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REPORT

Environmental Impact Report for the Kennecott Flambeau Project

Scope I.D.: 87K10

Volume II - Report Narrative

Kennecott Minerals Company
Ladysmith, Wisconsin

April 1989

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VOLUME 2
ENVIRONMENTAL IMPACT REPORT
FOR THE
KENNECOTT FLAMBEAU PROJECT



Gerald W. Sevick
4/1/89

Prepared for:

KENNECOTT MINERALS COMPANY

Prepared by:

FOTH & VAN DYKE and Associates Inc.
and Contributors
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012

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Foth & Van Dyke
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
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3.7 Surface Water and Bottom Sediments of the Flambeau River

3.7.1 Field and Laboratory Methods

3.7.1.1 Flow Measurements

Published flow data exist for the Flambeau River Basin from the year 1951 through September 1987 (Holmstrom, *et al.* 1988). The United States Geological Survey (USGS) gaging station nearest to the project area is located 2.5 miles downstream from the Thornapple Dam. This station, identified as No. 05360500, is located a total of approximately nine river miles below the proposed project area. Unpublished flow data were obtained from the USGS for the water year October 1987 through September 1988. This period coincides with the months in which surface water monitoring was conducted by Foth & Van Dyke.

3.7.1.2 Bottom Sediments Sampling

3.7.1.2.1 Site Selection

The purpose of sediment analysis was to establish a point of reference for background concentrations of selected chemical parameters. The Wisconsin Department of Natural Resources (WDNR) approved the proposed parameters, which were selected based on their pertinence to the project.

Little to no fine-grained river-bottom sediment was found in the vicinity of the project area, due to the nature of the river bottom, the natural scouring action of the river, and increased scouring due to the removal (in 1968) of Port Arthur Dam, formerly located about 2.5 miles downstream of the project area. Two sediment samples were taken using a polyvinyl chloride (PVC) tube core sampler--one from each sampling location upstream and downstream of the project area (Figure No. 3.7-1). The results of laboratory analysis of these samples, shown on Table No. 3.7-1, indicate no significant difference between the upstream and downstream samples.

In order to obtain additional quantitative sediment samples, it was decided to establish sampling sites in the impoundment above the Thornapple Dam. Figure No. 3.7-2 identifies six sediment sample site locations within the Thornapple Dam impoundment. Data from these sediment analyses appear in Table No. 3.7-2.

3.7.1.2.2 Treatment of Sediment Samples

Sediment samples were scheduled to be taken as a cross-section of the impoundment; however, during field investigations it was found that sites FL-4 through FL-6 contained no appreciable thickness of sediment. Consequently, samples could only be

TABLE NO. 3.7-1

Bottom Sediment Analytical Data
(Surface Water Sampling Sites)

Sampling Date: 8/9/88

Parameter	Units	Upstream Sediment	Downstream Sediment
	(Dry Weight)		
Arsenic	ug/g	0.9	1.1
Cadmium	ug/g	<0.5	<0.5
Chromium	ug/g	5.5	4.8
Copper	ug/g	2.8	2.6
Iron	ug/g	3000	2200
Lead	ug/g	<4.5	<4.5
Manganese	ug/g	130	63
Mercury	ug/g*	<0.10	<0.09
Zinc	ug/g	16	28
Total Solids	%	85	69
Total Sulfur	%	0.11	0.19

*Reported as ug/g as received

TABLE NO. 3.7-2

Bottom Sediment Analytical Data
(Thornapple Dam Impoundment)

Sampling Date: 3/1/88

Parameters	Units	Sample I.D. 1-1	1-2	2-1	2-2	3-1	3-2
	(Dry Weight)						
Arsenic	ug/g	4.8	8.5	5.3	6.0	3.7	4.2
Cadmium	ug/g	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	ug/g	11	13	9.8	13	11	7.9
Copper	ug/g	17	29	18	25	16	14
Iron	ug/g	8800	13,000	12,000	13,000	12,000	9,000
Lead	ug/g	22	26	18	28	20	12
Manganese	ug/g	260	380	410	500	480	230
Mercury	ug/g	0.15	0.41	0.16	0.24	0.22	0.26
Total Solids	%	62	50	54	46	50	64
Total Sulfur	ug/g	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Zinc	ug/g	58	85	77	82	69	58

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collected from sites FL-1 through FL-3. Figure Nos. 3.7-3, 3.7-4, and 3.7-5 identify the core samples that were taken and how they were composited to make the sediment samples. Three, two, and three cores were taken at sites FL-1, FL-2, and FL-3 respectively. All cores for each site were divided into soft and stiff sediment samples. All site, core, and lab identification codes are listed in Table No. 3.7-3 to facilitate tracking information on individual sites.

3.7.1.3 Surface Water Sampling

3.7.1.3.1 Site Selection

Two Flambeau River surface water sampling site locations are identified on Figure No. 3.7-1. The upstream sampling site, at the end of Blackberry Lane, provides background data on the Flambeau River. The second sampling site, located approximately 2.5 miles downstream of the project area, allows assessment of water quality downstream of the project area.

3.7.1.3.2 Parameters Tested & Field Methodology

Forty-three physical and chemical parameters were evaluated both upstream and downstream of the proposed project area. As was the case for bottom sediments, the WDNR approved the proposed parameters, which were selected based on their pertinence to the project. The purpose of this testing was to establish a baseline concentration for each of these parameters prior to the commencement of mining activities.

The list of parameters which were evaluated is found in Table No. 3.7-4. This list includes pertinent field information such as preservatives used, sample volume required, and holding times.

Samples from each of the two sites were collected once each month for twelve consecutive months--October 1987 through September 1988. Samples were taken at about the same time and date each month. Three grab samples were composited to form each site sample according to the following methodology: one-third of each sample originated from the mid-stream channel, one-third originated at a point one-third the distance from the east shore to the river center and the last one-third of the sample originated from the point one-third the distance from the west shore to the river center. Samples were collected at mid-depth using a nonmetallic Kemmerer sampler and/or a glass one-liter graduated cylinder, and were composited, split and preserved in the field.

3.7.1.4 Quality Assurance/Quality Control Procedures

Procedures for maintaining quality control/quality assurance during sample collection and analysis are described in the following paragraphs. Site selection, field methodology,

TABLE NO. 3.7-3

Site, Core, and Lab Identification Codes
Used for Compositing Core Samples

Site Code	Core	Lab ID Code[1]
F-1	1A 1B 1E 1G	1-1
F-1	1C 1D 1F 1H	1-2
F-2	2A 2B 2C 2D 2E 2F	2-1
F-2	2D 2G	2-2
F-3	3A 3C	3-1
F-3	3B 3E	3-2

[1]The collected sediment cores were divided into soft and stiff sediment fractions. The soft fractions were in the upper section of each core, with the stiff fractions being in the lower section. Samples 1-1, 2-1, and 3-1 correspond to the soft fractions. Samples 1-2, 2-2, and 3-2 correspond to the stiff fractions.

TABLE NO. 3.7-4

Analytical Parameters for Surface Water Samples

Parameters	Sample Volume (mL)	Preservatives	Maximum Allowable Holding Time
Alkalinity, Total	100	Cool 4°C	14 Days
Aluminum	50	HNO3	6 Months
Arsenic	200	HNO3	6 Months
Barium	100	HNO3	6 Months
Beryllium	50	HNO3	6 Months
B.O.D.	1,000	Cool 4°C	48 Hours
Cadmium	50	HNO3	6 Months
Calcium	50	HNO3	6 Months
Carbon, total Organic	50	H2SO4	28 Days
Chloride	100	NA	28 Days
Chlorophyll-a	1,000	Field Filter	NA
Chromium, Hexavalent	100	Cool 4°C	24 Hours
Chromium, Total	50	HNO3	6 Months
Cobalt	50	HNO3	6 Months
Copper	50	HNO3	6 Months
C.O.D.	50	H2SO4	28 Days
Fluoride	100	NA	28 Days
Hardness, Total	100	HNO3	6 Months
Iron	50	HNO3	6 Months
Lead	50	HNO3	6 Months
Magnesium	50	HNO3	6 Months
Manganese	50	HNO3	6 Months
Mercury	500	HNO3	28 Days
Molybdenum	50	HNO3	6 Months
Nickel	50	HNO3	6 Months
Nitrogen, Ammonia	500	H2SO4	28 Days
Nitrogen, Nitrate/Nitrite	100	Cool 4°C+H2SO4	28 Days

TABLE NO. 3.7-4 (Cont.)

Parameters	Sample Volume (mL)	Preservatives	Maximum Allowable Holding Time
Nitrogen, Total Kjeldahl	1,000	H2SO4	28 Days
Oxygen, Dissolved	NA	NA	Field
pH (Field)	NA	NA	Field
Selenium	500	HNO3	6 Months
Silver	50	HNO3	6 Months
Sodium	50	HNO3	6 Months
Solids, Total Dissolved	100	Cool 4°C	48 Hours
Solids, Total Suspended	500	Cool 4°	7 Days
Spec. Cond. (Field)	NA	NA	Field
Sulfate	100	Cool 4°	28 Days
Temperature (Field)	NA	NA	Field
Thallium	50	HNO3	6 Months
Tin	50	HNO3	6 Months
Titanium	50	HNO3	6 Months
Uranium	200	HNO3	6 Months
Zinc	50	HNO3	6 Months

NA = Not Applicable.

parameters to be analyzed, number of split samples, and necessary data detection limits were decided upon prior to the start of sample collection.

3.7.1.4.1 Quality Control During Sediment Sample Collection

A two-inch-diameter polyvinyl chloride tube was used to collect core samples, as this sampler would not bias the metal analyses. Core samples brought to the surface were placed into glass containers as diagrammed in Figure Nos. 3.7-3, 3.7-4, and 3.7-5. Stiff sediments were removed from the sampling apparatus with a fitted plunger. The sampler and plunger were rinsed with de-ionized water between samples. River water in the sampler tube was removed by displacement during the collection process.

3.7.1.4.2 Quality Control During Surface Water Sample Collection

Methodology for surface water sample collection is found in Section 3.7.1.3. Samples, including field blanks, were preserved in the field as indicated in Table No. 3.7-4. The blanks taken for October and November were trip blanks. Separate collection vessels were used for upstream and downstream samples. The blanks for samples taken from December 1987 through September 1988 were field blanks. Collection vessels were rinsed twice with deionized water between collection of upstream and downstream samples. The first rinse was discarded. The second rinse was saved as the field blank. Trip blanks or field blanks accompanied all samples from the field.

Surface water samples were split with the WDNR on a quarterly basis. Data generated by the WDNR from this split sample program showed good correlation with data generated by Foth & Van Dyke's laboratories. While the data were not identical, the differences were well within expected deviations for laboratory data.

3.7.1.4.3 Analytical Quality Control

All samples were analyzed by Wisconsin-certified laboratories, with the exception of the parameter uranium. Analyses for uranium were conducted by a laboratory certified by the U.S. Environmental Protection Agency (USEPA). Laboratory quality control procedures (ORTEK, 1988) were followed as established in Natural Resources Code NR 149.

Methodologies used to determine detection limits of various chemical parameters were implemented according to USEPA standards (Federal Register, 1984). Prior to any analytical work, the WDNR was requested to provide input as to the desired

level of detection necessary for each parameter. As a result, requirements for base levels of detection were established for chemical parameters to be tested for the Kennecott baseline monitoring project.

3.7.2 Regional Hydrologic Characterizations

3.7.2.1 Drainage Basin

The Flambeau River, which has a drainage area of 1,838 square miles, flows generally southwestward and is contained in the Upper Chippewa River Basin. The project area adjoins a 1.5-mile long segment of the Flambeau River. The project area is located approximately 15 miles above the confluence of the Flambeau with the Chippewa River. The Flambeau River is contained in a well-defined river bed. Since the removal of Port Arthur Dam, flood waters of the river have risen only to the normal pre-1968 river stage.

Water received within the area as precipitation is discharged from the area as runoff, groundwater recharge, and evapotranspiration. The effect of human activity on the water budget is negligible (Young and Hindall, 1972).

A general hydrologic budget for the Chippewa/Flambeau River Basin is contained in the Hydrologic Investigations Atlas (Young and Hindall, 1972). A discussion of the hydrologic budget, including precipitation, runoff, and evapotranspiration, is included in the following paragraphs.

3.7.2.2 Precipitation

The average annual precipitation for the Chippewa/Flambeau Basin is 31.2 inches, with extremes within the basin ranging from 21.3 to 45.1 inches. Average annual precipitation in the Ladysmith area is about 31 inches (Young and Hindall, 1972).

3.7.2.3 Runoff

Total runoff in the Flambeau Basin ranges from about 10 to 13 inches annually. Approximately eleven inches are estimated for the Ladysmith area. Of this, a base flow analysis of streamflow hydrographs performed by Foth & Van Dyke (Groundwater Section, Appendix 3.6-E) indicates that approximately 25 percent is surface water runoff and 75 percent is groundwater runoff.

3.7.2.4 Evapotranspiration

Evapotranspiration comprises water that is lost due to evaporation from soil, plants, and water surfaces, as well as water lost through transpiration by plants. Approximately 20 inches annually is estimated lost in the Flambeau Basin due to evapotranspiration (Young and Hindall, 1972).

3.7.2.5 Surface Water Use

The principal uses of the Flambeau River are for power generation, disposal of treated municipal and paper mill wastewater, recreation, and wild and domestic animal use. Overall industrial use tends to be nonconsumptive, returning used water to the river. In Rusk County, the river is not used for domestic water supplies or for commercial navigation (McKersie, *et al.* 1970). Opportunities for fishing and boating are available and, with the creation of several impoundments, several camping areas have opened up in these areas.

3.7.3 Hydrologic Characteristics of the Project Site

3.7.3.1 Flambeau River

The Flambeau River is the largest tributary of the Chippewa River. River flow past the project area is unimpeded by impoundments; the nearest dams are the Thornapple Dam located approximately 9 river miles below the proposed mine site, and the Ladysmith Dam located approximately 3.8 river miles above.

The Flambeau River is a 350-foot wide, meandering, low-gradient stream. The gradient of the Flambeau past the project area is approximately three feet per mile.

River flow records are have been obtained for a 36-year period through 1987 from the U.S. Geological Survey's Thornapple gaging station. Average river discharge is 1,855 cubic feet per second (cfs). The recorded extremes were 17,600 cfs in April 1986 and 100 cfs in August 1957. The seven-day ten-year low flow value (Q7,10) established for the Flambeau River in the area affected by proposed mining activities is 435 cfs (Holmstrom, 1979).

Instantaneous river flows at Ladysmith and the project area are influenced by rainfall and the operation of several power plants upstream from the project area--especially the Dairyland Dam REA Cooperative. Daily fluctuations of several feet at the project area accompany surges of power generation at Dairyland Dam and at Ladysmith Dam, located in Ladysmith.

Prior to 1969, the average water level adjacent to the project area was 1,094 feet above mean sea level (MSL) (BCMC, 1974). Due to the removal of Port Arthur Dam, the highest measured water level at the mine site since 1969 has been 1,091 feet MSL. A field inspection by the WDNR in 1973 indicated an average water level adjacent to the mine site of 1,085 feet MSL, and a normal high-water level of 1,086 feet MSL (BCMC, 1974).

3.7.3.2 Tributary Streams

3.7.3.2.1 Intermittent Tributaries to the Flambeau River

The study area contains three small intermittent streams which drain into the Flambeau. The locations of these intermittent streams, identified as A through C, are shown on Figure No. 3.7-6. Primary flow which occurs in intermittent streams A, B, and C are the result of rain events which surcharge wetlands feeding to the streams.

The removal of the Port Arthur Dam has resulted in renewed downcutting and bank erosion at the mouths of intermittent Streams A, B, and C. This has occurred as streams have adjusted to the new lower base water level.

3.7.3.2.2 Continuous-Flow Tributaries of The Flambeau River

The only continuous-flow tributary stream in the vicinity of the project area is Meadowbrook Creek. Wetlands draining to this creek lie south of the proposed project area. Flow of Meadowbrook Creek is east to west about one-half mile south of the project area.

3.7.3.3 Ponds and Wetlands

A study was conducted by Foth and Van Dyke in 1988 to assess pond and wetland resources in and around the Kennecott project area. This study is included as the Wetlands Inventory and Assessment, which is included as Appendix 3.8-C to Section 3.8 - Aquatic Biology. For a full discussion of surface waters and wetlands within the mining site, refer to Appendix 3.8-C.

3.7.3.4 Floodplains

A flood insurance study (USDHUD, 1978) was completed by the USGS for the Ladysmith area in 1978. This investigation defines the 100-year floodplain within the corporate boundaries of Ladysmith.

A study was initiated in March 1988 by Foth & Van Dyke to establish a 100-year flood elevation for the reach of the Flambeau River adjoining the project area. Using the flood insurance study as background, four additional cross-sectional transects were added to the model, extending the study about 2,500 feet downstream below the project area. Completion of modeling and contour verification took place in October 1988. The new elevation, established at 1095.4 feet MSL at the mine site, is within 1.5 feet above the average water level which occurred prior to the removal of the Port Arthur Dam. Appendix 3.7-A (Flambeau River Flood Study) details the methodology used to derive the 100-year flood elevation.

3.7.3.5 Water Quality

3.7.3.5.1 Presentation of Data - Surface Water

More than one thousand data points were obtained for evaluation during the one year sampling period. These data are presented in Table No. 3.7-5.

During the tabulation of the data, some anomalous data points were detected and were deleted from the data base. Overall, deletion of data due to suspect results accounted for less than four percent of the total data available. Results below detection limits were assigned a value of zero. Three broad categories of anomalous data were identified during review of the data:

1) Nonrepresentative samples
2) Contaminated blanks
3) Floating detection limits

Nonrepresentative Samples: The occurrence of nonrepresentative samples only happened once. This sample was taken downstream of the project area on January 6, 1988. Ice conditions did not allow collection of the sample according to established methodology. In an attempt to obtain a representative sample, bottom sediments were inadvertently disturbed and included in the aliquot. Consequently, this sample has been deleted from the data set and was not used in calculations of range and average concentration of parameters.

Contaminated Blanks: Certain field or trip blanks were reported by the analytical laboratory to contain the analyte of interest in concentrations that were sufficiently high to make the river analyses suspect. In some cases the reported concentration for a field blank exceeded concentrations of the analyte in one or both of the two corresponding river samples. These samples were deleted from the data set unless a satisfactory explanation of the results was found. This procedure was followed even for those cases in which the river samples were not obviously affected by possible contamination. Results deleted from calculations because of suspected contamination are identified on Table No. 3.7-5.

