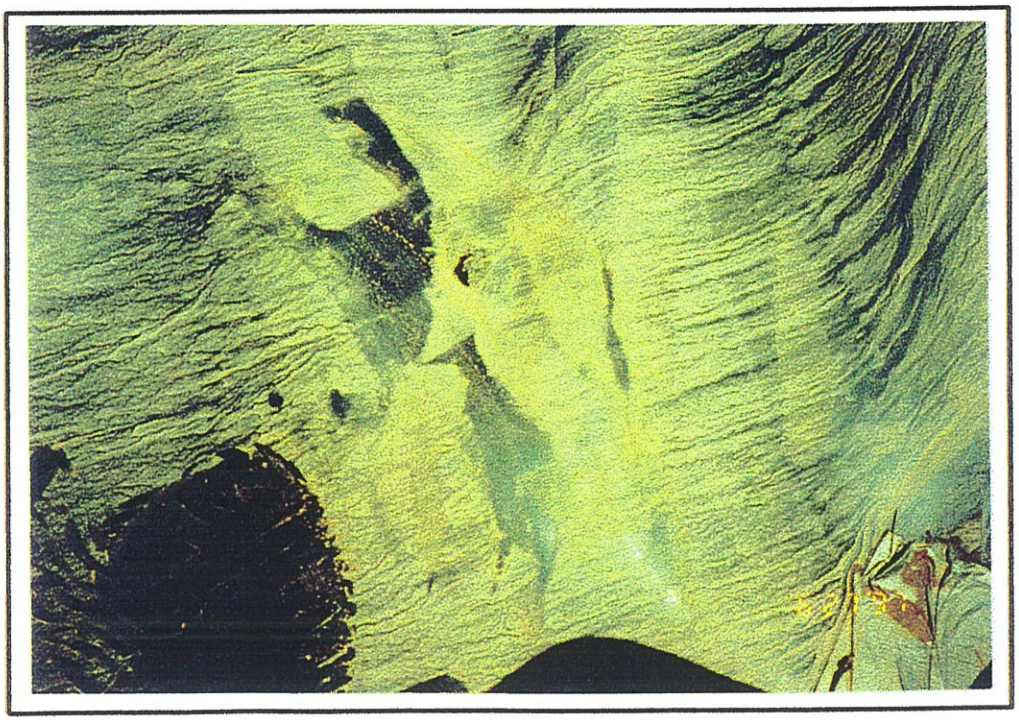
REPAIR LOCATION

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

SURGE POND LINER REPAIR
JUNE 27, 1997



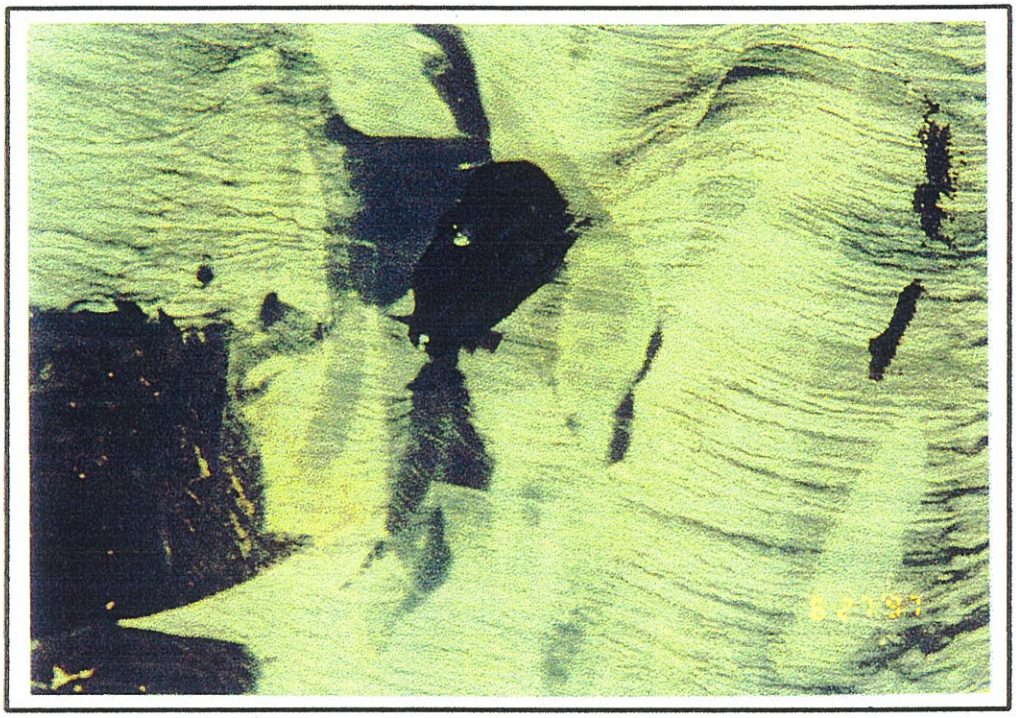
REPAIR PATCH LOCATION



PUNCTURE LOCATION

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

SURGE POND LINER REPAIR
JUNE 27, 1997



PUNCTURE REPAIR

Cooper Engineering Company, Inc.

310 WEST SOUTH STREET • RICE LAKE, WI 54868-2420
TELEPHONE (715) 234-7008 FAX (715) 234-1025

July 24, 1997

Ms. Jana Murphy
Flambeau Mining Company
N4100 Hwy. 27
P.O. Box 166
Ladysmith, WI 54848

Dear Ms. Murphy:

On July 17, 1997, maintenance repairs were made on the HDPE liner material in the run-off pond. The repairs were made by GSI, Inc. and witnessed by Craig Walkey, Cooper Engineering Company, Inc. The repairs were documented in the attached sketch, photographs, and narrative below:

Description and Repair

During the week of July 7, 1997, Flambeau Mine employees cleaned the run-off pond bottom to remove sand accumulation using a hose water jet and hand shovels. Final hose cleaning of the pond bottom revealed random damage to the HDPE liner material as a result of the shovel work. Two (2) locations showed penetration through the HDPE liner material.