Floating Detection Limits: Upon review of the analytical data, it became apparent that detection limits were not consistent for some given analytes over the entire study period. There were basically two reasons for inconsistent detection limits. At the beginning of the study, several labs were performing various portions of the analysis; however, as the study progressed, work was consolidated under fewer labs. Second, analytical methodology and/or instrumentation was changed during the study period so as to obtain better detection limits. However,

TABLE NO. 3.7-5

Analytical Results of Surface Water Sampling - Flambeau River

SAMPLING DATE	TOTAL ALKALINITY mg/l as CaCo3			ALUMINUM mg/l			ARSENIC mg/l			BARIUM mg/l			BERYLLIUM mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	43	43	11	0.066	0.042	0.022	<0.005	<0.005	<0.005	<1	<1	<1	<0.001	<0.001	<0.001
11/04/87	53	53	<10	0.074	0.058	0.013	<0.005	<0.005	<0.005	<0.50	<0.50	<0.05	<0.001	<0.001	<0.001
12/02/87	32	32	<10	(b)	(b)	(b)	<0.005	<0.005	<0.005	<0.50	<0.50	<0.50	<0.001	<0.001	<0.001
1/06/88	50	(a)	<10	0.111	(a)		<0.005	(a)		<0.50	(a)		<0.001	(a)	
2/03/88	50	50	<10	0.045	0.049	<0.011	<0.005	<0.005	<0.005	<0.50	<0.50	<0.50	0.001	<0.001	<0.001
3/01/88	(b)	(b)	(b)	0.074	0.044	0.012	<0.005	<0.005	<0.005	<0.50	<0.50	<0.50	<0.001	<0.001	<0.001
4/08/88	30	30	<10				<0.005	<0.005	<0.005						
5/05/88	31	31	<10				<0.005	<0.005	<0.005						
6/02/88	27	36	<10				<0.005	<0.005	<0.005						
7/07/88	57	43	14				<0.005	<0.005	<0.005						
8/09/88	48	48	<10				<0.005	<0.005	<0.005						
9/08/88	60	60	<10				<0.005	<0.005	<0.005						
AVERAGE	44	43	2.3	0.074	0.050	0.012	0.000	0.000	0.000	0.0	0.0	0.0	0.000	0.000	0.000
MINIMUM	27	30	<10	0.045	0.042	<0.011	<0.005	<0.005	<0.005	<0.5	<0.5	<0.5	<0.001	<0.001	<0.001
MAXIMUM	60	60	14	0.111	0.058	0.022	<0.005	<0.005	<0.005	<1	<1	<1	0.001	<0.001	<0.001

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	BOD mg/l			CADMIUM mg/l			CALCIUM mg/l			CHLORIDE mg/l			CHLOROPHYLL-a mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	<6	<6	<6	<0.0010	<0.0010	<0.0010	16.0	17.0	0.2	(b)	(b)	(b)	0.005	0.004	
11/04/87	<6	<6	<6	<0.0010	<0.0010	<0.0010	16.0	15.0	<0.2	5.0	5.0	<1	0.002	0.003	<0.001
12/02/87				<0.0010	<0.0010	<0.0010	14.0	13.0	<0.2	(b)	(b)	(b)	<0.001	<0.001	<0.001
1/06/88	9	(a)		<0.0010	(a)	<0.0010	15.0	(a)		7.0	(a)	<1	<0.001	(a)	
2/03/88	<10	<10	<6	(b)	(b)	(b)	15.0	16.0	<0.2	7.0	6.0	<1	<0.001	<0.001	<0.001
3/01/88	<6	<6	<6	(b)	(b)	(b)	16.0	16.0	<0.5	7.0	8.0	<2	<0.001	<0.001	<0.001
4/08/88				<0.0003	<0.0003	<0.0003	9.9	11.0	<0.5	2.0	3.0	<2	0.001	<0.001	<0.001
5/05/88				(b)	(b)	(b)	13.0	12.0	<0.2	2.7	3.4	<2	0.001	<0.001	<0.001
6/02/88				<0.0003	<0.0003	<0.0003	15.0	16.0	<0.5	5.0	5.0	<2	0.003	0.010	<0.001
7/07/88				<0.0003	<0.0003	<0.0003	14.0	16.0	<0.5	8.0	7.0	<2	0.005	0.009	<0.001
8/09/88				(b)	(b)	(b)	17.0	16.0	<0.5	9.0	9.0	<2	0.012	0.007	<0.001
9/08/88				<0.0003	<0.0003	<0.0003	14.0	19.0	0.7	7.0	7.0	<2	0.003	0.003	<0.001
AVERAGE	1.8	0	0	0.0000	0.0000	0.0000	15.0	15.0	0.0	6.0	5.9	0	0.003	0.004	0.000
MINIMUM	<6	<6	<6	<0.0003	<0.0003	<0.0003	9.9	11.0	<0.2	2.0	3.0	<1	<0.001	<0.001	<0.001
MAXIMUM	9	<10	<6	<0.0010	<0.0010	<0.0010	17.0	19.0	0.7	9.0	9.0	<2	0.012	0.010	<0.001

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	HEXAVALENT CHROMIUM mg/l			TOTAL CHROMIUM mg/l			COBALT mg/l			COPPER mg/l			C.O.D. mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	(b)	(b)	(b)	20	15	<5
11/04/87	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	35	35	5
12/02/87	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	35	35	10
1/06/88	<0.05	(a)		<0.005	(a)		<0.05	(a)	<0.05	<0.005	(a)		40	(a)	5
2/03/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	0.030	0.011	0.008	30	20	5
3/01/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	(b)	(b)	(b)	10	10	<5
4/08/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				0.009	0.013	0.007			
5/05/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				<0.010	<0.010	<0.010			
6/02/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				<0.010	<0.010	<0.010			
7/07/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				<0.010	<0.010	<0.010			
8/09/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				(b)	(b)	(b)			
9/08/88	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005				<0.010	<0.010	<0.010			
AVERAGE	0.00	0.00	0.00	0.000	0.000	0.000	0.00	0.00	0.00	<0.005	<0.005	<0.005	28	23	<5
MINIMUM	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	10	10	<5
MAXIMUM	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	0.030	0.013	0.008	40	35	10

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	FLUORIDE mg/l			TOTAL HARDNESS mg/l			IRON mg/l			LEAD mg/l			MAGNESIUM mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	0.2	0.1	<0.1	37	37	<2	0.20	0.16	<0.10	<0.005	<0.005	<0.005	4.1	4.3	0.07
11/04/87	0.1	0.1	<0.1	58	58	<2	0.39	0.33	<0.10	<0.005	<0.005	<0.005	4.3	4.0	<0.05
12/02/87	0.1	0.1	<0.1	49	49	<2	0.41	0.42	<0.10	<0.005	<0.005	<0.005	3.8	3.7	<0.05
1/06/88	0.2	(a)	<0.1	50	(a)	<2	0.45	(a)		<0.005	(a)	<0.005	4.2	(a)	
2/03/88	0.2	0.2	<0.1	60	60	<2	0.47	0.47	<0.10	<0.005	<0.005	<0.005	4.1	4.1	<0.05
3/01/88	0.2	0.2	<0.1	60	60	<2	0.51	0.54	<0.10	<0.005	<0.005	<0.005	4.1	4.2	<0.05
4/08/88	0.2	0.2	<0.1	40	40	<2				<0.005	<0.005	<0.005	2.9	3.1	<0.05
5/05/88	0.1	<0.1	<0.1	43	41	<2				<0.005	<0.005	<0.005	3.6	3.5	0.071
6/02/88	0.2	0.2	<0.1	40	42	<2				<0.005	<0.005	<0.005	4.0	4.4	0.14
7/07/88	<0.1	<0.1	<0.1	60	64	<2				<0.005	<0.005	<0.005	4.4	4.1	0.07
8/09/88	<0.1	0.2	<0.1	55	59	<2				<0.005	<0.005	<0.005	4.5	3.8	0.07
9/08/88	0.2	0.2	<0.1	71	63	4				<0.005	<0.005	<0.005	3.3	2.7	<0.05
AVERAGE	0.1	0.1	0.0	52	52	<2	0.40	0.38	0.00	0.000	0.000	0.000	3.9	3.8	<0.05
MINIMUM	<0.1	<0.1	<0.1	37	37	<2	0.20	0.16	<0.10	<0.005	<0.005	<0.005	2.9	2.7	<0.05
MAXIMUM	0.2	0.2	<0.1	71	64	4	0.51	0.54	<0.10	<0.005	<0.005	<0.005	4.5	4.4	0.14

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	MANGANESE mg/l			MERCURY mg/l			MOLYBDENUM mg/l			NICKEL mg/l			AMMONIA NITROGEN mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005	0.067	<0.029	<0.029	<0.007	<0.007	<0.007	<0.10	<0.10	<0.10
11/04/87	0.08	<0.05	<0.05	<0.0005	<0.0005	<0.0005	0.042	<0.029	<0.029	<0.007	<0.007	<0.007	0.3	0.1	<0.1
12/02/87	(b)	(b)	(b)	<0.0005	<0.0005	<0.0005	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1/06/88	<0.05	(a)	<0.05	<0.0005	(a)		<0.029	(a)		<0.007	(a)		2.2	(a)	<0.1
2/03/88	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005	<0.029	<0.029	<0.029	0.010	<0.007	<0.007	0.4	0.4	<0.1
3/01/88	<0.05	0.055	<0.05	<0.0005	<0.0005	<0.0005	<0.029	<0.029	<0.029	<0.007	<0.007	<0.007	0.3	0.2	<0.1
4/08/88				<0.0005	<0.0005	<0.0005				<0.007	<0.007	<0.007	0.2	0.2	<0.1
5/05/88				<0.0005	<0.0005	<0.0005				<0.030	<0.030		<0.1	<0.1	<0.1
6/02/88				<0.0005	<0.0005	<0.0005				<0.030	<0.030	<0.030	0.2	0.1	<0.1
7/07/88				<0.0005	<0.0005	<0.0005				<0.030	<0.030	<0.030	0.17	0.17	0.11
8/09/88				<0.0005	<0.0005	<0.0005				<0.030	<0.030	<0.030	0.12	<0.1	<0.1
9/08/88				<0.0005	<0.0005	<0.0005				<0.030	<0.030	<0.030	0.25	0.27	0.14
AVERAGE	<0.05	<0.05	0.00	0.0000	0.0000	0.0000	<0.029	0.000	0.000	<0.007	0.000	0.000	0.4	0.15	<0.1
MINIMUM	<0.05	<0.05	<0.05	<0.0005	<0.0005	<0.0005	<0.029	<0.029	<0.029	<0.007	<0.007	<0.007	<0.10	<0.1	<0.1
MAXIMUM	0.08	0.055	<0.05	<0.0005	<0.0005	<0.0005	0.067	<0.029	<0.029	<0.010	<0.030	<0.030	2.2	0.40	0.14

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	NITRATE/NITRITE NITROGEN mg/l			TOTAL KJELDAHL NITROGEN mg/l			DISSOLVED OXYGEN mg/l (field)			pH s.u. (field)			SELENIUM mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	0.07	0.06	<0.05	2	1	<1	10.5	10.5		6.26	6.23		<0.005	<0.005	<0.005
11/04/87	(b)	(b)	(b)	<1	<1	<1	10.4	10.3		6.29	6.20	6.60	<0.005	<0.005	<0.005
12/02/87	0.11	0.10	<0.05	2	1	1				6.38	6.38		<0.005	<0.005	<0.005
1/06/88	0.12	(a)	0.06	2	(a)	<1				6.73	(a)		<0.005	(a)	<0.005
2/03/88	0.21	0.18	<0.05	2	2	2	11.2	11.0		6.59	6.33		<0.005	<0.005	<0.005
3/01/88	0.16	0.16	<0.05	<1	<1	<1	10.2	10.0		6.45	6.62		<0.005	<0.005	<0.005
4/08/88	0.35	0.34	<0.07	<1	<1	<1	11.8	11.9		7.04	7.06		<0.005	<0.005	<0.005
5/05/88	0.17	0.18	<0.05	<1	<1	<1	10.6	9.5		7.10	7.07		<0.005	<0.005	<0.005
6/02/88	0.14	0.10	<0.05	<1	<1	<1	9.0	9.05		6.98	7.14		<0.005	<0.005	<0.005
7/07/88	<0.05	<0.05	<0.05	<1	<1	<1	6.5	6.0		7.09	7.01		<0.005	<0.005	<0.005
8/09/88	(b)	(b)	(b)	2	2	<1	7.3	7.9		6.95	7.16		<0.005	<0.005	<0.005
9/08/88	<0.05	<0.05	<0.05	<1	<1	<1	11.7	11.7		7.98	7.92		<0.005	<0.005	<0.005
AVERAGE	0.13	0.12	<0.05	<1	<1	<1	9.9	9.8		6.82	6.83	6.60	0.000	0.000	0.000
MINIMUM	<0.05	<0.05	<0.05	<1	<1	<1	6.5	6.0		6.26	6.20	6.60	<0.005	<0.005	<0.005
MAXIMUM	0.35	0.34	0.06	2	2	2	11.8	11.9		7.98	7.92	6.60	<0.005	<0.005	<0.005

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	SILVER mg/l			SODIUM mg/l			TOTAL DISSOLVED SOLIDS mg/l			TOTAL ORGANIC CARBON mg/l			TOTAL SUSPENDED SOLIDS mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	<0.005	<0.005	<0.005	6.0	6.3	<0.5	83	95	<1	15	8.3	<0.1	1	5	1
11/04/87	<0.005	<0.005	<0.005	6.2	5.1	<0.5	99	110	4	8.98	13.9	<0.1	7	<5	<5
12/02/87	(b)	(b)	(b)	6.0	6.2	0.55	86	84	<1	18.1	23.1	<0.10	7	<5	<5
1/06/88	<0.0004	(a)	<0.0004	6.6	(a)	<0.5	130	(a)		13.89	(a)		<5	(a)	
2/03/88	<0.0004	<0.0004	<0.0004	7.8	7.9	<0.5	100	100	<5	10.0	0.26	<0.1	<5	11	<5
3/01/88	<0.0004	<0.0004	<0.0004	8.1	8.4	<0.5	100	120	<20	8.99	7.81	<0.10	<5	<5	<5
4/08/88	<0.0004	<0.0004	<0.0004				36	21	<20	(b)	(b)	(b)	<10	<10	<10
5/05/88	<0.0004	<0.0004	<0.0004				120	120	33	11.1	12.3	0.84	<10	<10	<10
6/02/88	<0.0004	<0.0004	<0.0004				140	120	<20	12.4	11.4	0.62	<10	<10	<10
7/07/88	<0.0004	<0.0004	<0.0004				130	140	36	10.4	10.6	0.54	12	<10	<10
8/09/88	<0.0004	<0.0004	<0.0004				79	89	<20	11.2	10.7	0.5	13	15	<10
9/08/88	<0.0004	<0.0004	<0.0004				93	83	<20	11.3	10.5	0.37	<10	<10	<10
AVERAGE	0.0000	0.0000	0.0000	6.8	6.8	<0.5	100	98	7	11.9	10.9	0.29	3	3	<1
MINIMUM	<0.0004	<0.0004	<0.0004	6.0	5.1	<0.5	36	21	<1	8.98	0.26	<0.1	1	<5	1
MAXIMUM	<0.005	<0.005	<0.005	8.1	8.4	0.55	140	140	36	18.1	23.1	0.84	13	15	1

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	SPECIFIC CONDUCTIVITY Micro mhos/cm (field)			SULFATE mg/l			SULFUR mg/l			TEMPERATURE Degrees Celcius (field)			THALLIUM mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	139	138		11	11	<5	(b)	(b)	(b)	10	10		<0.005	<0.005	<0.005
11/04/87	131	122		8	9	<5	<7	<7	<7	8	8		<0.005	<0.005	<0.005
12/02/87	118	130		10	11	<5	<7	<7	<7	3	3		<0.005	<0.005	<0.005
1/06/88	160	(a)		12	(a)	<5	<7	(a)		1	1		<0.005	(a)	<0.005
2/03/88	169	177		14	14	<5	<11	<11	<11	1	1		<0.005	<0.005	<0.005
3/01/88	169	171		10	9	<5	<7	<7	<7	1	1		<0.005	<0.005	<0.005
4/08/88	126	115		<5	<5	<5	<7	<7	<7	2	2				
5/05/88	109	101		8	7	<5	3.1	3.3	<1.7	11.0	12.0				
6/02/88	120	121		7	6	<5	4.2	2.9	<1.7	18.0	18.5				
7/07/88	152	150		15	15	<5	3.2	3.0	<1.7	22.5	24.5				
8/09/88	179	153		13	13	<5	4.0	4.0	<1.7	23.5	23.5				
9/08/88	152	150		11	11	<5	3.7	3.8	<1.7	20.5	20.5	20.5			
AVERAGE	144	139		10	10	0	1.7	1.7	0.0	10.1	10.4	20.5	0.000	0.000	0.000
MINIMUM	109	101		<5	<5	<5	3.1	2.9	<1.7	1.0	1.0	20.5	<0.005	<0.005	<0.005
MAXIMUM	179	177		15	15	<5	4.2	4.0	<11	23.5	24.5	20.5	<0.005	<0.005	<0.005

TABLE NO. 3.7-5 (Cont.)

SAMPLING DATE	TIN mg/l			TITANIUM mg/l			URANIUM mg/l			ZINC mg/l		
	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK	UP STREAM	DOWN STREAM	FIELD BLANK
10/14/87	<0.067	<0.067	<0.067	<0.004	<0.004	<0.004	<0.001	<0.001	<0.001	<0.05	<0.05	<0.05
11/04/87	<0.067	<0.067	<0.067	<0.004	<0.004	<0.004	<0.001	<0.001	<0.001	<0.05	<0.05	<0.05
12/02/87	<0.067	<0.067	<0.067	0.004	<0.004	<0.004	0.011	0.009	0.003	<0.05	<0.05	<0.05
1/06/88	0.093	(a)		<0.004	(a)		<0.001	(a)		<0.05	(a)	<0.05
2/03/88	<0.067	<0.067	<0.067	<0.004	<0.004	<0.004	(b)	(b)	(b)	<0.05	<0.05	<0.05
3/01/88	(b)	(b)	(b)	<0.004	<0.004	<0.004	0.002	0.002	<0.001	0.05	0.068	<0.05
4/08/88										<0.05	<0.05	<0.05
5/05/88										<0.05	<0.05	<0.05
6/02/88										<0.05	<0.05	<0.05
7/07/88										<0.05	<0.05	<0.05
8/09/88										<0.05	<0.05	<0.05
9/08/88										<0.05	<0.05	<0.05
AVERAGE	<0.067	0.000	0.000	<0.004	0.000	0.000	0.003	0.003	<0.001	<0.05	<0.05	0.00
MINIMUM	<0.067	<0.067	<0.067	<0.004	<0.004	<0.004	<0.001	<0.001	<0.001	<0.05	<0.05	<0.05
MAXIMUM	0.093	<0.067	<0.067	0.004	<0.004	<0.004	0.011	0.009	0.003	0.05	0.068	<0.05

(a)-Data Point Deleted From Data Set - Sample Non-Representative
(b)-Data Point Deleted From Data Set - Contamination in Field Blank

changes were verified with documentation so that resultant data met project quality control objectives. Results below level of detection were assigned a value of zero, as stated above.

3.7.3.5.2 Discussion of Data - Surface Water Quality

Proposed regulations in the Wisconsin Administrative Code, NR 105, establish water quality criteria for toxic substances in surface waters. Table No. 3.7-6 lists the criteria as applied to the Flambeau River.

Table No. 3.7-6 contains the data produced for this report which indicate the ambient water quality for the Flambeau River. Forty-three parameters were evaluated. Fifteen of these parameters have toxicity threshold values established under NR 105. Of these fifteen parameters, only copper and zinc were found in concentrations above water quality criteria as listed in Table No. 3.7-6. Exceedance of the values occurred once for each metal. Most of the copper data show concentrations below the detection limit and, except for the March data entry, all zinc data points are below detection limits. It is reasonable to expect trace quantities of both zinc and copper in surface waters.

3.7.3.5.3 Discussion of Data - Bottom Sediments

The results of bottom sediment analysis appear in Table No. 3.7-2. The data are striking in that there is almost an homogeneity among samples in both horizontal and vertical directions. This suggests a consistent deposition of the parameters tested.

Sediments deposited on the river bottom may release chemical constituents naturally in several ways. 1) Translocation - removal of sediment to downstream locations by the scouring action of the river. 2) Absorption via biological activity into the food chain. 3) Transformation to a soluble state and removal. This latter process could be caused by biological activity or a chemical process such as pH change.

There are no established toxicity criteria for sediments.

3.7.4 Summary and Conclusions

The study area contains within it four surface water areas; three intermittent streams and the Flambeau River. There are also wetlands located within the study area; these are discussed in Appendix 3.8-C - Wetlands Inventory and Assessment to this report.

The main emphasis on data collection for this evaluation involved the Flambeau River and its associated sediments. The

TABLE NO. 3.7-6

Estimated NR 105 Waste Quality Criteria
for the Flambeau River

Parameter	NR105 Criteria (ug/L)[1] Acute	Chronic	Human Health	Human Cancer	Wild and Domestic Animal
Arsenic	363.8	153	--	50	--
Chromium^{+6}	14.2	9.74	9,000	--	--
Chromium^{+3}	1061	30.6	9,500,000	--	--
Mercury	1.53	--	0.08	--	0.002
Selenium	58	7.07	170	--	--
Cadmium	13.25	0.216	82	--	--
Copper	8.63	5.99	--	--	--
Lead	69.96	4.17	50	--	--
Nickel	599.5	36.79	460	--	--
Silver	0.885	0.885	430	--	--
Zinc	57.39	27.57	--	--	--
Thallium	--	--	11	--	--

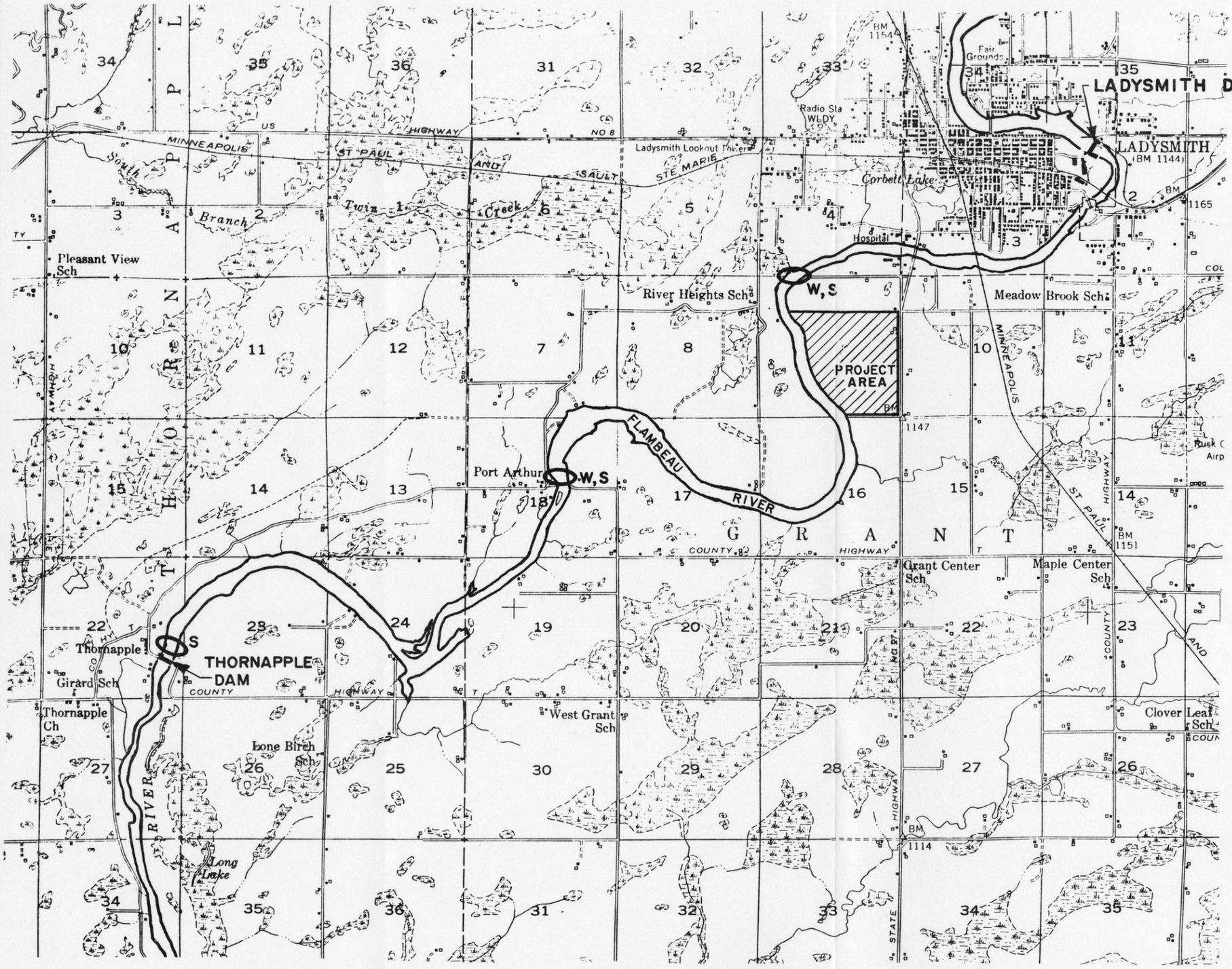
[1]Concentrations based on criteria as provided in Green Sheet for NR 105, July 1988. Concentrations are estimates. Where water quality parameters are applicable, a hardness of 50 ppm was assigned as reasonable (see data Table No. 3.7-5). The Flambeau River is considered "warm water sport fishery."

data presented in Section 3.7 represent the background conditions that exist without any mining activity.

Surface water of the Flambeau River was sampled in two locations--one upstream and one downstream from the project area. The chemical characteristics of both sites did not vary significantly. Of all samples collected and analyzed, only two parameters, copper and zinc, were ever measured in concentrations above the levels of toxicity established by the proposed water quality criteria in Chapter NR 105 of the Wisconsin Administrative Code. However, elevated concentrations of copper and zinc are not uncommon in surface waters of the area.

There is very little fine-grained sediment in that portion of the Flambeau River which is adjacent to the project area. This is a direct result of the velocity of water flow in this segment of the river. Samples of sediment were collected both in the upstream/downstream sampling sites and the Thornapple impoundment area. The uniformity of the data collected from this sampling program is an indication of consistent deposition of sediment over time. This data will provide a base for future comparisons.

Figures for Section 3.7



LEGEND

- O_W RIVER SAMPLING LOCATIONS FOR SURFACE WATER SAMPLES
- O_S RIVER SAMPLING LOCATION FOR SEDIMENTS

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

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

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 3.7-1
SAMPLING SITE LOCATIONS

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

REFERENCES	DWG. NO.	DESCRIPTION

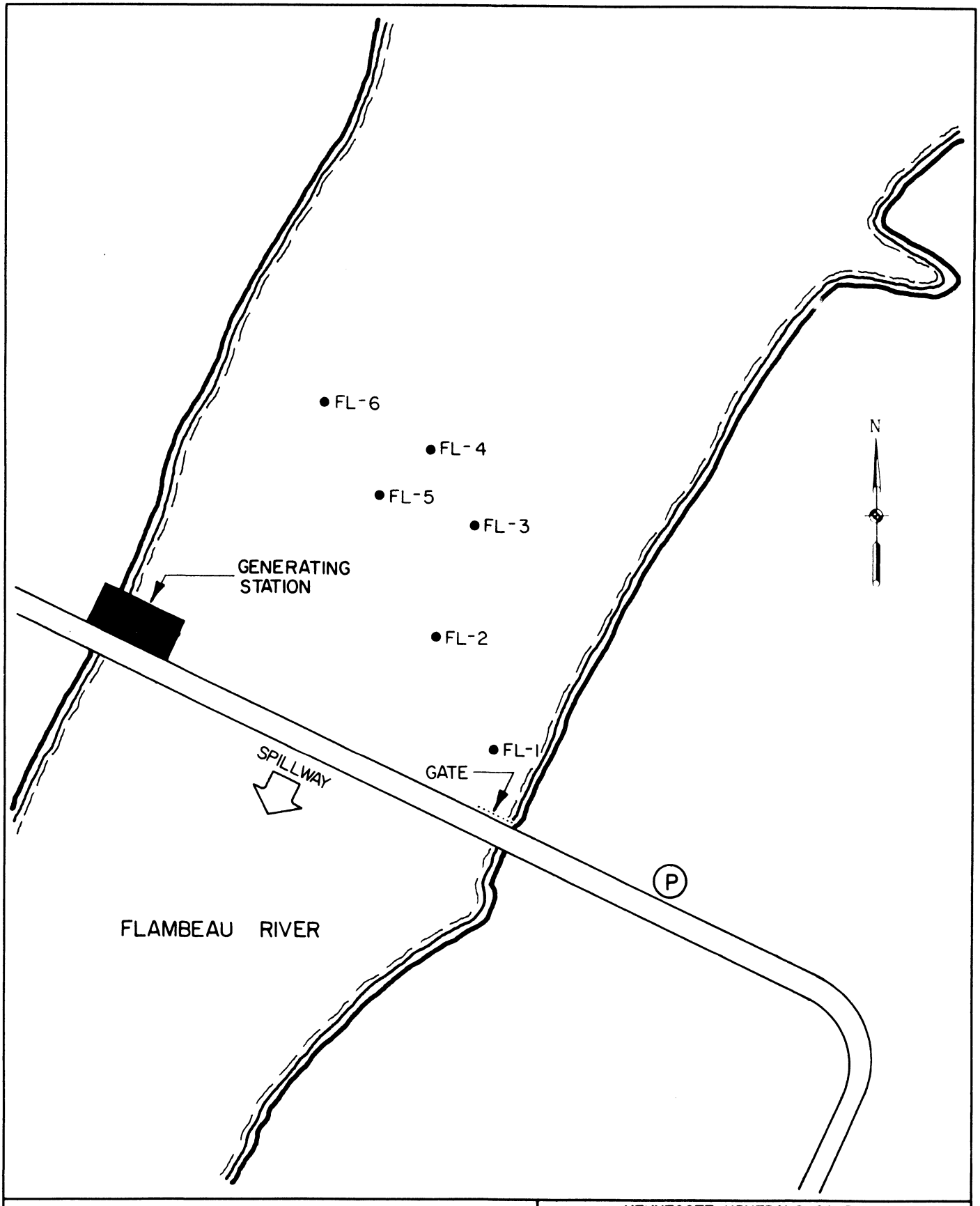
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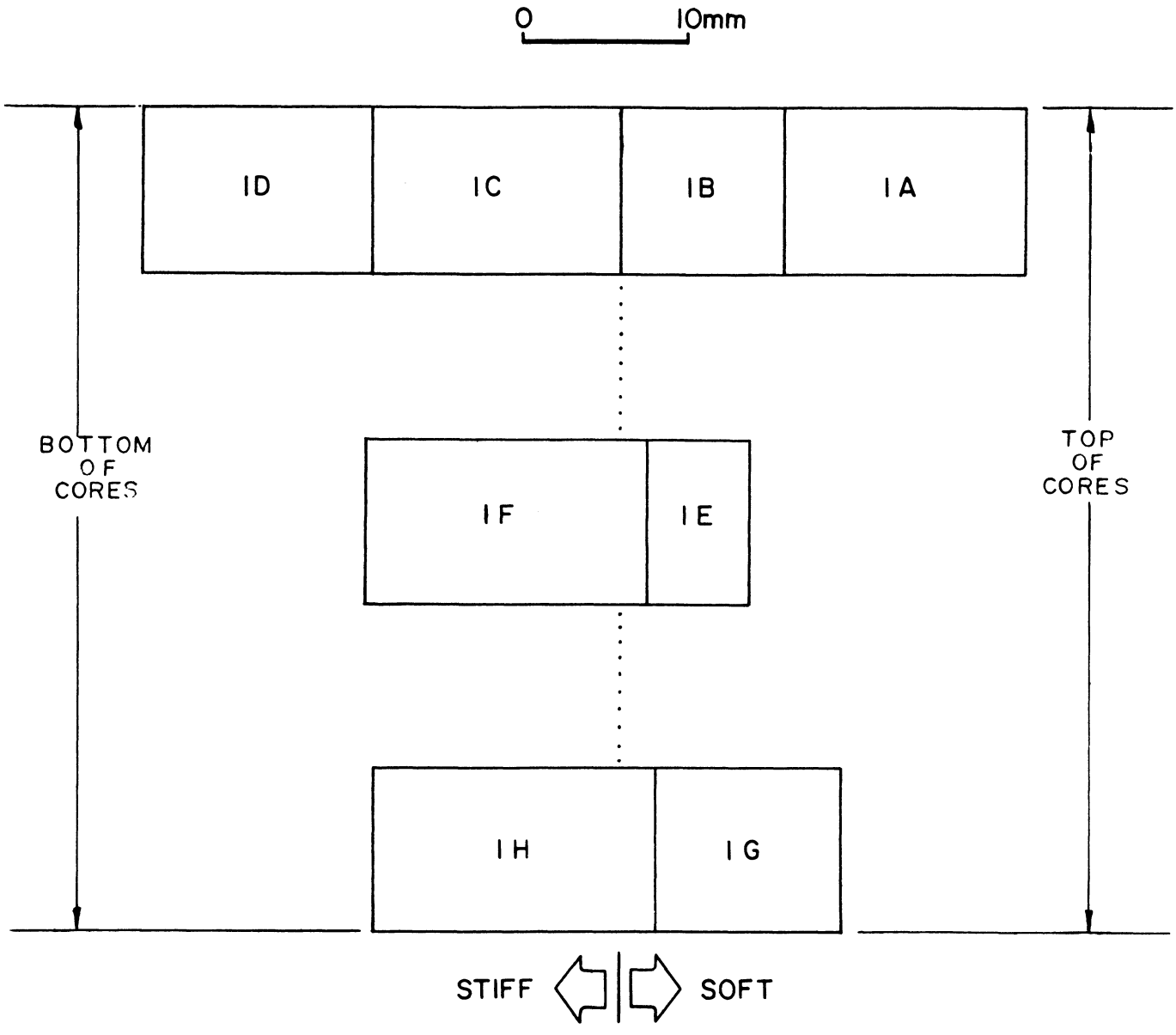
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MGR. PROCESS ENG'R		
ENG'R MGR.		

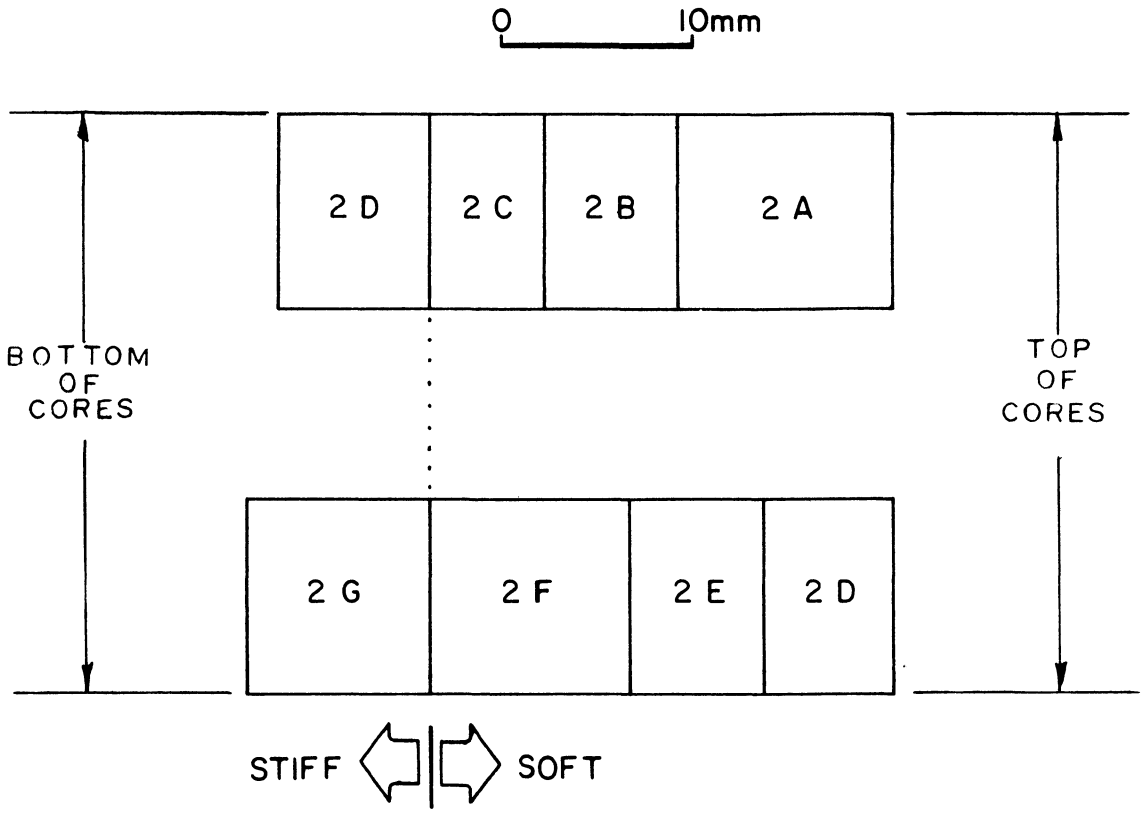
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DRAWN	SJL	2/89
CH'K'D	GJB	3/89
DES. ENG'R		
SECT. ENG'R		



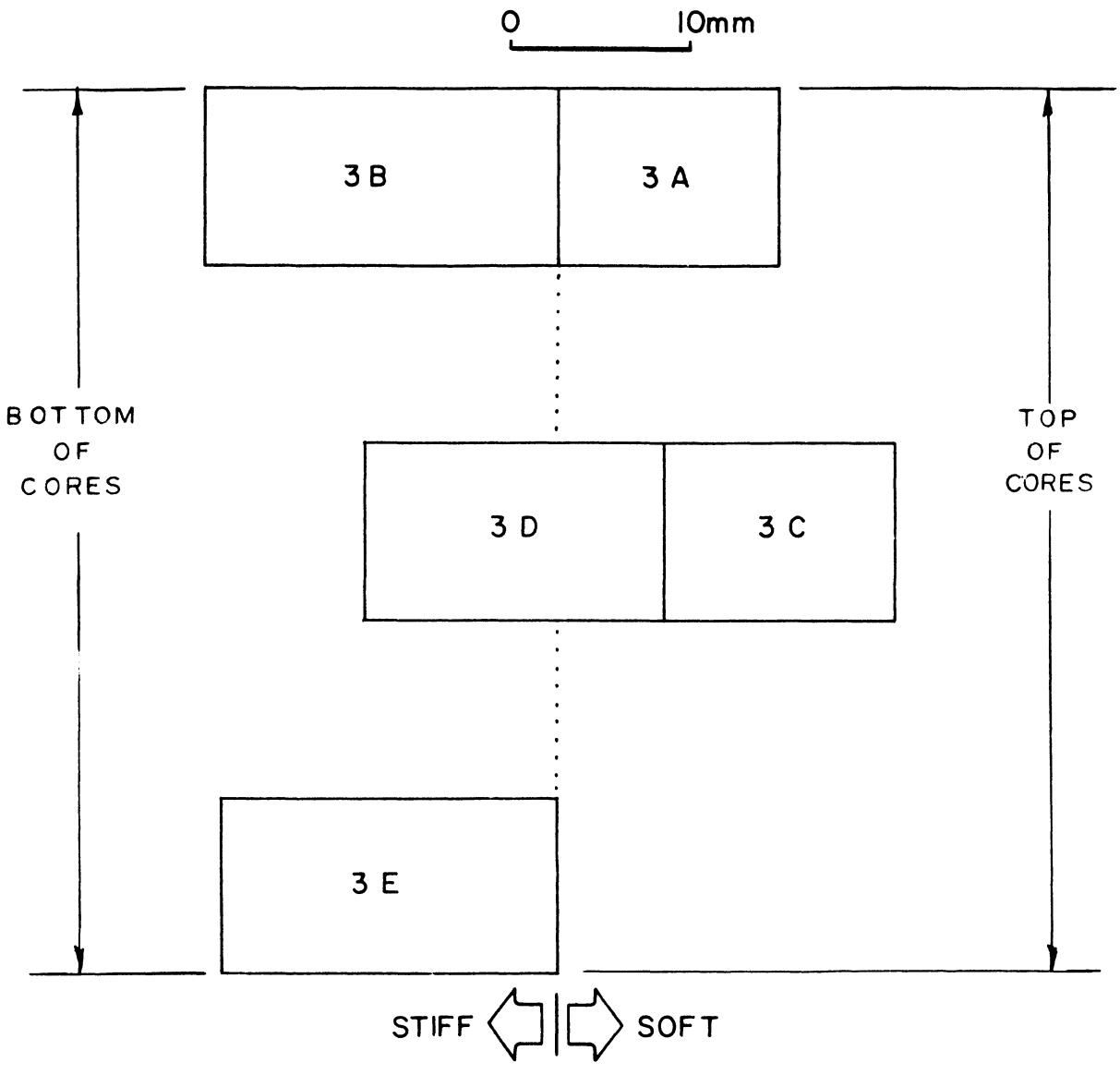
FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 3.7-2 SEDIMENT SAMPLE LOCATIONS AT THORNAPPLE DAM
	DESIGNED BY		
	DRAWN BY M W B	1/89	
	CHECKED BY G J B	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 200'		Job No / Dwg No / REV



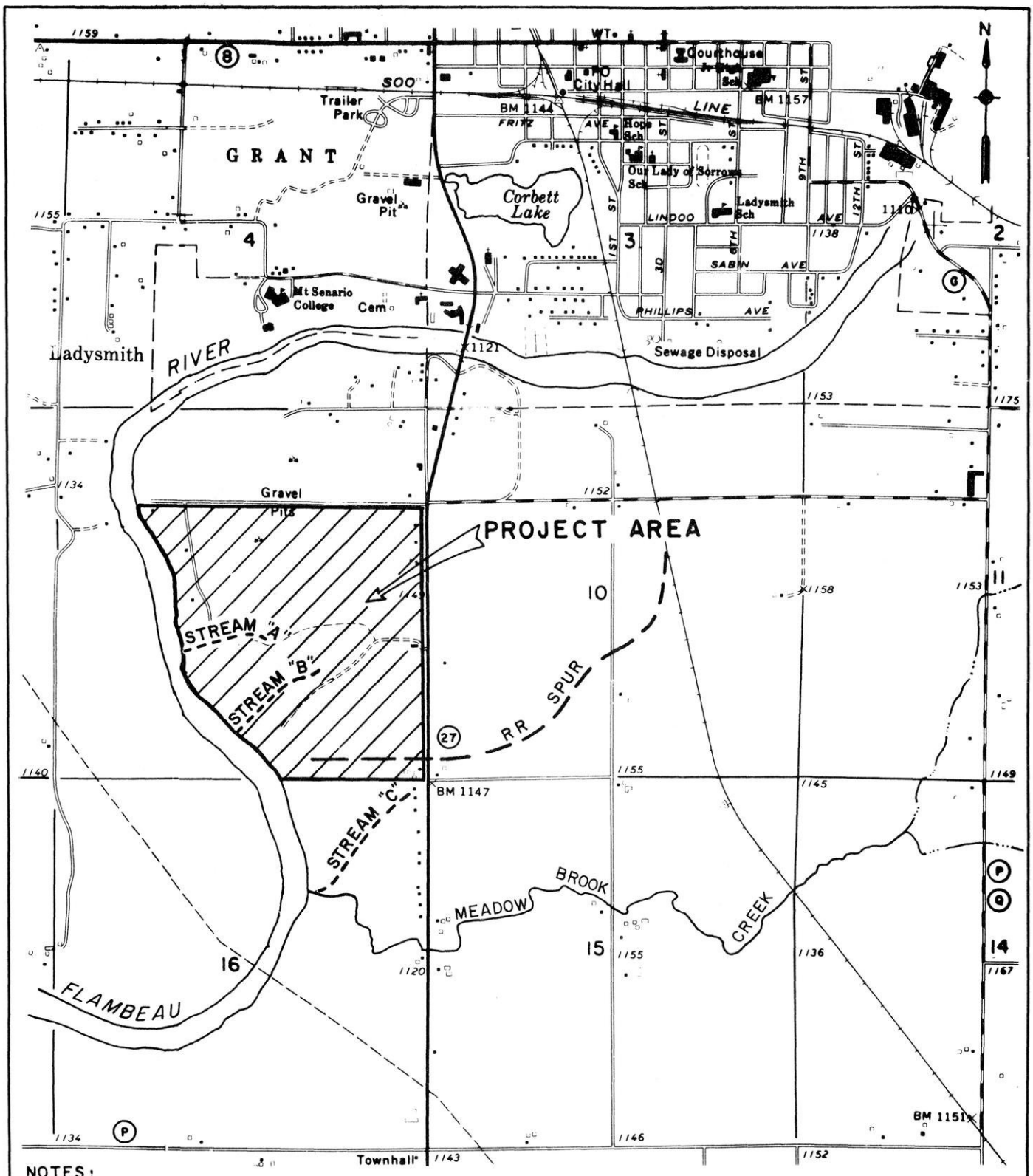
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NOTES	APPROVAL	DATE	FIGURE NO. 3.7-3 SEDIMENT CROSS SECTION LOCATION FL-1
	DESIGNED BY		
	DRAWN BY SJL	1/89	
	CHECKED BY GJB	3/89	
	APPROVED BY		
	CAD No. SCALE		Job No / Dwg No / REV



FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 3.7 - 4 SEDIMENT CROSS SECTIONS LOCATION FL-2
	DESIGNED BY		
	DRAWN BY M W B	1/89	
	CHECKED BY G J B	3/89	
	APPROVED BY		
	CAD No. SCALE		Job No / Dwg No / REV



FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 3.7-5 SEDIMENT CROSS SECTIONS LOCATION FL-3
	DESIGNED BY		
	DRAWN BY MWB	1/89	
	CHECKED BY GJB	3/89	
	APPROVED BY		
	CAD No. / SCALE		Job No / Dwg No / REV



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
NOTES	APPROVAL	DATE	FIGURE NO. 3.7-6 STREAM LOCATIONS
	DESIGNED BY		
	DRAWN BY SJL	2/89	
	CHECKED BY GJB	3/89	
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	Job No / Dwg No / REV

3.8 Aquatic Biology

The objective of this report is to present descriptive information on the occurrence, abundance, and ecology of aquatic communities within the study area. A data base for the site was developed in the 1970s and has been supplemented with information collected in 1987 and 1988. The area studied by Dames and Moore (1973) included a larger area than is presently under study in this report.