Only treated water was used in cleaning the pond, and only treated water puddles remained in the pond until repairs were made on July 17, 1997. Exposed damage was patched with duct tape until final repair was completed.

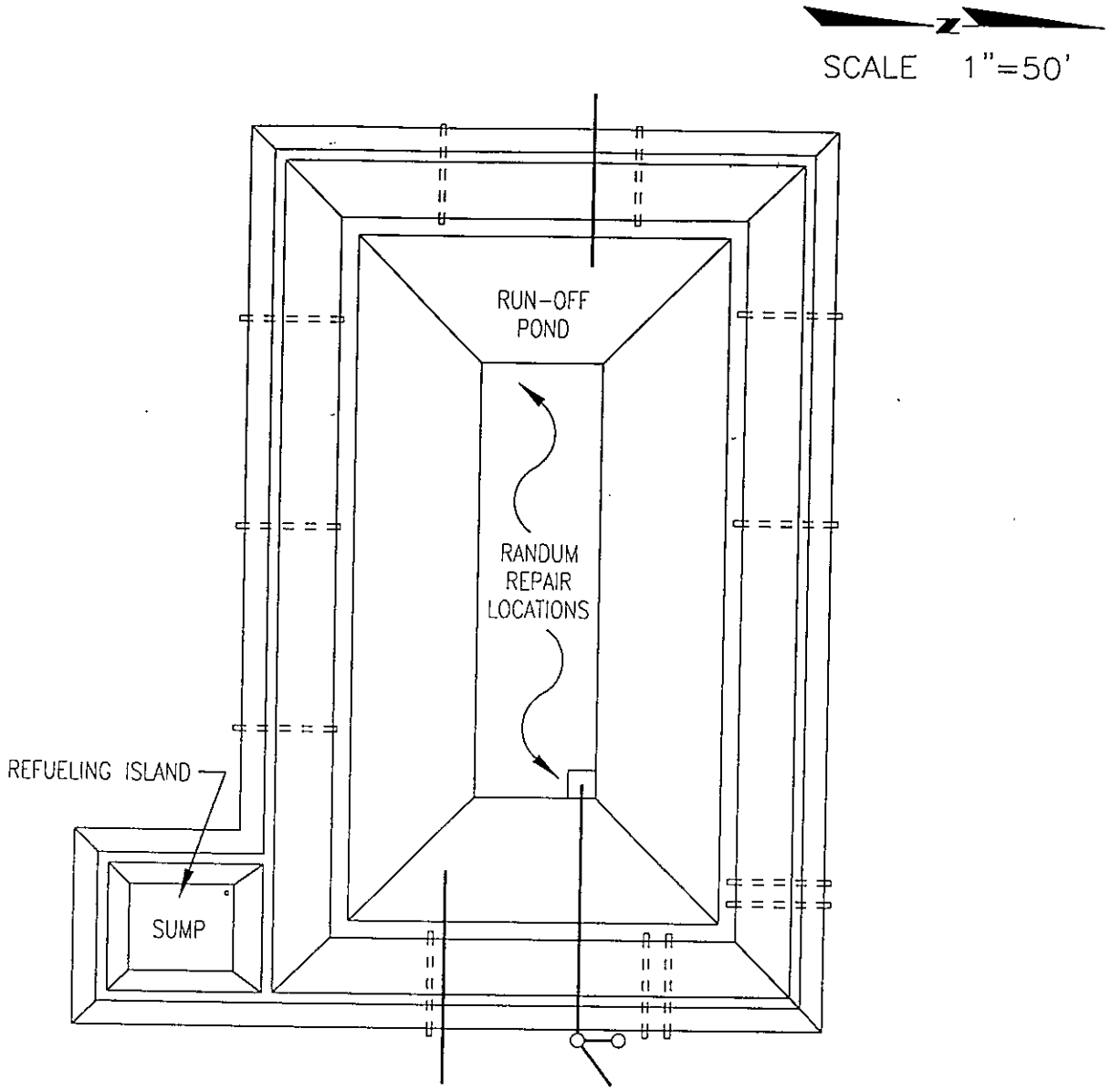
In total, thirty-five (35) "dents" from shovel work on the liner material were identified. Two (2) had penetrated through the HDPE liner material. The damage was at random locations on the pond bottom.

The dents were repaired by cleaning and roughing the area using an electric hand held grinder. The dents were filled with an extruded partial penetration weld.

Sincerely,

Craig Walkey, P.E.
Vice President

br:CS94081



RUN-OFF POND INSPECTION
FLAMBEAU MINING COMPANY
JULY 17, 1997

COOPER ENGINEERING COMPANY
310 WEST SOUTH STREET RICE LAKE, WISCONSIN
TELEPHONE 715-234-7008
C:\94-PROJ\CE94081\RUNOFF2.DWG 7-22-97 MRE

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

RUN–OFF POND REPAIR
JULY 17, 1997

DAMAGE SHOWN IN RED AND WHITE PAINT
CAMERA LOOKING WEST

CAMERA LOOKING EAST

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

RUN–OFF POND REPAIR
JULY 17, 1997

TYPICAL DAMAGE WITH DUCT TAPE PATCH

ELECTRIC GRINDER PREPARATION

FLAMBEAU MINING CO.
LADYSMITH, WISCONSIN

RUN–OFF POND REPAIR
JULY 17, 1997

TYPICAL WELD REPAIR