The most important body of surface water in the region is the Flambeau River, which flows southwest from Sawyer County, meanders through the center of Rusk County, and empties into the Chippewa River in the southern part of Rusk County. Its watershed is approximately 1,838 square miles (BCMC, 1974). Above and below the study area, water level fluctuations are controlled by two impoundments: Ladysmith Dam (17 ft. of head), approximately 3.8 miles upstream; and Thornapple Dam (13 ft. of head) approximately 7.6 miles downstream (Sather *et al.*, 1971). The study area consists of a stretch of the Flambeau River from the State Highway 27 (STH 27) bridge downstream to Thornapple Dam, a distance of about 11.4 miles. The confluence of Meadowbrook Creek was also included.

Meadowbrook Creek drains a subwatershed which empties into the Flambeau River approximately 2,000 feet south of the project area. It obtains its water supply from wetlands to the east, seepage areas of the study area, and surface runoff.

Three unnamed intermittent streams (designated "A", "B", and "C") also drain the study area. Due to their intermittent flow, their aquatic communities are ephemeral, and they have not been included in the aquatic biota studies.

3.8.1 Field and Laboratory Methods

Aquatic biota studies on the Flambeau River and lower Meadowbrook Creek waters were conducted from October 1987 through August 1988. Biota sampled included periphyton, benthic macroinvertebrates, and fish. Even though low flow conditions in 1987-1988 and rapid fluctuations in the river level hampered field work, the available data is sufficient to characterize the aquatic communities in the study area. Previous work by Dames and Moore (1973) included studies of periphyton, phytoplankton, zooplankton, aquatic macrophytes, benthic macroinvertebrates, and fish collected in the river. That work provides a data base for this study.

Sampling stations are upstream and downstream of the project area as shown on Figure No. 3.8-1. A station is represented by a 20-foot-wide cross section of the river. Location relative to the project area, and comparability between sites, were used as criteria in site selection. Stations M-1 and M-2 are located upstream from the open pit site approximately 9,700 feet and

3,800 feet respectively. Station M-3 is located opposite the open pit site. Stations M-5 and M-4 are downstream from the open pit site and are located 150 feet north and south of the mouth of Meadowbrook Creek, respectively. Aquatic sampling stations were selected to include pool and riffle conditions.

3.8.1.1 Phytoplankton

Phytoplankton data for this report are included in the 1973 study of the aquatic ecology on the Flambeau River near the project area (Dames & Moore, 1973).

Samples were collected in 1973 midway in the water column at six stations. A 2.1-liter Kemmerer water sampler was used to collect the samples. The samples were preserved in borate-buffered formalin. Water temperature, dissolved oxygen, and pH were recorded at each station. Methods used are discussed in Dames & Moore (1973).

3.8.1.2 Zooplankton

Zooplankton collected on May 2, 1973, and methods used are presented in Dames & Moore (1973).

3.8.1.3 Periphyton

Artificial substrates (barbecue basket-type) were constructed of 1/2-inch square wire mesh. The dimensions were 12 x 18 x 24 inches. The cages were anchored to the river bottom with 20 inches of #3 rebar for a period of three months (May-August 1988).

Three cages were placed above and three below the project area at sampling stations M-2 and M-5 in May 1988. Cobble-sized rocks were collected from the surrounding bottom sediment, cleaned of debris, and placed into the cages until full. The cages were allowed to remain undisturbed until collected in August 1988. Organisms were removed from the rocks and preserved in sample bottles with a solution of 10 percent buffered formalin.

The substrates were developed to obtain up-to-date information on the macroinvertebrate community and the algae in the Flambeau River.

3.8.1.4 Aquatic Macrophytes

Previous studies by Dames and Moore (1973) provide data on aquatic macrophytes in the Flambeau River. Aquatic macrophytes were also collected and identified during the 1987-1988 field investigation.

3.8.1.5 Benthic Macroinvertebrates

Quantitative and qualitative techniques were used to sample sand, pebble, and cobble-sized substrates of the Flambeau River. Surber samplers were used to semiquantify populations while dip-netting and handpicking were employed to supplement the species list and aid in determining relative abundance.

Surber samples and handpicked samples were taken at each of the five sampling sites on the river in October 1987 and April and August 1988. Three Surber samples were taken at each site using accepted sampling techniques. Handpicked samples were collected from all available habitats using dip nets and standard No. 30 size sieves. Handpicking at each station was conducted for a minimum of one manhour, or until no new taxa were encountered for a period of fifteen minutes. Surber sampling was seriously hindered by the frequent and often unpredictable changes in river elevation due to operation of the hydroelectric dam upstream. It was not possible to be certain that a given riffle site had not been stranded recently. Despite these conditions, every reasonable attempt was made to assure that samples were representative of each given station.

Field logs recorded time of day, air and water temperature, location, time spent at each site, name and number of collectors. All samples were labeled and preserved in a solution of 10 percent buffered formalin and sent to the laboratory for identification and classification. Taxonomic services were provided by George Kandler, Jr., of Swanson Laboratories, and James Yanko of Yanko Environmental Services.

3.8.1.6 Fish

Fish surveys were performed in the study area during Fall 1987 and Spring and Summer 1988. Sampling techniques included gill netting, electroshocking, hook-and-line, minnow trapping, and creel census.

Experimental gill nets, 150 feet in total length, with mesh sizes ranging from 3/4-inch to 4 inches in five 30-foot panels per net were used. Nets were deployed at three stations and set in deep pool areas in the impoundment above Thornapple Dam. Sampling occurred in three days/two nights in October 1987 and two days/one night in August 1988.

Hook-and-line sampling was conducted for 96 hours during Spring and Summer 1988 at various locations between Ladysmith Dam and Thornapple Dam. Two of each game species were collected for metals analyses.

Supplemental data were provided by the Wisconsin Department of Natural Resources (WDNR), which involved three hours of electroshocking performed on the Thornapple Flowage in May 1988 to verify species present.

Minnow traps were placed at each of the five sampling locations on the river in Fall 1987, and Spring and Summer 1988. A minimum of four traps were set in pools at each location for up to three consecutive days and baited with slices of potato. Traps were checked daily and the fish caught were identified. Nongame species were frozen for metals analysis.

A creel census organized with local members of the Ladysmith Bass Master Club yielded no results due to extremely low water conditions in the Flambeau River during the study period. Most sport fishing in this area was precluded. This planned sample area included the Flambeau River between Ladysmith and Thornapple Dams.

3.8.1.7 Tissue Chemistry

Heavy metal analysis was performed on crayfish (*Orconectes virilis*) and fish collected from the study area during Fall 1987 and Spring and Summer 1988. Trace metals, comprising mercury (Hg), nickel (Ni), copper (Cu), lead (Pb), selenium (Se), chromium (Cr), cadmium (Cd), arsenic (As), silver (Ag), zinc (Zn), and uranium (U), were analyzed from fish samples collected by gill netting and hook-and-line methods. These metals were selected as a result of the scope of study process. From the collection of fish, two of the largest individuals were selected for tissue analysis of fillets and livers. Fillets were tested because they are the portion of the fish consumed by the public. Liver tissue has been found to be the selective storage organ for copper in fish (Salanki et al, 1982). Crayfish were collected from artificial substrates at sampling locations M-2 and M-5.

3.8.1.8 Quality Control

Quality control measures were implemented in every stage of the field and laboratory procedures to assure accuracy of collected data.

Daily logs were completed by field personnel. Entries included date, time, individuals involved, and a detailed account of work completed. Taxonomic identifications were made by trained personnel with experience in the specific group. All field activities were conducted by or under the direct supervision of trained and experienced personnel.

3.8.2 Flambeau River

The Flambeau River originates in Iron County, Wisconsin, near the Turtle-Flambeau Flowage. The river flows in a southwesterly direction through the counties of Ashland, Price, Sawyer, and Rusk before entering the Chippewa River above Lake Holcombe in the southern part of Rusk County. There are four impoundments of the Flambeau River within Rusk County; Big Falls Flowage (50-

foot head), Dairyland Flowage (68-foot head), Ladysmith Flowage (17-foot head), and Thornapple Flowage (13-foot head). A fifth impoundment--the Port Arthur Flowage--previously located between the Ladysmith and Thornapple Flowages, was removed in 1968 (Sather et al., 1971). Skinner Creek, George Cadd Creek, and Crooked Creek are tributaries to the Flambeau River in Rusk County. Deer Trail Creek is the largest tributary in the county. It enters the Chippewa River downstream from the Flambeau/Chippewa River junction.

The overall length of the impounded river in Rusk County is 24.2 miles. The impounded portion of the river covers 610 acres. It has a low gradient of approximately three feet per mile in the study area (Sather et al., 1971). The entire river drains approximately 1,838 square miles (BCMC, 1974) and has watershed cover above Ladysmith which is similar to the study area, and which is relatively undisturbed. The exception to this is the area below the first impoundment, Big Falls Flowage, which has scattered agricultural uses. The upper region of the Flambeau River lies within the Flambeau River State Forest. No significant wetlands border directly on the river (Sather et al., 1971).

The course of the river near the project area has apparently changed very little during postglacial time. The large meanders of the river were probably formed while the Flambeau was still receiving large quantities of glacial melt-water. There are no 100-year flood records for the Flambeau River in the vicinity of the project area. It is probable that a large flood would only refill the streambed as it existed prior to the removal of the Port Arthur Dam (BCMC, 1974).

The river bottom is made up primarily of gravel, cobble, and boulder bottom types, with some minor areas of sand and silt. Littoral bottom types in the vicinity of the project area are estimated to include 50 percent gravel, 35 percent sand, 10 percent cobble and boulders, and 3 percent muck based on habitat characterization in the field.

Surface water sampling was conducted on the Flambeau River at two locations, approximately 0.8 miles upstream and 2.5 miles downstream from the proposed outfall locations. The results of this study indicated that the water in the Flambeau River is soft and well-oxygenated, with a near-neutral pH. No undue demand on oxygen was determined to exist at any time of the year. The highest levels of pH, dissolved oxygen (D.O.), and total suspended solids (TSS) were recorded in samples taken during the late summer. Ranges for these parameters were: pH (6.20 to 7.98); D.O. (6.0 to 11.9 mg/l); TSS (<5 to 15 mg/l). There were no anomalous results noted in the 43 parameters tested (refer to Section 3.7).

The principle uses of the river are for power generation, disposal of treated sewage and paper mill effluent, recreation,

and wild and domestic animal use. In Rusk County, the river is not used for domestic water supplies or commercial navigation. Water levels in the river fluctuate daily according to discharge patterns at the Dairyland Flowage operated by Northern States Power. Fluctuations of as much as two feet in three hours were measured at the project area during August 1988.

Aquatic samples were collected near the project area at five sampling locations on the river (Figure No. 3.8-1). Sampling location M-1 is located 500 feet downstream from the Highway 27 bridge in Ladysmith, M-2 is located at the end of Blackberry Lane north of the site. M-3 is directly west of the open pit area; M-5 is located 150 feet upstream of Meadowbrook Creek; M-4 is located 150 feet downstream from Meadowbrook Creek.

3.8.2.1 Periphyton

Six artificial substrate samplers were used to collect periphyton algae on the Flambeau River at locations M-2 and M-5 between May 19 and August 24, 1988. Rocks of various sizes were cleaned of growth and used to fill the basket-type substrates. The substrates remained in place over the three-month period prior to removal. The predominant periphyton taxa identified at both stations were *Ulothrix* sp. and *Oedogenium* sp. The communities at both locations were similar in abundance and taxa, but were very limited in diversity compared to the 1973 results. The extremely low flow conditions experienced in 1988, during late summer, probably contributed to these results.

According to Dames and Moore (1973), Aufwuchs appeared to be sparse on the study area. Their studies found 28 diatom species and one green algae (*Chaetophora attenuata*). The most abundant genera present in 1973 were *Cocconeis, Cymbella, Gomphonema, Melosira, Navicula, Nitzchia,* and *Tabellaria*.

3.8.2.2 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected at the five sampling locations shown on Figure No. 3.8-1 in October and December 1987 and in April and August 1988. They were collected with a 30-mesh net and a Surber sampler. Table No. 3.8-1 compares taxa collected in 1973 and 1987-1988.

The major groups of organisms identified in previous benthic studies of the Flambeau River, conducted by the WDNR in 1969 and referenced by Dames and Moore in 1973, were Chironomids, Ephemeropterans, and Tricopterans. In 1969, Tricopterans and Chironomids comprised 48 percent and 32 percent of the benthic taxa, respectively. Results of the 1973 benthos survey indicate that 47 percent of the benthic taxa were Chironomids and only 6 percent Tricopterans. It was hypothesized that the decrease in

TABLE NO. 3.8-1

Benthic Macroinvertebrates - Taxa Collected during 1973 and 1987-1988

Taxa	Common Name	1987 October M1	M2	M3	M4	M5	1987 December M1	M2	M3	M4	M5	1988 April M1	M2	M3	M4	M5	1988 August M1	M2	M3	M4	M5	1973
Naididae	Aquatic worm									C												
Tubificidae	Aquatic worm	R	R	R		R				C		R			R	C						
Ferrissia sp.	Limpet	A	A	A		A				C												
Lymnaea sp.	Snail	R																				
Physa sp.	Snail					R				C			R	R	R							
Heliosoma sp.	Snail														C	R				R	R	
Sphaerium sp.	Clam	C	C	C		A				A		R	R	R	A	A				A	R	X
Lampsilis sp.	Clam			R																		
Asellus sp.	Aquatic sowbug									C		R			R							
Hyallella azteca	Scud	R								R												
Orconectes virilis	Crayfish			R										R			R			R		
Baetis sp.	Mayfly																					
Blasturus cupidus	Mayfly																					
Callibaetis sp.	Mayfly																					
Ephemerella sp.	Mayfly	A	A	A		C							A	A	A	A			R		C	X
Isonychia sp.	Mayfly		R	R		R																
Leptophlebia sp.	Mayfly									A												
Stenocron interpunctatum	Mayfly									R												
Ephemera simulans	Mayfly		R	R		A				R				C	C	R						
Hexagenia limbata	Mayfly											R		A	A	A				C	R	
Stenonema sp.	Mayfly	C	C	C		A				R		A	C	C	A	R			R	A		X
Paraleptophlebia sp.	Mayfly												A									
Potamantha sp.	Mayfly		C	A		A				A				A				C				
Taeniopteryx	Stonefly	R																				
Neoperla sp.	Stonefly		R	R						R												
Phasganophora sp.	Stonefly	R	C	C									R	C		R			R		R	
Ophiogomphus sp.	Dragonfly		R	R		R										R						
Micrasema sp.	Caddisfly																					
Brachycentrus sp.	Caddisfly	R																				
Helicopsyche sp.	Caddisfly	C	R	R		C				R		C	A	A	R	R	R				R	X
Cheumatopsyche sp.	Caddisfly	C	C																			
Hydropsyche sp.	Caddisfly	C	C	A		A				R		C	A	A	R	C	R	R	R			X
Macronema zebratum	Caddisfly		C	R																		
Hydroptila sp.	Caddisfly	A	A	A		A																
Lepidostoma sp.	Caddisfly	C	R			R																
Frenesia sp.	Caddisfly	R																				
Neophylax sp.	Caddisfly		R							R			R		R	R						

TABLE NO. 3.8-1 (Cont.)

Taxa	Common Name	1987 October M1	M2	M3	M4	M5	1987 December M1	M2	M3	M4	M5	1988 April M1	M2	M3	M4	M5	1988 August M1	M2	M3	M4	M5	1973
Pseudostenophylas uniformis	Caddisfly					R				R												
Pycnopsyche sp.	Caddisfly															C						
Molanna sp.	Caddisfly									R												
Chimarra sp.	Caddisfly	R		R		R				R										R		
Polycentropus sp.	Caddisfly	C	C	R						R												
Psychromia flavida	Caddisfly	C	C	R		R																
Paraponyx sp.	Aquatic moth	R																				
Coptotomus sp.	Diving beetle													R								
Dineutus sp.	Whirligig beetle																					
Berosus sp.	Aquatic beetle													A	R							
Ectopria sp.	Waterpenny beetle	R	R	R		R				R												
Dupiraphia sp.	Riffle beetle									R												
Stenelmis sp.	Riffle beetle	A	A	A		A							R			R				R		
Optioservus sp.	Riffle beetle	A	A	A		A				R												
Albabesmyia sp.	Midge	A		A		A				A												
Cladotanytarsus sp.	Midge	A	A	A						A		R		R		A		R			X	
Chaoborus sp.	Midge			A																		
Chironomus sp.	Midge									A												
Dicroptendipes sp.	Midge									A												
Microtendipes sp.	Midge	A	A	A		A				A												
Paracladopelma sp.	Midge		A																			
Pentaneura monilis	Midge																		R			
Stictochironomis sp.	Midge	A	A	A		A				A												
Cricotopus sp.	Midge	A	A			A																
Orthocladius sp.	Midge					A																
Procladius sp.	Midge	A	A			A				A												
Tribelos sp.	Midge					A				A												
Atherix variegata	Snipefly	R		R		R																
Chrysops sp.	Horsefly												R			R						
Antocha sp.	Cranefly	R	C	R																		
Hexatoma sp.	Cranefly		R	R		R				C									R			

TABLE NO. 3.8-1 (Cont.)

Taxa	Common Name	1987 October M1	M2	M3	M4	M5	1987 December M1	M2	M3	M4	M5	1988 April M1	M2	M3	M4	M5	1988 August M1	M2	M3	M4	M5	1973
Tipula sp.	Cranefly															R						
Corisella sp.	Water boatman		C							A										R		
Nigronia sp.	Fishfly			R		R																
Sialis sp.	Alderfly									R												

R - 0 to 5
C - 5 to 10
A - 10 or more
X - Present

species. They are also the primary food source of many fishes.

The class Tricoptera (caddisflies) are terrestrial insects as adults. Prior to metamorphosis, the larvae and pupae are aquatic, and may be found in most fresh water habitats. Tricoptera larvae are primarily omnivorous feeders--as grazers, scrapers, suspension feeders, and net filter feeders.

There were 16 Tricoptera genera collected at the five sample locations. The two most abundant genera were *Helicopsyche* and *Hydropsyche*. *Helicopsyche* were collected in 12 of 15 samples, and *Hydropsyche* were collected in 13 of 15 samples. On an average, both genera are common in the Flambeau River, although they became less abundant in the August 1988 samples.

More than 1,100 species of adult caddisflies are known from the United States (Pennak, 1978). There were 16 genera collected from the Flambeau River during quantitative sampling. Pennak describes the primary habitat for these 16 genera as swift-moving waters. As larvae, these Trichoptera serve as a food source to fish of the Flambeau River.

Chironomidae (midges) were the most abundant genera samples of the class Diptera. Chironomid larvae occur everywhere in aquatic vegetation and on the bottoms of all types of fresh water bodies. Larvae are chiefly herbivorous and feed on algae, higher aquatic plants, and organic detritus (Pennak, 1978).

The family Chironomidae is divided into five subfamilies, of which three were collected from the Flambeau River. The most abundant subfamilies were Chironomidae, Orthocladiinae, and Tanypodinae, in descending order. According to Pennak (1978), subfamilies Orthocladiinae and Tanypodinae prefer a variety of habitats ranging from ponds to steams and rivers. A majority of the species in the subfamily Chironomidae prefer slower-moving streams, ponds, and lakes. Pennak states that chironomid larvae form an important item as food for young and adult fishes.

Four additional families; Elmidae (riffle beetle), Tipulidae (cranefly), Sphaerium (clam), and Chloroperlidae (stonefly) are taxa of lesser abundance in the study area.

The genera found within these families, with the exception of *Sphaerium*, were found within the study area within their preferred habitat of swift-moving streams. *Sphaerium* occur in a variety of habitats but are most abundant in larger rivers (Pennak, 1978).

3.8.2.4 Aquatic Macrophytes

Macrophyte sampling conducted by Dames and Moore (1973) concluded that five species were present on the Flambeau River and its tributaries. The species identified, *Lobelia dorthmanna*, *Polygonum*, sp. *Anacharis canadensis*, *Sagittaria* sp., and *Fontinalis* sp. are not listed as endangered or threatened by the Wisconsin Natural Heritage Inventory. No rare, endangered, or threatened aquatic macrophytes were encountered on or near the site in 1987-1988 study either.

3.8.2.5 Fish

During the 1987-1988 study period, fish were collected on the Flambeau River between the Ladysmith and Thornapple Dams. Table No. 3.8-2 indicates that similar species were observed during the 1972-1973 and 1987-1988 studies. Length measurements and abundances of fish observed during 1987-1988 collections are listed in Appendix 3.8-A.

Common species collected in 1987-1988 included white sucker (*Catostomus commersoni*), yellow perch (*Perca flavescens*), and creek chub (*Semotilus atromaculatus*). No unusual occurrences were observed during the sampling period. Sturgeon (*Acipenser fulvescens*) and muskellunge (*Esox masquinonay*) netted in the Thornapple Flowage were measured and released to protect the resource. The remaining species were identified, measured, labeled, and frozen as reference specimens and for use as samples for heavy metals analysis (Table No. 3.8-3).

The most common species observed by the WDNR while boomshocking between the old Port Arthur Dam and Thornapple Dam in 1972 were black bullhead (*Ictaluras melas*), walleye pike (*Stizostedion vitreum*), yellow perch, redhorse, northern pike (*Esox lucius*), and white sucker.

Hook-and-line collections were made during the summer of 1988. Due to drought conditions in the region, fish remained relatively inactive during the extended period of low water levels and above-average water temperatures. As a result, a low average catch of 0.15 fish per manhour fished was recorded over a 96-hour period. In conjunction, a creel census conducted on the river near the project area recorded no catches during May through August 1988 with very limited fishing due to low flow conditions.

TABLE NO. 3.8-2

Common and Scientific Names of Fishes
Occurring in the Flambeau River
Between Ladysmith and Thornapple Dams

1972-1973 and 1987-1988

Family Common Name	Scientific Name
Acipenseridae	
*Lake sturgeon	Acipenser fulvescens
Catostomidae	
*White sucker	Catostomus commersoni
*River redhorse	Moxostoma carinatum
*Silver redhorse	Moxostoma anisurum
Centrarchidae	
*Black crappie	Pomoxis nigromaculatus
Bluegill	Lepomis macrochirus
*Pumpkinseed	Lepomis gibbosus
*Rock bass	Ambloplites rupestris
*Smallmouth bass	Micropterus dolomieui
Cyprinidae	
Blacknose dace	Rhinichthys atratulus
*Common shiner	Notropis cornutus
*Creek chub	Semotilus atromaculatus
*Emerald shiner	Notropis atherinoides
Hornyhead chub	Nocomis biguttatus
Longnose dace	Rhinichthys cataractae
Northern red-belly dace	Phoxinus eos
Redside dace	Clinostomus elongatus
Esocidae	
*Muskellunge	Esox masquinongy
*Northern pike	Esox lucius
Gadidae	
Burbot	Lota lota
Ictaluridae	
*Black bullhead	Ictaluras melas
*Channel catfish	Ictaluras punctatus
Percidae	
Johnny darter	Etheostoma nigrum
*Walleye	Stizostedion vitreum vitreum
*Yellow perch	Perca flavescens
Percopsidae	
Trout-perch	Percopsis omiscomaycus

*Species identified as part of 1987-1988 surveys.

3.8.2.6 Aquatic Tissue Chemistry

Fish

Six fish sampled from the Flambeau River above Thornapple Dam were analyzed for concentrations of arsenic, nickel, copper, lead, cadmium, chromium, zinc, selenium, silver, and mercury in fillets and liver. The species sampled include two walleyes *(Stizostedion vitreum)*, one shorthead sucker *(Moxostoma macrolepidotum)*, one silver redhorse *(Moxostoma anisurum)*, one northern pike *(Esox lucius)*, and one smallmouth bass *(Micropterus dolomieui)*. The fish were collected with experimental gill nets, identified, measured, and frozen prior to laboratory analysis. The liver and a fillet were dissected from each fish and analyzed as separate samples.

Copper was found in all of the samples, at levels ranging from 0.50 ppm to 6.3 ppm as dry weight. The highest copper values were 5.1 and 6.3 ppm, found in the livers of walleye and northern pike. Levels of copper in fillets ranged from 1.0 ppm to 4.6 ppm. Salanki *et al.* (1982), in studying pike-perch *(Stizostedion lucioperca)*, determined the liver to be the selected storage organ for copper in fish. They found levels of copper ranging from 1.72 ppm in muscle material to 7.73 ppm in liver tissue. Copper levels recorded for this study are similar to levels recorded by the WDNR from whole fish sampled in 1977 from the Flambeau River (WDNR, 1977). Whole-body copper levels reported by the WDNR in adult walleyes (11.3 to 17.8 inches in length) ranged from 0.70 to 0.90 ppm dry weight. The WDNR did not selectively analyze liver or fillet tissue for copper. There is no maximum acceptable level of copper in food stuffs. Copper levels found during the present study are generally comparable to previously-reported concentrations.

Concentrations of zinc in fish livers sampled from the Flambeau River during 1988 studies ranged from 5.3 ppm to 38 ppm with a mean of less than 13 ppm. The high of 38 ppm in northern pikes is an unexplained level--much higher than other samples from this study. The levels within the predator fish sampled were, in general, slightly greater than omnivorous fish. Zinc levels in fillets ranged from 6.0 to 9.0 ppm. Kleinert et al. (1974) found similar mean zinc concentrations of about 4.3 ppm in predatory fish sampled from the Flambeau River. There are no maximum acceptable levels for zinc in fish.

Mercury was detected in all of the fillet samples analyzed and in three to six liver samples. Concentrations were greater in the fillet samples, ranging from 0.26 ppm to 0.86 ppm, whereas values from the liver samples ranged from <0.07 ppm to 0.35 ppm. Salanki et al. (1982) also noted that mercury levels were lower in livers than in muscles of pike-perch from Lake Balton in Hungary. They recorded mean values of 0.35 ppm in liver and

0.46 ppm in muscle but noted that the kidney was the preferred storage organ for mercury in fish. Their fish kidney samples contained 1.35 ppm mercury. The WDNR (1977) recorded mercury levels in walleye fillet samples collected from the Dairyland Flowage of the Flambeau River ranging from 0.53 ppm to 0.99 ppm. This sampling site is upstream of the project area. Mercury is the only metal for which the U.S. Food and Drug Administration has established a maximum acceptable level in food stuffs. Their "action level" is 1 ppm. The WDNR has lowered this level to 0.5 ppm for children and pregnant women (pers. comm., R. Martin, 1989). Mercury is known to be present in the Flambeau River and to be readily accumulated in fish tissues. Older fish tend to have higher levels (pers. comm., L. Liebenstien, 1988).

Chromium was detected in one fish sample collected from the Flambeau River. A liver sample from a shorthead sucker contained 0.6 ppm chromium--slightly above the <0.5 ppm detection limit. Mathis and Cummings (1973) reported whole body chromium levels ranging from 0.02 to 0.27 ppm in carnivorous fish collected from the Illinois River. Although their detection limits were apparently lower, their values are representative of freshwater fish in the Midwest.

As presented in Table No. 3.8-3, fish analyzed for the remaining metals (As, Ni, Pb, Cd, Se, and Ag) were below detection limits. As noted, there was insufficient sample amount to determine arsenic and selenium levels in liver samples. The WDNR (1977) did not detect arsenic in fish analyzed from the liver in their studies. Composite minnow samples showed similar values. A selenium concentration of 4.7 ppm was reported for one composite but is well above the other nine values reported in Table 3.8-3.

Crayfish

Approximately 12 crayfish from locations M-2 and M-4 on the Flambeau River were selected for metals analysis. Sample sizes of other invertebrates were insufficient for metals analysis. The samples were a composite from the artificial substrate samples taken at each location.

There are no significant differences in the background metals from the two sites.

3.8.3 Tributary Streams

The study area includes two intermittent streams on the project area (Streams A and B), one intermittent stream south of the project area, (Stream C), and Meadowbrook Creek south of the project area as shown on Figure No.3.8-1. Roger Jasinski, WDNR Area Water Management Investigator, inspected the three streams and determined Streams A and B to be nonnavigable and intermittent (Appendix 3.8-B, Jasinski, 1988). In the project area the three streams are frequently dry and are unable to support measurable aquatic life. During Spring and Summer 1988,

Table 3.8-3

Fish-Invertebrate Tissue Metals

Control No.	Lab No.	Date Collected	Common Name	Sample Description	Sampling Location	Sex	Total Length (in.)	Weight (gm)	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	Hg
1	KENN 991A	8-24-88	Walleye	fillet	Thornapple Dam	F	20.0	1,000.2	<0.25	<0.3	1.8	<0.9	<0.1	<0.5	6.0	<0.25	<0.50	0.86
	KENN 991B	8-24-88	Walleye	liver	Thornapple Dam	F			IS	<0.3	5.1	<0.9	<0.1	<0.5	13	IS	<0.50	0.24
2	KENN 991C	8-24-88	Shorthead Sucker	fillet	Thornapple Dam	F	19.0	1,233.7	<0.25	<0.3	1.3	<0.9	<0.1	<0.5	5.6	<0.25	<0.50	0.26
	KENN 991D	8-24-88	Shorthead Sucker	liver	Thornapple Dam	F			IS	<0.3	0.5	<0.9	<0.1	<0.6	5	IS	<0.50	0.07
3	KENN 991E	8-24-88	Silver Redhorse	fillet	Thornapple Dam	F	18.0	897.9	<0.25	<0.3	2.2	<0.9	<0.1	0.5	6	<0.25	<0.89	0.30
	KENN 991F	8-24-88	Silver Redhorse	liver	Thornapple Dam	F			IS	<0.3	1.4	<0.9	<0.1	<0.5	9	IS	<0.50	<0.07
6	KENN 991G	10-28-87	Northern Pike	fillet	Thornapple Dam	M	20.0	866.2	<0.25	<0.3	1.0	<0.9	<0.1	<0.5	9	<0.25	<0.78	0.46
	KENN 991H	10-28-87	Northern Pike	liver	Thornapple Dam	M			IS	<0.3	6.3	<0.9	<0.1	<0.5	38	IS	<0.50	0.35
10	KENN 991I	6-20-88	Walleye	fillet	North of Meadbrk	M	14.0	407.9	<0.25	<0.3	4.6	<0.9	<0.1	<0.5	7	<0.25	<0.50	0.24
	KENN 991J	6-20-88	Walleye	liver	North of Meadbrk	M			IS	<0.3	2.0	<0.9	<0.1	<0.5	6	IS	<0.50	<0.07
13	KENN 991K	5-21-88	Smallmouth Bass	fillet	South of Meadbrk	M	13.0	441.2	<0.25	<0.3	2.1	<0.9	<0.1	<0.5	6	<0.25	<0.50	0.28
	KENN 991L	5-21-88	Smallmouth Bass	liver	South of Meadbrk	M			IS	<0.3	1.3	<0.9	<0.1	<0.5	5	IS	<0.96	0.07
15	KENN 119A	8-23-88	Crayfish	whole body					<0.25	<0.3	16.0	<0.9	<0.1	<0.5	25	<0.25	<0.50	<0.05
17	KENN 119B	8-23-88	Crayfish	whole body					0.26	20.3	21.0	<0.9	<0.1	<0.5	29	<0.25	<0.50	<0.05
8	KENN 120C	10-27-87	Misc. Minnows (1)	whole body	Meadowbrook Ck.				<0.25	<0.3	1.5	<0.9	<0.1	<0.5	40	0.25	<0.50	<0.05
9	KENN 120D	6-10-88	Misc. Minnows (2)	whole body	Flamb. at Meadbrk				IS	<0.3	2.0	<0.9	<0.1	<0.5	51	4.70	<0.50	<0.05

NOTE: "IS" = insufficient sample
Units = all units ug/g dry weight except for Hg which was analyzed wet.

the streams were visited periodically and found to be dry. Previous work done by Dames and Moore (1973) reported similar conditions for streams A, B, and C. Results of measurements in 1973 (BCMC, 1974) for these streams show them to have intermittent flows as follows:

Stream	Location	Max. Flow cfs
A	Project area	1.0
B	Project area	1.4
C	Control Area	6.2
Meadowbrook	Control Area	N/A

Meadowbrook Creek is the nearest stream with continuously flowing water. It is located south of the project area and drains several wetlands to the east of the project area. Steep slopes and an extensive floodplain near the mouth of Meadowbrook Creek are remnants of high flows formerly carried by the creek. Early successional plants in the floodplain area are indicative of higher water levels prior to the removal of the Port Arthur Dam.

Water levels at the mouth of Meadowbrook Creek fluctuate in conjunction with water level fluctuations of the Flambeau River caused by varying discharge rates at Dairyland Dam. The depth of Meadowbrook Creek at its mouth was 2.6 feet during 1987 sampling. Dames and Moore (1973) determined the creek depth to be approximately 0.5 feet at a point 0.5 miles east of its confluence with the Flambeau. The littoral bottom of Meadowbrook Creek is similar to the Flambeau River, including sand, gravel, boulders, and silt.

3.8.4 Wetlands

Criteria for including a given area in the wetlands inventory include the presence of hydric soils, as listed by the Soil Conservation Service for Rusk County, and/or the occurrence of aquatic or hydrophytic vegetation. Wetlands occurrences are shown on Figure 4 of the Wetlands Inventory and Assessment, which forms Appendix 3.8-C of this report. The soils were mapped by the U.S. Department of Agriculture (USDA) Soil Conservation Service. Vegetation was mapped by Foth & Van Dyke using full spectrum color and color infra-red aerial photography flown in 1987. A site reconnaissance and vegetation survey completed during Fall 1987 and Spring and Summer 1988 verified the limits of each wetland.

Similar hydrophytic vegetation and hydric soil criteria are used by the U.S. Fish and Wildlife Service (refer to Appendix 3.8-C) to identify wetlands on a national scale. Listed in descending order, palustrine and riverine are the major systems identified

in the study area. The palustrine system comprises nontidal wetlands bounded by upland and dominated by trees, shrubs, persistent emergents, emergent mosses or lichens. Further breakdown of classes and subclasses identifies more specific characteristics of each wetland. The riverine system refers to the Flambeau River and its banks.

Figure 4 in the Wetlands Inventory and Assessment, Appendix 3.8-C, identifies ten wetlands in the wetland study area. They are classified into six plant communities; northern wet forest, northern sedge meadow, northern wet forest, alder thicket, northern mesic forest, and bog. The largest, covering 58 acres, is a perched wetland located east of the project area. This community is a combination of bog, alder thicket, and northern wet communities. The largest undisturbed wetlands on the open pit site are Wetland Areas 1 and 2, which are 5.4 and 2.5 acres, respectively. They are classified as northern wet-mesic forests. The remaining wetlands on the wetland study area are primarily disturbed and isolated depressions in upland areas.

Appendix 3.8-C contains further information on the wetlands of the study area.

3.8.5 Ecological Relationships

The water of the Flambeau River can be characterized as moderately soft (Section 3.7, this report). In general, the surface waters of the Flambeau are of high quality and support a diverse and high quality macroinvertebrate community with a composition indicative of relatively clean, fast flowing, unpolluted water conditions as described by Edmonds et al., 1976. The common occurrences of mayflies and stoneflies at all stations in 1987-88 indicates clean water conditions and their high abundance provides game fish with an adequate potential food source.

Water quality has improved since 1973, when Chironomids dominated the macrobenthic invertebrate community, and black bullheads the fish community. At this time, Chrionomids, Ephemeroptera, Plecoptera, and Tricopterans have increased in frequency, indicating improving habitat conditions.

Fish populations in the river proper were very difficult to sample during the current study period due to extremely low flows. However, the available data indicates a healthy community structure with all tropic levels represented.

Wetland Areas 1 and 2 are associated with outwash parent material. Seeps and springs occur at the contact point of outwash sands and at the perched water table of the upland till material. The seeps and surface drainage provide the water needed to support wetland conditions and provide flow for intermittent Streams A and B. Streams A and B are part of two subwatersheds on the site. Flows in Streams A and B occur

generally during spring runoff and in years with above-average rainfall. Therefore, the aquatic life that may be present is ephemeral, and contribute insignificantly to the overall project area productivity.

The fact that two species of periphytic algae dominated the Aufwuchs community in the study area during 1988 probably reflects stressed conditions due to low flow and high water temperatures. The low frequency of algae-feeding macroinvertebrates in the Flambeau River is probably a direct result of the sparseness of algae present. Dames and Moore (1973) also reported sparse algae growth and low densities of herbivorous macroinvertebrates present. Also, during August of 1988, many dead crayfish (*Ocronectes virilis*) were found in the riffle area at sampling station M-2. A survey of about 1,000 feet of the eastern shoreline of the river revealed over 100 dead individuals.

The low number of fish caught by hook and line in 1988, 0.15 fish per manhour of fishing, indicate sparse fish populations near the project area. Low fish populations in this section of the Flambeau River were also observed by Dames and Moore (1973). They listed several factors that may contribute to low fish populations:

- Lack of protective in-stream cover and physical habitat diversity.
- Low abundance of planktonic fish food.
- Fluctuating water levels during spawning seasons.
- Low calcium carbonate hardness, which may be directly related to productivity.
- Lack of pools as fish habitats.
- Removal of Port Arthur Dam, which changed habitat and abundance of fish.

3.8.6 Rare, Endangered or Threatened Species

As of November 1988, the Wisconsin Natural Heritage Inventory identified 14 endangered or threatened fish species in Wisconsin (Appendix B of the Wetlands Inventory and Assessment, Appendix 3.8-C). During the 1972-1973 and 1987-1988 collection period, 26 species of fish were identified between Ladysmith Dam and Thornapple Dam (Table No. 3.8-2). None of the species identified are recognized as endangered or threatened.

Three of the species observed in 1972-1973 and/or 1987-1988, lake sturgeon (*Acipenser fulvescens*), redside dace *Clinostomus elongatus*), and river redhorse (*Moxostoma carinatum*) are considered rare in parts of their range. Three sturgeon were

observed by Foth & Van Dyke personnel during gill netting operations on the Thornapple Flowage, one in October 1987 and two in August 1988. The fish ranged in length from 19.5 to 29.0 inches respectively. WDNR officials recorded a 20.2 inch sturgeon while boomshocking the Thornapple Flowage in May 1988. A 41-inch sturgeon was also caught in hook-and-line sampling on the Thornapple Flowage in August 1988. In all occurrences, the fish were handled with care and released without injury.

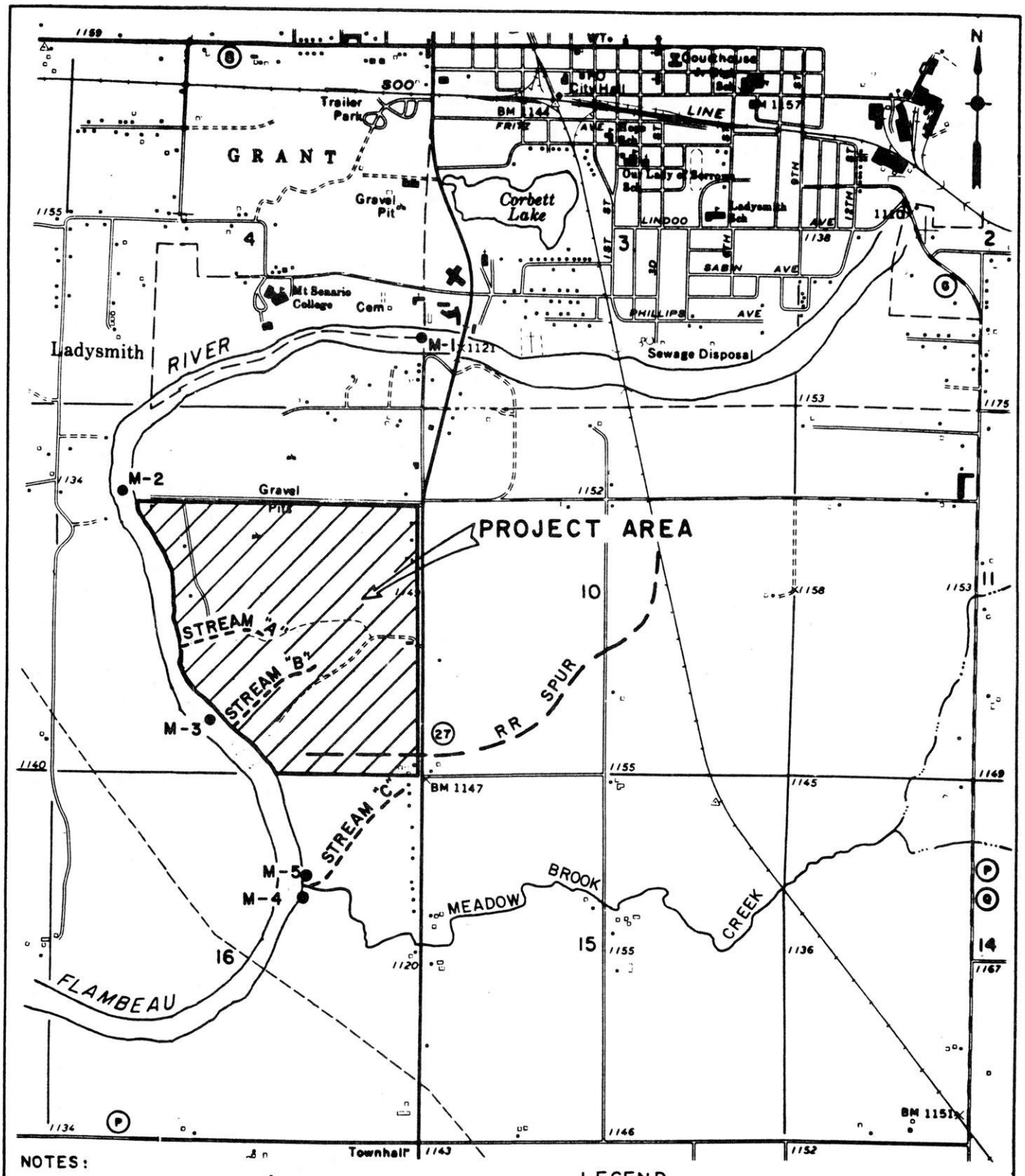
Two redside dace were identified during fish trapping operations at Meadowbrook Creek in October 1987. The dace were identified and frozen for heavy metals analysis.

River redhorse were identified during fish surveys conducted in 1972-1973 (Dames and Moore, 1973), but were not found in 1987-1988.

3.8.7 Summary and Conclusions

Results of the work performed in 1972-1973 by Dames and Moore (1973) and recent work reveal the Flambeau River to be limited in diversity and overall productivity. Water quality studies show no apparent adverse effects due to water pollution. Other factors related to the physical and hydrologic characteristics of the river probably are significant in their influence on the biological community. These factors include rapid and frequent fluctuations in flow, water depths, scouring action, water temperature, and variability in light penetration at a given location. These factors have been shown to affect abundance and distribution of attached algae and macroinvertebrates.

Figures for Section 3.8



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

LEGEND

●M-3 AQUATIC SAMPLING LOCATION

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

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.8-1
AQUATIC SAMPLING LOCATIONS

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

Job No	Dwg No	REV

3.9 Terrestrial Biology

Flora and fauna sampling techniques were developed to identify and describe major terrestrial communities and to evaluate impacts of the proposed project on these communities. Terrestrial communities were systematically sampled to supplement data collected in the 1970s (BCMC, 1974). The following field activities occurred during the study period:

- Observation, collection, and identification of flora and fauna species at the proposed site.
- Analysis of aerial photographs and "ground-truthing" of major flora communities to update plant community maps.

3.9.1 Field and Laboratory Methods

3.9.1.1 Soils

3.9.1.1.1 Mapping

The soils on the environmental study area illustrated on Figure No. 2 in the Wetlands Inventory and Assessment (Appendix 3.8-C) were mapped by the U.S. Department of Agriculture, Soil Conservation Service (SCS) personnel in 1964-1966. Updated mapping by SCS personnel in June and August 1988 was conducted upon request of Foth & Van Dyke in order to verify soil boundaries. Soil mapping was completed in accordance with SCS guidelines and soil classification procedures. Field verification included soil identification with 60-inch soil borings, aerial photo interpretation, and surface topography relationships.

3.9.1.1.2 Heavy Metals Analysis in Soils

Soils sampled for heavy metals analysis were collected from three sites on the control area and three sites hydrologically downgradient from the deposit. Three composite samples were collected within ten inches of the surface and stored in a labeled polyethylene bag. The samples remained refrigerated prior to laboratory analysis. Equipment used in collecting the samples was washed with distilled water between sample locations to prevent cross-contamination. The soils were analyzed for the following metals: mercury (Hg), nickel (Ni), copper (Cu), lead (Pb), selenium (Se), chromium (Cr), cadmium (Cd), silver (Ag), zinc (Zn), arsenic (As), and uranium (U). These were selected during the scope of study development process.

3.9.1.2 Vegetation

Plant communities on the study area were sampled systematically by community type to verify and supplement species identified by Matson (1974). Of the eight different plant communities that were on the study area proposed for mining and processing in

1973, which included a much larger area, six are represented on the currently proposed project area, including:

- Mixed, lowland, deciduous-coniferous forest.
- Mixed, upland, deciduous-coniferous forest.
- Alder thicket.
- Old field/early successional.
- Northern sedge meadow.
- Disturbed/residential area.

Field identification and qualitative sampling were used to update the existing species list. Special attention was given to habitats that could potentially support species identified as endangered or threatened, by the Wisconsin Bureau of Endangered Resources. During previous work and the recent study, no endangered or threatened species were found within the area to be affected by the project.

3.9.1.2.1 Mapping

Vegetation on the environmental study area was identified using color aerial photography (September 1987; scale 1"=200 and 1"=500) in conjunction with field reconnaissance.

Wetland mapping was conducted on the study area using aerial photos, intensive ground-truthing, and soils information. A 100-foot grid method was used to map wetland vegetation where photographs and available mapping were inconclusive.

For example, the mixed lowland deciduous-coniferous wetland on the study area was mapped by flagging boundaries, surveying the perimeter, identifying wetland vegetation, and plotting this information on large-scale topographic maps. This lowland deciduous forest was mapped by identifying and mapping vegetation encountered on a 100-foot grid. Further ground-truth mapping was conducted east of State Highway 27 (STH 27) in the area of the proposed railroad spur.

Field verification of wetlands was conducted by Robert Read, Botanist, and Thomas Hunt, Reclamation Specialist, Wisconsin Department of Natural Resources (WDNR). Figure No. 3 in the Wetlands Inventory and Assessment (Appendix 3.8-C) identifies plant communities observed on the study area.

3.9.1.2.2 Quantitative Sampling

Quantitative sampling techniques were used to identify plant species in the study area in 1973. Data presented herein is a composite of Matson's (1974) work and field observations completed during this study. In 1987-1988, plants were collected and identified from the six previously mentioned communities on the study area during spring, summer, and autumn seasons. Field personnel systematically transected each community and collected and/or identified species.

Matson (1974) used the Point-Quarter Method to quantify woody species in each community. The following is a summary of his procedures and calculations:

1. Stations were established 25 steps from each other along a predetermined compass line.

2. Each station was divided into four quarters or quadrants by visualizing the compass line and a line crossing it at right angles.

3. The closest tree (minimum of three-inch diameter) to the point was selected in each quarter. Each tree was measured for diameter at breast height, distance from the point, and the species name recorded (Smith, 1966).

Computations

1. Basal area = R^2

2. Relative frequency = $\frac{\text{\# of points of occurrence of each species}}{\text{\# of points of occurrence of all species}} \times 100$

3. Relative density = $\frac{\text{\# of individuals of species}}{\text{\# of individuals of all species}} \times 100$

4. Relative dominance = $\frac{\text{Total basal area of the species}}{\text{Total basal area of all species}} \times 100$

5. Average distance = $\frac{\text{Sum of all distances}}{\text{Total number of trees}}$

6. Trees per acre = $\frac{43,560}{\text{Average distance (2)}}$

7. Average basal area per tree = $\frac{\text{Total basal area}}{\text{Total \# of trees}}$

8. Basal area per acre = trees per acre x average basal area per tree.

3.9.1.2.3 Qualitative Surveys

Qualitative vegetation surveys were conducted in each community on the site. Surveys were conducted during October 1987 and May, June, July, and August 1988. Plant communities were randomly transected in the field to identify and/or collect plants encountered. Plant species were identified using Britton and Brown (1970), Courtenay and Zimmerman (1972), Peterson (1968), Brockman (1968), Fassett (1951), and Fassett (1957).

Species identified were added to the existing species list compiled by Matson (1974), and a comprehensive list was prepared for the study area. A summary of the revised comprehensive species list is included in Appendix 3.9-A.

3.9.1.2.4 Heavy Metal Analysis in Vegetation

Vegetation samples were collected from three locations on the project area and a control area location illustrated on Figure No. 3.9-1. Vegetation was collected in June 1988. Collection points on the open pit site include Site 1, which was located over the northwest end of the deposit, and Site 2, which was located west and downgradient of the deposit. The third open pit location was selected west of the site.

The control area was selected because it is owned by Kennecott and is not influenced hydrogeologically by the deposit. This area is also very similar to the project area in topography, soils, and vegetation.

The vegetation was analyzed for the following metals: mercury (Hg), nickel (Ni), copper (Cu), lead (Pb), selenium (Se), chromium (Cr), cadmium (Cd), silver (Ag), zinc (Zn), arsenic (As), and uranium (U). The absorption, accumulation and release of heavy metals are known to vary from species to species (Gerloff *et al.* 1966). To reduce variability in the heavy metal data, three common plant species were sampled. These three species were used for similar purposes at a northeastern Wisconsin site, so comparative data is available. New foliage from balsam fir (*Abies balsamia*), red raspberry (*Rubus idaeus*), and Pennsylvania sedge (*Carex pennsylvanica*) were collected from each of the six sampling locations.

Plant tissue samples were collected by hand. Each discrete or composite sample was sealed in an airtight polyethylene bag and labeled. Each sample was washed with distilled water to remove dust and other surface contaminants and was then sealed into another plastic bag and refrigerated prior to laboratory preparation.

Each sample was oven-dried and weighed prior to being acid-digested in the laboratory. Various techniques were used to digest each individual metal (ORTEK, 1988).

3.9.1.3 Wildlife

3.9.1.3.1 Mammals

Terrestrial vertebrates were observed, sampled, and collected to qualitatively determine species present. Data was gathered from visual observations, trapping, voice recordings, and from review

of previously collected data from the project area and from the region. Visual observations by field personnel were recorded into a field log or on special observation forms.

Small mammals were captured using Sherman live traps, museum specials, and large snap traps baited with peanut butter and sunflower seeds. Traps were set on three different grids on the open pit site and at four locations in the control area as illustrated on Figure No. 3.9-1.

Approximately 50 traps were set in each habitat on a grid pattern at 15-foot intervals and checked in the morning following a 24-hour period. All mammals caught were identified, weighted, sexed, measured, and frozen in a labeled polyethylene bag for laboratory analysis.

Specific trapping grid locations were selected to sample a cross section of the available habitats. Area A includes old field and early successional habitats with a history of disturbance (clearing and agricultural activity) in the past 20 years. Area B supports old field, and lowland and upland deciduous habitats. Area C borders a wetland area and supports an early successional forest with a history of recent disturbance.

The control area is located approximately 2,500 feet south of the project area, near Meadowbrook Creek, and is not hydrologically influenced by the deposit. Soils, vegetation, and wetland conditions are similar to those found in the three sample locations on the project area. A total of 50 traps were set in each area. A total of 750 trap nights were recorded on these three areas and on the control area. Trapping occurred in October 1987 and during spring and summer periods in 1988.

3.9.1.3.2 Birds

Bird observations were conducted by Foth & Van Dyke personnel during Fall 1987 and Spring and Summer 1988. Five bird observation routes were established to qualitatively determine species in a variety of habitats on or adjacent to the mine site. These routes were selected to include all major habitat types on the site. Habitats transected by the five routes are as follows:

- Old field, upland deciduous, wetland and early sucessional habitats.
- Wetland, field, and lowland mesic habitats.
- Shoreland meadow, and riverine habitats.
- Lowland deciduous, early successional, and upland deciduous habitats.
- Wetland and lowland wet mesic habitats.

The observers identified songbirds, upland gamebirds, and waterfowl by sight and song. The procedure for each route including stopping at regular intervals and identifying birds for approximately three to five minutes. Each transect lasted approximately 60 minutes.

Incidental field observations, and observations along five prescribed routes established in different habitats as shown on Figure No. 3.9-2, were recorded. Additional information on avian species was gathered by randomly walking the study area and noting observations in field logs as to time, location, and date observed.

3.9.1.3.3 Amphibian and Reptiles

Amphibian and reptile observations on the study area were recorded during October 1987, and May and June 1988 field activities. Voice surveys of amphibians were recorded at five survey points during May and June using a cassette recorder for a period of ten minutes in the evening during spring singing rituals. These survey points are illustrated on Figure No. 3.9-2. The survey points included wet mesic forest surrounded by upland forest, alder thicket, wet meadows, and bog wetland habitats.

Reptile surveys included incidental observations during normal field work on the study area. Additional species were added to the existing list of amphibian and reptile species observed during 1973 field work.

3.9.1.3.4 Heavy Metal Analysis in Mammals

Small mammal samples were collected from three specific areas within the project area as shown on Figure No. 3.9-2 and from various locations within the control area. Red-backed vole (*Clethrionomys gapperi*) and deer mice (*Peromyscus maniculatus*) were selected for analysis because they were abundant at both the project and control sites and because they represent a herbivore and an omnivore, respectively. All samples were analyzed for arsenic, nickel, copper, lead, cadmium, chromium, zinc, selenium, silver, mercury, and uranium. Four red-backed voles and eight deer mice were analyzed from Area B and the control area. The largest individuals within each species were selected for tissue analysis to achieve a representative value.

After each individual was captured, it was identified, sexed, and placed in a polyethelene bag. The samples were then frozen prior to processing in the laboratory. Processing procedures included purging the small intestine with distilled water to remove digested material. The whole carcasses were blended as a preparation technique prior to acid digestion. The blender was

washed beween samples to prevent cross-contamination. Laboratory techniques used to digest the metals are discussed in ORTEK (1988).

3.9.1.3.5 Heavy Metal Analysis in Soil Invertebrates

Earthworms were collected for heavy metal analysis from Wetland Areas 1 and 2 on the project area and from the control area. Sample locations included organic soil conditions. Composite soil invertebrate samples were collected from each of the four sample locations.

Approximately 15 soil invertebrates were collected from each sample location. Following sample collection, the invertebrates were washed with distilled water and frozen prior to laboratory analysis. The reader is referred to ORTEK (1988) for laboratory procedures used to digest each tissue sample.

3.9.1.4 Threatened or Endangered Species

A list of threatened or endangered terrestrial species published by the Wisconsin Bureau of Endangered Resources is located in Appendix B of the Wetlands Inventory and Assessment (Appendix 3.8-C). Field observations in habitats that could support endangered or threatened species were included in the 1987-88 studies. While a bald eagle was observed using the Flambeau River west of the project area, no endangered or threatened species were collected or otherwise observed on the project area.

3.9.1.5 Quality Control Procedures

Field and laboratory quality control procedures were utilized as a means to assure that the techniques used to study terrestrial biology were completed according to currently accepted standards and methods. Identifications were cross-checked with available survey information.

3.9.1.5.1 Field Procedures

Field procedures were recorded daily in a field journal by all field personnel. Journal entries included date, time, individuals involved, and a detailed account of work completed or terrestrial life observed. Personnel directing the field studies were trained field biologists.

Bird survey observation forms were completed during bird transects on the study area. The number and species encountered were recorded along with date, time, and weather conditions. Incidential observation made during other field activities were recorded in the field book as to date, time, and weather conditions.

Fauna observed by field personnel on the project area were recorded daily in a field journal. Additional on-site faunal observations were periodically made by Joe Gorla, a local field investigator, during the study. Observations were documented by species, location, time of day, and date.

Wisconsin Department of Natural Resources (WDNR) personnel accompanied Foth & Van Dyke scientists during periodic site investigations. WDNR officials inspected trapping and sampling techniques and offered expert consultation throughout the study.

Plant, mammal, amphibian, and reptile specimens were collected and preserved whenever possible. Each collection was documented by date, time, location, and individual collector.

Photography was used to document methodologies, techniques, and flora and fauna encountered.

3.9.1.5.2 Laboratory Procedures

Plant and animal specimens collected for heavy metal analysis were frozen prior to laboratory analysis. Selected samples were tested for mercury (Hg), nickel (Ni), copper (Cu), lead (Pb), silver (Ag), zinc (Zn), arsenic (As), selenium (Se), chromium (Cr), cadmium (Cd), and uranium (U). Analysis was conducted by Foth & Van Dyke's affiliated laboratory using accepted preparation and analytical techniques (ORTEK, 1988).

Certain specimens collected during the study period are preserved and are on file at the laboratory. Some specimens have been donated to the Milwaukee Public Museum and are preserved as voucher specimens to document occurrences in Rusk County.

3.9.1.5.3 Data Analysis

Field data was analyzed using a desktop calculator, plus spreadsheet and word processing computer programs. All results were checked for accuracy by the machine operator and field personnel.

3.9.2 Soils Data

For specific information regarding the types of soils present within the study area, refer to Section 3.5 - Geology.

3.9.2.1 Soils: Heavy Metals Analysis

Soils were gathered for heavy metals analysis from six sampling locations on the study area as shown on Figure No. 3.9-2. Samples from locations A, B, and C were collected from wetlands near the west end of the deposit. These locations are downgradient of the deposit. Control samples D, E, and F were gathered from soils associated with seeps on the control area.

Hydrologically, the seeps are not affected by the deposit, and the soils are similar in soil characteristics to those samples collected from the project area.

The samples consisted of moist, black, organically rich soils composited from the top ten inches of soil at the three discrete locations at each site. In selecting the sampling sites, it was desired to obtain samples of soils with the highest possible heavy metal content, in order to represent "worst case" conditions. Because the organic content of soils is a significant positive covariate with most heavy metals, and because soils vary considerably in composition on local levels, care was taken to select only organically rich wetland soils. In addition, topsoil samples from the east, central, and west portions of the proposed open pit area were analyzed for certain metals. These are referred to as general composite samples in this section.

Table No. 3.9-1 shows concentrations of the 11 metals analyzed: arsenic, nickel, copper, lead, cadmium, chromium, zinc, selenium, silver, uranium, and mercury for the wetland soil samples. The mean values for lead, arsenic, copper, cadmium, zinc, and silver range from approximately 1.5 times to 4.5 times as high on the project area as on the control area.

The mean value of copper on the project area was two times the amount found on the control area. All three samples collected on the project area had higher copper values than any sample collected on the control area. General composite samples for the project area had copper values that ranged from 2.7 to 4.0 ppm (refer to Table No. 3.5-9).

Lead concentrations for wetland soils on the project area were about four times higher than those from the control area. General composite soils on the project area had concentrations ranging from 5.0 to 10.0 ppm.

The mean cadmium level for wetland soils on the project area was 1.0 ppm. Locations A and B had levels of 1.2 ppm and 1.3 ppm, respectively, whereas Location C concentrations were below the detection limit of <0.5 ppm. Control area levels at the three locations were below detection limits. Life Systems (1987), under contract by the U. S. Environmental Protection Agency reported typical soil levels of cadmium of approximately 0.26 ppm. General topsoil composites from the project area were all less than 0.5 ppm. This indicates that levels found on the control area are within typical ranges for background soils reported elsewhere.

Mean concentrations of zinc from project area wetland soils are approximately 2.5 times higher than the mean value on the control area. Zinc levels on the project area ranged from 50 ppm to 91 ppm whereas on the control area they ranged from 19 ppm to 33 ppm. Zinc is a necessary micronutrient in soils.

TABLE NO. 3.9-1

Soil Samples for Heavy Metals Analysis

Sample No.	Sampling Location	Date Collected	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	U	Hg
KENN 600A-1	Mine Site-Wetl #1	6-29-88	4.8	7.0	23	29	1.2	7	66	<0.5	0.07	0.25	<0.10
KENN 600B-1	Mine Site-Wetl #1	6-29-88	6.5	11	42	46	1.3	16	91	<0.5	0.12	0.39	<0.10
KENN 600C-1	Mine Site-Wetl #1	6-29-88	4.1	6.5	28	29	<0.5	18	50	<0.5	0.07	0.7	<0.10
KENN 600D-1	Control Area	6-29-88	2.8	13	15	8	<0.5	45	29	<0.5	0.03	0.7	<0.10
KENN 600E-1	Control Area	6-29-88	4.5	11	22	10	<0.5	21	33	<0.5	0.03	0.04	<0.10
KENN 600F-1	Control Area	6-29-88	2.6	7.5	7	5	<0.5	14	19	<0.5	0.02	0.6	<0.10
Mean Value for Site =			5.1	8.2	31	35	1.0	14	69	<0.5	0.09	0.45	<0.10
Mean Value for Control =			3.3	10.5	15	8	<0.5	27	27	<0.5	0.03	0.45	<0.10

1. Soil samples were composites taken from 0 to 12 inches at three discrete locations. All sampling sites were saturated and located in groundwater seep areas. Soils were a very dark, fine organic muck.

2. All units ug/g dry weight except mercury which was analyzed without drying.

Soil concentrations of silver on the site (0.09 ppm) are higher than those found on the control area (0.03 ppm). Levels on the site range from 0.07 to 0.12 ppm. Levinson (1974, pp. 43-44) reports the average abundance of silver in soils worldwide to be 0.1 ppm, which corresponds to the values found in the project area.

Mean values of nickel, chromium, and uranium were higher on the control area than the project area. Concentrations of chromium from soils in the control area ranged from 14 to 45 ppm whereas site values ranged from 7.0 to 18.0 ppm. Levinson (1974, pp. 43-44) reports typical worldwide values in soils as follows: nickel (5-500 ppm); chromium (5-1,000 ppm); uranium (1 ppm).

The mean concentration of nickel in soil samples from the control area is slightly higher (10.5 ppm) than on the project area (8.2 ppm). Uranium concentrations from the control area soils compare very closely to the project area values. The control area had a mean value of 0.45 ppm, the same as the mean concentration on the project area.

Levels of mercury and selenium samples from the project area and the control area were below detectable limits (Table No. 3.9-1).

3.9.3 Vegetation Data

3.9.3.1 Regional Study Area

Prior to settlement, Wisconsin was divided into two major vegetational ecotypes. A transition zone extended roughly southeast from St. Croix Falls to Eau Claire to Stevens Point to Appleton to Milwaukee, separating northern and southern ecotypes (Curtis 1959). South of the transition zone, a widespread occurrence of prairie-forest plant communities existed. North of the transition zone, conifer-hardwood plant communities primarily dominated. According to Curtis, the two major floristic provinces do not have entirely similar climates. The northern zone, which includes Rusk County, has a shorter growing season, lower annual temperature, and lower evaporational stress to which the conifer-hardwood forest ecotype has adapted.

Curtis (1959) identifies the original ecotype in the regional study area as northern mesic forest. Dominant species found in this region include sugar maple (*Acer saccharum*), hemlock (*Tsuga canadensis*), beech (*Fagus grandifolia*), yellow birch (*Betula lutea*), and basswood (*Tilia americana*), with smaller abundances of white pine (*Pinus strobus*) and red pine (*Pinus resinosa*). Associated lowland swamp species include tamarack (*Larix laricina*), black spruce (*Picea mariana*), and white cedar (*Thuja occidentalis*).

3.9.3.2 Vegetation on the Study Area

Major plant communities were identified on the study area as illustrated in Figure No. 3 in the Wetlands Inventory and Assessment, Appendix 3.8-C, in 1972-1974 and 1987-1988. Matson (1974) quantitatively and qualitatively identified five cover types on the study area: mixed deciduous-coniferous upland; old field; meadow; field; and residential/industrial. Aerial photography interpretation and field identification, in conjunction with a comprehensive forest inventory by Lee in 1988, contained in Appendix 3.9-B, was used in interpreting plant communities present on the site area. Current cover types include: upland mixed forest; lowland mixed forest; coniferous plantings; old field; agriculture; wetland; and residential/industrial. All of the study area appears to have been culturally affected in the past by activities such as logging, farming, draining low areas, and road construction.

Comparison of 1974 and 1988 qualitative maps of the site area indicates successional as well as cultural changes in vegetative cover. Aspen ranging between 15 and 35 years old have invaded the residential/industrial and old fields mapped in 1974 within the northwest and east-central portions of the project area. Conifers ranging between 8 and 18 years old have also been planted throughout the site in previously farmed areas.

The 1974 survey did not specifically identify the mixed lowland forest (i.e., Wetlands 1 and 2 as described in the Wetlands Inventory and Assessment, Appendix 3.8-C) at the west end and northwest of the proposed open pit. These were described and studied during the 1987-1988 field efforts.

The following is a detailed description of vegetation found within the seven cover types.

Upland Mixed Forest

The mixed upland forest is the largest community found on the project area, comprising 35.5 percent of the total. This community includes northern hardwood and aspen stands mapped by Lee (1988). Dominant species identified are sugar maple, red maple (*Acer rubrum*), basswood, white ash (*Fraxinus americana*), quaking aspen (*Populus tremuloides*), and big-tooth aspen (*Populus grandidentata*) which, according to Curtis (1959), categorizes this area as a northern mesic forest community. Matson (1974), using relative density figures from Quarter Method tables, determined the dominant species to be: red maple, white birch (*Betula papyifera*), black ash (*Fraxinus nigra*), hemlock, sugar maple, elm (*Ulmus americana*), basswood, quaking aspen and bur oak (*Quercus macrocarpa*).

Seventy-nine percent of the mixed hardwood community on the site consists of pole-sized timber, 5-11 inches in diameter at breast height (dbh). The majority of pole-sized timber implies that this community is medium-aged, ranging from 30 to 60 years old. Matson (1974) observed that site vegetation had been disturbed on several occasions within recorded history. During his work, he noted that the mature trees had been removed for pulpwood.

Sugar maple is the most dominant canopy species, as measured by Lee (1988). It accounted for 79 percent of the total board feet measured, for trees with greater than 15-inch dbh. Ash was the second most dominant species, and is responsible for 15 percent of the total. Red maple, basswood, and elm represent species less important to the structure of the community. Special note should be given to aspen stands which dominate some areas that were recently disturbed and which are currently in early successional stages.

In Matson's work, an unusually large number of dead trees were noted on the proposed pit area. Upon analysis of a one-acre quadrant, it was discovered that 23 percent of the trees were dead. Further analysis indicated 88 percent of the dead trees were butternut hickory (*Carya cordiformis*). Matson theorized that the removal of Port Arthur Dam in 1968 caused lowering of the water table, thus causing a "die back" of butternut hickory, a tree associated with wet bottomlands. This lowering of the water table may be responsible for changing the structure of the community from wet mesic-mesic northern forest as described by Matson to a true mesic northern forest as described in this report.

Matson identified 56 families of flora on the site area. The most prevalent ground layer forbs include Liliaceae, Ranunculaceae, Polypodiaceae, Violaceae. The most prevalent spring flowers identified include wood anemone (*Anemone quinquefolia*), hepatica (*Hepatica acutiloba*), Canada mayflower (*Mainthemum canadense*), twisted stalk (*Streptopus roseus*), and trillium (*Trillium grandiflorum*). In comparison, Curtis (1959) studied 58 families that represent the total flora in a mesic-northern hardwood forest. He found Liliaceae, Cyperacea, Rosaceae, Compositae, and Ranunculaceae as dominant families. The most common species identified by Curtis include Solomon's-seal (*Polygonatum pubescens*), Canada mayflower wild sarsaparila, (*Aralia nudicaulis*), and twisted stalk.

Lee (1988) calculated pulpwood and saw timber volumes for the project site. Mixed hardwood trees account for 67 percent of total pulpwood cords and 58 percent of saw timber (board feet). The total value of hardwood, pulpwood, and saw timber on the

site equals about $12,800. According to Lee the stocking class or growing space effectively used by trees in this ecotype is medium to full (40-100 percent+) pole timber and saw timber.

Mixed Lowland Forest

The project area contains about eight acres or 2.7 percent of mixed lowland forest. As discussed in the wetland assessment, this area is classified as a northern wet-mesic forest community, and lies directly over the open pit area on the west side. This area is shown on Figure No. 4 in the Wetlands Inventory and Assessment, Appendix 3.8-C. Matson (1974) and Lee (1988) did not distinguish this area as a separate community in their work; therefore, quantitative figures are not available.

Major canopy trees observed include balsam fir (*Abies balsamia*), white cedar, black ash, and hemlock. These species form a dense to sparse canopy layer throughout the ecotype.

Balsam fir, tag alder (*Alnus rugosa*), hemlock, and red maple are the important species in the understory. Areas with a dense canopy layer, which restricts sunlight penetration, contain little or no understory. In these areas the ground cover is primarily forest litter and club moss (*Lycopodium* sp.). Portions of the community with an open canopy layer have a more dense understory.

The ground layer vegetation contains 34 species that are largely associated with cool, moist forest conditions. Club moss (*Lycopodium*), goldthread (*Coptic groenlandicum*), starflower (*Trientalis borealis*), and clintonia (*Clintonia borealis*) are species commonly found in this community. These findings are in conformance with Curtis (1959) for species in a northern wet-mesic forest community. Species associated with standing water--for example, marsh marigold (*Caltha palustris*)--were also found in shallow ponds on site. Wet soil conditions were found in the wet-mesic forest during the entire length of the growing season.

Conifer Plantings

Lee (1988) distinguishes ten separate conifer plantations, covering a total of 28 acres within the project area, and groups them into four timber types. Mixed conifers account for about 14 acres, or 52 percent of the total conifers planted on the project area. Two stands along State Highway 27 are largely white spruce (*Picea glauca*), red pine (*Pinus resinosa*), jack pine (*Pinus resinosa*), and white cedar. The average diameter at breast height is approximately one inch. These stands are roughly 15 years old; they were planted in 1973 to provide a vegetative screen for the proposed mine and facilities.

Thirty-seven percent, or about 11 acres, of the conifer plantations comprise six red pine plantations scattered throughout the project area. The average diameter at breast height of five of the stands is 6.5 inches. The stands range from 15 to 20 years old. Lee states that the stands are overstocked and could be maintained by thinning. The sixth stand of red pine, on the northern side of the open pit area, consists of eight-year-old seedlings. These trees were planted in 1983 and have an average diameter at breast height of less than one inch.

Two white spruce plantations on the project area appear to have been planted as three-year-old seedlings in 1973. These 15-year-old stands include white spruce saplings, approximately one inch in diameter. The stands account for about 3 acres, or 11.0 percent of the total conifer plantations on the project area.

Old Field

The old field community is old agricultural fields that have been idle for several years and have been allowed to proceed in natural succession. Figure No. 3 in the Wetlands Inventory and Assessment (Appendix 3.8-C) shows areas identified as old fields. This cover type includes about 55 acres or about 19 percent of the total project area. This is the second-largest natural community on the site and includes invading early successional trees, shrubs, herbaceous plants, and grasses.

Matson (1974) studied old field communities on the site and found invading quaking aspen, big-toothed aspen, white birch, (*Betula papyifera*), staghorn sumac (*Rhus typhina*), and choke cherry (*Prunus virginiana*). The most prevalent of the 33 families found in ground layer vegetation were Gramineae, Compositae, Caryophylaceae, Cyperaceae, Rosaceae, and Leguminosae. Twenty-five total families were found during 1988 field identification; the most dominant include Compositae, Graminae, and Rosacea, which closely relates to those found by Matson. Common species include: timothy (*Phleum pratense*), quack grass (*Agropyron repens*), Kentucky bluegrass (*Poa pratensis*), yarrow (*Achilles millefolium*), daisy fleabane (*Erigeron strigosus*), pussy toes (*Antennaria plantaginifolia*), wild strawberry (*Fragaria virginiana*), chickweed (*Stellaria graminea*), red clover (*Trifolium pratense*), and white clover (*Trifolium repens*). If the process of natural succession is allowed to continue, the old field will eventually succeed to a shrubland, then to a climax forest (Curtis 1959).

Agriculture

Active agricultural fields on the project area include 57 acres, or 19 percent of the total area. Agricultural fields are the second largest cover type on the area. Figure No. 3 in the Wetlands Inventory and Assessment (Appendix 3.8-C) identifies fields actively in agriculture. Comparison with previous studies (Matson, 1974) shows that there have been changes in types and locations of agricultural activity in the study area. Two fields previously farmed in 1973 along State Highway 27 are now mixed conifer plantations. Agricultural fields are disturbed annually with crop rotations of alfalfa, corn, and wheat.

Industrial/Residential

Only one industrial area was found on the study area. It consists of an inactive gravel pit south of Blackberry Lane. Residential areas include structures with maintained land parcels along roadways. This cover type includes 32 acres or 10.7 percent of the total project area as shown on Figure No. 3 in the Wetlands Inventory and Assessment, Appendix 3.8-C.

Other Communities

The lowland brush community described by Lee (1988) is relatively small in size, 1.9 acres, but includes a variety of wetland plant species and a dug pond. Tag alder, aspen, willow, and red osier dogwood (*Cornus stolonifera*) are the dominant woody species present. Lee describes the area as having very dense vegetation, which makes it very difficult for tree species to become established. The area also provides habitat for a number of small birds and animals.

For more detailed information on the wetlands on the environmental study area refer to the Wetland Inventory and Assessment (Appendix 3.8-C).

3.9.3.3 Vegetation: Heavy Metal Analysis

Several previous studies are relevant to the tissue collection and analysis program which has been conducted by Kennecott during 1987 and 1988. Such studies include those performed by the Bear Creek Mining Company (BCMC, 1974) and Smith & Rongstad (1981) in the project area, one by Dames and Moore (1973) in northeastern Wisconsin, and a statewide investigation by Gerloff *et al.*, 1966. In addition, numerous other studies conducted throughout the world have contributed data relevant to this investigation. Values reported in BCMC (1974) vary considerably from the other sources reviewed and data collected in 1987-1988. The 1974 data had no apparent quality assurance/quality control program and is not evaluated in the following discussions for that reason.

The purpose of this investigation was to obtain baseline data on the project area and a control area in order to: 1) compare the 1987-1988 data to existing information for the project area, for some of which there are no documented quality control procedures; and 2) to establish background levels.

Species and organisms collected for laboratory analysis were selected in cooperation with Robert Read and Ron Martin of the WDNR, Madison, Wisconsin.

Red raspberry (*Rubus strigosus*), balsam fir (*Abies balsamia*), Pennsylvania sedge (*Carex pennsylvania*) were sampled from the study area for heavy metal analysis. Three discrete samples of each species were collected from the open pit site and three from the control area. First- and second-year balsam fir stems, and first-year Pennsylvania sedge and red raspberry foliage, were sampled from each location and put into labeled polyethylene bags. The samples were analyzed for arsenic, nickel, copper, lead, cadmium, chromium, zinc, selenium, silver, uranium, and mercury. Results of the analyses are presented in Table No. 3.9-2.

In order to permit a species-specific data comparison, the species selected for analysis were the same as those used in another project in northeastern Wisconsin (Exxon, 1982). Vegetation samples were collected by Robert Read, WDNR Botanist, and Foth & Van Dyke personnel in June 1988. The samples were processed by the Foth & Van Dyke laboratory prior to splitting the digested material with the WDNR for separate analytical testing.

Red Raspberry

Nickel, copper, zinc, and uranium values in red raspberry samples from the project area were similar to those from the control area. Red raspberry appeared to be the most sensitive indicator for nickel; three samples returned values above the detection limit occurred in red raspberry, while only one of the sedge or balsam fir samples contained levels above the detection limit. No comparable nickel data has been found in existing literature.

Copper was detected in all of the red raspberry samples. Levels in the project area were comparable to the control area. The mean value of samples from the project area (9.3 ppm) was slightly higher than the mean value from the control area of (7.5 ppm).

In comparison, the mean value of nine red raspberry samples collected at another project in northeastern Wisconsin was 12.6 ppm copper. Gerloff et al. (1964) discusses baseline values of

TABLE NO. 3.9-2

Biological Samples for Heavy Metal Analysis
Terrestrial Flora
(ug/g as dry Weight)

Station No. (1)	Lab No	Date Collected	Species	Site/ Control	Sampling Site	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	U	Hg	Notes
1A	616A	06-29-88	Red Raspberry	S	North of Pit Area	< 0.3	< 3	8.1	< 9.0	< 1.0	< 3.0	60	< 1.0	< 0.04	0.3	-	2
2A	616B	06-29-88	Red Raspberry	S	W. Wetland No. 1	< 0.3	8.4	9.8	< 9.0	< 1.0	< 3.0	52	< 1.0	< 0.04	0.1	-	2
3	616C	06-29-88	Red Raspberry	S	West of Pit Area	< 0.3	5	9.9	< 9.0	< 1.0	< 3.0	81	< 1.0	< 0.04	0.6	-	2
2A	616H	06-29-88	Red Raspberry	S	W. of Wetl No. 1	-	-	-	-	-	-	-	-	-	0.05	< 0.10	3
3	616I	06-29-88	Red Raspberry	S	Fldpln W. of Pit	-	-	-	-	-	-	-	-	-	-	< 0.10	3
1A	616G	06-29-88	Red Raspberry	S	N. of W. Pit Area	-	-	-	-	-	-	-	-	-	(1)0.02	< 0.10	3
					Mean	< 0.3	5.5	9.3	< 9.0	< 1.0	< 3.0	64	< 1.0	< 0.04	0.3	< 0.10	
3	616O	06-29-88	Pennsyl. Sedge	S	Fldpln W of Pit	< 0.3	< 3	6.0	< 9.0	< 1.0	< 3.0	33	< 1.0	< 0.04	0.4	-	2
1	616M	06-29-88	Pennsyl. Sedge	S	E of Wetl No. 2	< 0.3	< 3	4.8	< 9.0	< 1.0	< 3.0	58	< 1.0	< 0.04	0.3	-	2
2	616N	06-29-88	Pennsyl. Sedge	S	W of Wetl No. 1	< 0.3	< 3	5.2	< 9.0	< 1.0	< 3.0	47	< 1.0	< 0.04	2.3	-	2
1	616S	06-29-88	Pennsyl. Sedge	S	E of Wetl No. 2	-	-	-	-	-	-	-	-	-	(1)0.56	< 0.10	3
2	616T	06-29-88	Pennsyl. Sedge	S	W of Wetl No. 1	-	-	-	-	-	-	-	-	-	-	< 0.10	3
3	616U	06-29-88	Pennsyl. Sedge	S	Fldpln W of Pit	-	-	-	-	-	-	-	-	-	-	< 0.10	3
					Mean	< 0.3	< 3	5.3	< 9.0	< 1.0	< 3.0	46	< 1.0	< 0.04	0.9	< 0.10	
1	616E-1	06-29-88	Balsam Fir	S	E of Wetl No. 2	-	-	-	-	-	-	-	-	-	(1)0.08	< 0.10	3
2	616F-1	06-29-88	Balsam Fir	S	W of Wetl No. 1	-	-	-	-	-	-	-	-	-	-	< 0.10	3
3	616G-1	06-29-88	Balsam Fir	S	Fldpln W of Pit	-	-	-	-	-	-	-	-	-	-	< 0.10	3
1	616Y	06-29-88	Balsam Fir	S	E of Wetl No. 2	< 0.3	<3	3.8	< 9.0	< 1.0	< 3.0	54	< 1.0	< 0.04	0.2	-	2
2	616Z	06-29-88	Balsam Fir	S	W of Wetl No. 1	< 0.3	<3	4.4	< 9.0	< 1.0	< 3.0	47	< 1.0	< 0.04	0.3	-	2
3	616A-1	06-29-88	Balsam Fir	S	Fldpln W of Pit	< 0.3	3.6	5.0	< 9.0	< 1.0	< 3.0	50	< 1.0	< 0.04	0.2	-	2
					Mean	< 0.3	< 3	4.4	< 9.0	< 1.0	< 3.0	50	< 1.0	< 0.04	0.2	< 0.10	
4	616J	06-29-88	Red Raspberry	C	NW of Alfal Fld	-	-	-	-	-	-	-	-	-	(1)0.04	< 0.10	3
5	616K	06-29-88	Red Raspberry	C	SE of Crk	-	-	-	-	-	-	-	-	-	-	< 0.10	3
6	616L	06-29-88	Red Raspberry	C	Mouth of Strm C	-	-	-	-	-	-	-	-	-	-	< 0.10	3
4	616D	06-29-88	Red Raspberry	C	Field S. of Crk	< 0.3	<3	7.1	< 9.0	< 1.0	< 3.0	52	< 1.0	< 0.04	0.2	-	2
5	616E	06-29-88	Red Raspberry	C	South of Crk	< 0.3	3.1	7.2	< 9.0	< 1.0	< 3.0	70	< 1.0	< 0.04	0.2	-	2
6	616F	06-29-88	Red Raspberry	C	At Mouth of Str C	< 0.3	<3	8.1	< 9.0	< 1.0	< 3.0	52	< 1.0	< 0.04	0.3	-	2
					Mean	< 0.3	3.0	7.5	< 9.0	< 1.0	< 3.0	58	< 1.0	< 0.04	0.2	< 0.10	

TABLE NO. 3.9-2 (Cont.)

Station No. (1)	Lab No	Date Collected	Species	Site/ Control	Sampling Site	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	U	Hg	Notes
4	616P	06-29-88	Pennsyl. Sedge	C	NW of Alfal Fld	< 0.3	<3	13.0	< 9.0	< 1.0	< 3.0	39	< 1.0	< 0.04	0.2	-	2
5	616Q	06-29-88	Pennsyl. Sedge	C	SE of Crk	< 0.3	<3	8.2	< 9.0	< 1.0	< 3.0	36	< 1.0	< 0.04	0.4	-	2
6	616R	06-29-88	Pennsyl. Sedge	C	Mouth of Strm C	< 0.3	<3	9.4	< 9.0	< 1.0	< 3.0	38	< 1.0	< 0.04	0.2	-	2
5	616W	06-29-88	Pennsyl. Sedge	C	SE of Crk	-	-	-	-	-	-	-	-	-	-	< 0.10	3
6	616X	06-29-88	Pennsyl. Sedge	C	Mouth of Strm C	-	-	-	-	-	-	-	-	-	-	< 0.10	3
4	616V	06-29-88	Pennsyl. Sedge	C	NW of Alfal Fld	-	-	-	-	-	-	-	-	-	(1)0.14	< 0.10	3
					Mean	< 0.3	<3	10.2	< 9.0	< 1.0	< 3.0	38	< 1.0	< 0.04	0.2	< 0.10	
6	616D-1	06-29-88	Balsam Fir	C	Mouth of Strm C	< 0.3	<3	5.7	< 9.0	< 1.0	< 3.0	63	< 1.0	< 0.04	0.5	-	2
4	616B-1	06-29-88	Balsam Fir	C	NW of Alfal Fld	< 0.3	<3	4.3	< 9.0	< 1.0	< 3.0	57	< 1.0	< 0.04	0.3	-	2
5	616C-1	06-29-88	Balsam Fir	C	SE of Crk	< 0.3	<3	5.5	< 9.0	< 1.0	< 3.0	55	< 1.0	< 0.04	0.4	-	2
4	616H-1	06-29-88	Balsam Fir	C	NW of Alfal Fld	-	-	-	-	-	-	-	-	-	(1)0.05	< 0.10	3
5	616I-1	06-29-88	Balsam Fir	C	SE of Crk	-	-	-	-	-	-	-	-	-	-	< 0.10	3
6	616J-1	06-29-88	Balsam Fir	C	Mouth of Strm C	-	-	-	-	-	-	-	-	-	-	< 0.10	3
					Mean	< 0.3	< 3	5.2	< 9.0	< 1.0	< 3.0	58	< 1.0	< 0.04	0.3	< 0.10	

All units in ug/g as dry weight except Hg which was not dried prior to analysis.

1. From Field Notebook
2. Dried for metals Except Hg
3. Kept cool for Hg Test

(1) Additional uranium data on selected samples 2/9/88. All samples dried.

6.2 ppm and 3.3 ppm at two locations. These values are lower than values determined from either of the recently proposed mine sites in Wisconsin.

The mean zinc value in the project area was 64 ppm, which is slightly higher than the value of 58 ppm found on the control area. Of the three species sampled, red raspberry contained the highest concentration of zinc. Values at both project sites are higher than the baseline level of 48.5 ppm found by Gerloff (1964) in two samples. Zinc values in red raspberry from another site in northeastern Wisconsin ranged from 30 to 117 ppm.

Uranium levels found in red raspberry samples on the site averaged 0.3 ppm, slightly higher than the value of 0.2 ppm from the control area. Levels in control area samples were consistent at 0.2 to 0.3 ppm whereas samples from the site ranged from 0.1 ppm (the lowest reported value for red raspberry) to 0.6 ppm. Based on the existing information, this difference in mean values for uranium does not appear to be significant. Sheppard (1984) reported mean uranium concentrations in a variety of terrestrial plants ranging from zero to 27.6 ppm at a Canadian study site.

The remaining seven metals analyzed all had concentrations below detectable limits in red raspberry.

Pennsylvania Sedge

Average concentrations of copper in Pennsylvania sedge samples were higher in the control area (10.2 ppm) than in the project area (5.3 ppm). Both values are comparable to the 9.1 ppm copper found in six samples gathered from another site in northeastern Wisconson. Gerloff (1964) found baseline copper levels of 4.5 ppm in *Carex laxiflora*.

Mean values for zinc in samples of Pennsylvania sedge from the control area were 38 ppm compared to 46 ppm for the project area. The mean zinc value for Pennsylvania sedge at another proposed mining project in northeastern Wisconsin was 38.5 ppm. Gerloff determined baseline levels for zinc in *Carex laxiflora* of 37.3 ppm.

Uranium values from the control and project areas were consistent and nearly equal in five of six samples taken. A higher concentration of 2.3 ppm in sample two from the site appears to be a data anomaly and was discounted.

The remaining metals values in Pennsylvania sedge were lower than the analytical detection limits.

Balsam Fir

Mean concentrations of copper, zinc, and uranium were generally higher in balsam fir samples collected from the control area compared to those from the project area.

Mean copper values were slightly greater on the control area (5.2 ppm) than on the project area (4.4 ppm). The mean value of copper from balsam fir sampled at another site in northeastern Wisconsin was 9.5 ppm, which is almost twice as high as values found in the present project area. Warren *et al.* (1955) found levels of 5 to 20 ppm of copper in first- and second-year balsam fir stems. Gerloff (1964) found similar baseline concentrations of copper (4.2 ppm) in balsam fir samples. Copper values in balsam fir in the project area are similar to other background values reported in Wisconsin.

Gerloff found that balsam fir contained baseline levels of zinc at 46.5 ppm. Warren *et al.* (1955) found a range of zinc concentrations in first- and second-year balsam fir stems of 80 to 192 ppm. Slightly higher levels were found in balsam fir samples collected from the project area (50 ppm) and control area (58 ppm). The mean value of nine balsam fir samples collected at another site in northeastern Wisconsin was similar, at 58.2 ppm.

Uranium values in balsam fir from the control area had a mean of 0.3 ppm, slightly higher than the mean (0.2) from the project area samples. All uranium values from the control area were greater than or equal to those from the project area. No analytical data was found in existing literature concerning levels of uranium in balsam fir.

The remaining eight metals tested in balsam fir returned levels very near or below analytical detection limits.

3.9.4 Wildlife Data

3.9.4.1 Mammals

3.9.4.1.1 Regional Populations

Jackson (1961) identified 67 mammal species existing in Wisconsin, of which 52 are known to exist in the study region, including: 2 big game, 5 small game, 14 furbearers, and 31 nongame species. Appendix C to the Wetlands Inventory and Assessment (Appendix 3.8-C) lists 30 species that were observed in the environmental study area during this study and in 1974 by Bear Creek Mining Company.

3.9.4.1.2 Study Area Populations

Habitat in the study area is comparable to that found in the region. Curtis (1959) describes Rusk County as being part of a

regional northern hardwood forest ecotype. For a comparison, 1982 Soil Conservation Service data reports 90,765 acres, or 15 percent of the total land in Rusk County, as tillable. Similarly, the project area contains about 65 acres, or 19 percent, tillable land.

Appendix C to the Wetlands Inventory and Assessment (Appendix 3.8-C) shows the abundance of mammals identified during field work in 1973 and 1988. Twenty-nine species were observed on the project area during the two study periods. Observations were made by field sightings, trapping, and track identification. The most abundant species observed include eastern chipmunk (*Tamias striatus*), deer mouse (*Peromyscus maniculatus*), meadow vole (*Microtus pennsylvanicus*), and whitetail deer (*Odocoileus virginianus*).

Big Game

Whitetail deer and black bear (*Ursus americanus*) are the two big game mammals found in Rusk County. The species are recreationally, aesthetically, and economically important to the region. It is the policy of Kennecott not to allow hunting on its property.

The status of whitetail deer in Wisconsin has been locally variable, punctuated with increases and decreases from year to year and from county to county. In the days of the early explorers, deer were found throughout the state; they were more plentiful in the southern part than in the northern, but deer were common big game mammals in all areas (Jackson, 1961). Extensive logging around 1900 increased the preferred habitat by producing young aspen stands and increasing forest openings, thus increasing the population of the deer herd. Populations have increased steadily statewide since that time. Presently, the state deer herd numbers approximately 1,250,000.

Dahlberg and Guettinger (1956) estimated the deer herd population in northwest Wisconsin at ten deer per square mile. The project area is currently in deer management unit number 23 in the Department of Natural Resources northwest management district. The 1988 over-winter goal for the deer herd in management unit 23 was 20 deer per square mile, with an estimated 28 deer per square mile entering the fall deer season. Sixty-five percent of the annual antlered deer harvest is 18 months old (pers. comm., Vanasac, 1988). Table No. 3.9-3 shows a steady increase in deer harvested in Rusk County over the last five years. The 1987 deer harvest in Rusk County was 4,476 (WDNR, 1983-1987). Regionally, the intermix of agriculture, northern hardwoods, and mixed lowland swamps provide good deer habitat.

Black bears formerly inhabited all counties in the state, but became extinct in the southern one-third of the state during

TABLE NO. 3.9-3

Big Game Harvest in Rusk County
1983-1987

	1983	1984	1985	1986	1987	Total
Whitetail Deer -						
Gun	2,115	2,343	3,164	3,264	4,117	15,001
Bow	108	192	287	243	359	1,189
TOTALS	2,223	2,535	3,451	3,505	4,476	16,190
Black Bear	55	61	--	20	53	189

Source: Wisconsin Department of Natural Resources--Annual Harvest Data from Bureau of Wildlife Management.

settlement in the late nineteenth century. The present range now extends north of central Wisconsin and hunting is allowed in the 19 northernmost counties, including portions of Rusk County north of Ladysmith. Over-harvest and low bear populations led to a closed season in 1985 and a more restrictive permit system thereafter.

The preferred habitat of black bears is heavily wooded areas and dense brushland, particularly deciduous species (Jackson (1961). This preferred habitat exists on the environmental study area, but signs of black bears were not observed during present or previous studies.

Black bear hunting is permitted in Rusk County east of State Highway 27 and north of State Highway 8. The average bear harvest over the past five seasons in Rusk County is 52 per year as shown on Table No. 3.9-3. Densities of black bear in preferred habitat in the county are one bear per three square miles (pers. comm., Vanasac, 1988).

Small Game

Small game in Wisconsin constitute an important recreational and aesthetic value. Eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Scuirus carolinensis*), and snowshoe hare (*Lepus americanus*) are commonly hunted small mammals in Rusk County. These species populations are cyclic, changing in response to habitat and predator relationships.

Cottontail rabbit is the most common small game species found on the environmental study area. The species range did not extend into northern Wisconsin until deforestation and agriculture provided suitable habitat (Jackson, 1961). The diverse communities of interspersed old fields, early successional vegetation, brushy areas, and forest edges provide ideal habitat for cottontails.

Gray squirrels are found throughout the state and were commonly observed on the project area. According to Jackson (1961), populations plummeted after deforestation in Wisconsin, but have rebounded as second growth northern hardwood stands have emerged. The preferred habitat for gray squirrels is hardwood forests with nut-producing trees such as native oaks.

Snowshoe hare are commonly hunted in Rusk County but were not observed on the project area during this study or previous studies. Snowshoe hare populations are cyclic and peak approximately every ten years in Wisconsin. The preferred habitat is bogs and swamps, particularly those having growths of alder, willow, and conifers (Jackson, 1961). The project area has no areas of preferred habitat for snowshoes, but the eastern portion of the study area contains potential habitat.

Furbearers

Common furbearers in Rusk County include red fox (*Vulpes fulva*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), mink (*Mustela vison*), river otter (*Lutra canadensis*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*) (pers. comm., Vanasac, 1988). Furbearers are important to the regional ecology, recreation, and economy. As predators, they occupy and ecological niche near the top of the food chain. Fur trapping in Wisconsin during 1987-1988 generated approximately $8.5 million in pelt sales (pers. comm., Pils, 1989).

WDNR records indicate that muskrat, beaver, and river otter are the most commonly trapped furbearers in Rusk County. Muskrat harvest figures are not recorded by the WDNR, but muskrats are believed to be the most commonly trapped furbearer in Rusk County. Table No. 3.9-4 lists harvest figures for beaver and river otter between 1983 and 1987. Over the past ten-year period, Rusk County harvested 1.65 percent of the total statewide beaver harvest. Beaver harvest records for 1987 show that Rusk County harvested 546 beavers, the third lowest beaver harvest of 12 counties in the northwest district. River otter harvest records for 1987 indicate that Rusk County's harvests are average with respect to other counties in the northwest district.

Generally, the preferred habitat of muskrat, beaver, and river otter is lakes, streams, and marshes (Jackson, 1961). Beaver and muskrat were commonly observed on the Flambeau River during 1987-1988 but were not observed during 1972-1973 field work on the study area. Conversely, river otter were observed near the Flambeau River during 1972-1973 field work, but not in 1987-1988. Habitat exists on the Flambeau River for the three species.

Bobcat harvest is permitted in the northern one-third of the state, north of State Highway 64, which includes Rusk County. According to Creed and Ashbrenner (1976), bobcat population densities are one per five to 20 square miles. The preferred bobcat habitat is brushy and woodland areas, particularly in swamps and rocky areas (Jackson, 1961). WDNR records (Table No. 3.9-5) indicate that, between 1983 and 1985, Rusk County ranked in the top five counties with respect to the state bobcat harvests. Bobcats were not observed on the study area during present or previous studies, although suitable habitat exists. This may be in part due to the close proximity of the site to Ladysmith. The solitary habits of bobcat preclude them from populated areas.

Red fox, coyote, raccoon, and mink are found throughout the state and are important to the fur industry in Rusk County although no harvest figures are available. Coyote and mink were

TABLE NO. 3.9-4

Beaver and River Otter Harvests in Rusk County
1983-1987

	1983-1984	1984-1985	1985-1986	1986-1987	Total
Beaver	277	314	288	546	1,425
Otter	44	41	29	52	166

Source: Wisconsin Department of Natual Resources--Annual Harvest Data from Bureau of Wildlife Management.

TABLE NO. 3.9-5

Counties of Highest Bobcat Harvest
1983-1986

1983		1984		1985		1986	
Price	36	Rusk	34	Price	24	Price	21
Sawyer	17	Price	32	Rusk	23	Marinette	21
Marinette	18	Sawyer	24	Taylor	18	Oneida	16
Taylor	18	Taylor	20	Washburn	17	Sawyer	16
Rusk	17	Burnett	19	Sawyer	15	Rusk	12
State Totals	205		260		189		183

Source: Wisconsin Department of Natural Resources--Annual Harvest Data from Bureau of Wildlife Management.

not observed during field work on the environmental study area in 1972-1973 or 1987-1988. Raccoon and red fox were commonly observed on the study area in 1972-1973 and 1987-1988. Two active red fox dens, probably the same family, were observed on the open pit site in 1987-1988. Red fox frequently relocate when food supplies are reduced.

Nongame Species

Nongame species are important to the ecological community. Thirty-six nongame species are known to exist in the region, 12 of which were observed on the environmental study area during 1972-1973 and 1987-1988 field work. All of the species observed on the environmental study area are within the range for the species. The most abundant include deer mouse, meadow vole, and eastern chipmunk (Table No. 3.9-6).

Ten species of small mammals were trapped during small mammal surveys on the biological study area (Table No. 3.9-6). Figure No. 3.9-2 shows the three trapping locations on the project area. Habitats studied include mature forest, early successional, and old fields. Sherman live traps (3 x 3 x 9 inches) and large snap traps were set on a 15-foot grid pattern, for a total of 750 trap nights.

Small mammal trapping on Area B, which consists of mixed upland and lowland forest and old field habitats, had the highest capture rate and species diversity of the three sampling locations. All seven species trapped on the project area were found in Area B. The most abundant were meadow vole and deer mice, which accounted for 69.7 percent of all species trapped. Other species include white-footed mouse (*Peromyscus leucopus*), boreal redback vole (*Clethrionomys gapperi*), eastern chipmunk, shorttail shrew (*Blarina brevicauda*), and southern flying squirrel (*Glaumcomys volans*). The diverse vegetation in this sample area reflects the diversity of small mammals observed. Sparse small mammal populations in Areas A and C reflect a low capture rate of two deer mice in each area during 200 trap nights.

The primary purpose for trapping on the control area was to capture individuals for heavy metals analysis. Eight species were trapped in 350 trap nights, the most common being deer mice. Less common species include masked shrew (*Sorex cinereus*), white-footed mouse (*Peromyscus leucopus*), eastern chipmunk, longtail weasel (*Mustela frenata*), red squirrel (*Tamiasciurus hudsonius*), and shorttail shrew. All of the above species were observed during 1972-1974 qualitative surveys and are within the range for the species. During the minnow trapping at the mouth of Meadowbrook Creek in 1987, a northern water shrew (*Sorex palustris*) was collected.

TABLE NO. 3.9-6

Small Mammal Collection Results

Control No.	Lab No.	Date Collected	Species	Common Name	Location	Sex	Body Measurements (mm) Total Length	Tail Length	Hind Foot	Ear	Weight (gm)
1M	KENN 119A	10-09-87	Peromyscus maniculatus	Deer mouse	Site - Area B	M	165	77	22	18.00	23.8
2M		10-09-87	Peromyscus maniculatus	Deer mouse	Site - Area B	F	140	62	21	12.00	13.7
3M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	132	32	20	11.00	23.2
4M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	F	134	42	20	13.00	17.2
5M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	F	140	45	21	12.00	22.3
6M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	133	42	20	13.00	21.9
7M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	F	136	42	19	12.00	19.1
8M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	F	133	42	20	13.00	21.1
9M	KENN 119B	10-09-87	Clethrionomys gapperi	Redback vole	Site - Area B	F	128	39	20	14.00	17.5
10M		10-09-87	Clethrionomys gapperi	Redback vole	Site - Area B	M	120	35	20	14.00	14.6
11M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	140	40	21	14.00	21.5
12M		10-09-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	F	147	45	21	13.00	28.1
13M		10-09-87	Blarina brevicauda	Shorttail shrew	Site - Area B	F	125	3	16	6.00	16.6
14M		10-07-87	Peromyscus maniculatus	Deer mouse	Site - Area B	M	151	67	21	16.00	14.8
15M	KENN 119C	10-07-87	Peromyscus maniculatus	Deer mouse	Site - Area B	F	175	81	21	16.00	21.2
16M		10-08-87	Peromyscus maniculatus	Deer mouse	Site - Area B	F	144	67	21	16.00	14.5
17M	KENN 119D	10-08-87	Peromyscus maniculatus	Deer mouse	Site - Area B	M	161	75	21	16.00	17.4
18M	KENN 119E	10-08-87	Peromyscus maniculatus	Deer mouse	Site - Area B	M	156	77	22	17.00	17.4
19M		10-08-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	142	47	20	12.00	19.1
20M		10-08-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	137	47	20	12.00	22.7
21M	KENN 119F	10-08-87	Clethrionomys gapperi	Redback vole	Site - Area B	F	115	36	20	10.00	14.8
22M	KENN 119G	10-08-87	Clethrionomys gapperi	Redback vole	Site - Area B	M	144	40	19	15.00	26.6
23M		10-08-87	Tamias striatus	Eastern chipmunk	Site - Area B	F	255	110	39	20.00	82.9
24M	KENN 119H	10-07-87	Peromyscus maniculatus	Deer mouse	Site - Area B	F	154	68	21	14.00	17.6
25M	KENN 119I	10-07-87	Peromyscus maniculatus	Deer mouse	Site - Area B	M	160	75	22	17.00	20.6
26M		10-07-87	Microtus pennsylvanicus	Meadow vole	Site - Area B	M	136	40	20	11.00	20.0

TABLE NO. 3.9-6 (Cont.)

Control No.	Lab No.	Date Collected	Species	Common Name	Location	Sex	Body Measurements (mm) Total Length	Tail Length	Hind Foot	Ear	Weight (gm)
27M	KENN 119J	10-07-87	Clethrionomys gapperi	Redback vole	Site - Area B	F	126	39	18	13.00	15.0
28M		10-07-87	Blarina brevicauda	Shorttail shrew	Site - Area B	F	139	3	17	6.00	22.3
29M		10-08-87	Glaucomys (volans ?)	S. Flying squirrel	Site - Area B	F	245	111	32	20.00	65.5
30M		05-18-88	Peromyscus maniculatus	Deer mouse	Control Area	F	178	83	22	17.00	21.9
31M		05-20-88	Peromyscus maniculatus	Deer mouse	Control Area	F	160	72	21	16.00	20.8
32M		05-20-88	Peromyscus leucopus	White-footed mouse	Control Area	F	167	78	22	19.00	23.8
33M	KENN 119K	05-20-88	Clethrionomys gapperi	Redback vole	Control Area	F	137	39	19	13.00	20.3
34M		08-18-88	Microtus pennsylvanicus	Meadow vole	Control Area	M	137	39	20	13.00	17.6
35M		08-18-88	Sorex cinereus	Masked shrew	Control Area	F	108	50	13	5.00	3.4
36M		08-18-88	Sorex cinereus	Masked shrew	Control Area	F	102	41	12	5.00	3.5
37M	KENN 119L	08-18-88	Clethrionomys gapperi	Redback vole	Control Area	F	136	38	19	15.00	19.9
38M		08-18-88	Sorex cinereus	Masked shrew	Control Area	M	101	44	12	5.00	3.3
39M		08-18-88	Peromyscus maniculatus	Deer mouse	Control Area	F	135	59	20	15.00	9.8
40M		08-18-88	Mustela frenata	Longtail weasel	Control Area	F	310	102	42	20.00	114.1
41M		08-18-88	Peromyscus maniculatus	Deer mouse	Control Area	M	175	80	21	17.00	18.1
42M		08-18-88	Peromyscus maniculatus	Deer mouse	Control Area	F	152	71	22	16.00	15.5
43M	KENN 119M	08-18-88	Peromyscus maniculatus	Deer mouse	Control Area	F	165	73	20	18.00	22.0
44M		08-24-88	Microtus pennsylvanicus	Meadow vole	Mine Site - B	F	135	29	20	13.00	24.9
45M	KENN 119N	08-24-88	Peromyscus maniculatus	Deer mouse	Mine Site - B	M	166	78	22	19.00	17.5
46M	KENN 119O	08-24-88	Peromyscus maniculatus	Deer mouse	Mine Site - B	F	176	83	22	16.00	17.3
47M		08-24-88	Blarina brevicauda	Shorttail shrew	Mine Site - B	M	123	25	15	6.00	14.5
48M		05-18-88	Tamias striatus	Eastern chipmunk	Control Area	F	263	113	38	20.00	88.2
49M	KENN 119P	05-19-88	Peromyscus maniculatus	Deer mouse	Control Area	F	175	75	23	17.00	25.2
50M		05-19-88	Peromyscus leucopus	White-footed mouse	Control Area	M	171	73	23	17.00	24.9
51M	KENN 119Q	05-19-88	Peromyscus maniculatus	Deer mouse	Control Area	F	160	71	20	16.00	24.1

TABLE NO. 3.9-6 (Cont.)

Control No.	Lab No.	Date Collected	Species	Common Name	Location	Sex	Body Measurements (mm) Total Length	Tail Length	Hind Foot	Ear	Weight (gm)
52M		08-19-88	Peromyscus maniculatus	Deer mouse	Control Area	M	159	71	21	15.00	16.0
53M		08-19-88	Tamiasciurus hudsonius	Red Squirrel	Control Area	M	342	151	50	24.00	183.9
54M		08-19-88	Sorex cinereus	Masked shrew	Control Area	F	158	45	12	5.00	3.2
55M		08-19-88	Peromyscus maniculatus	Deer mouse	Control Area	M	103	71	21	16.00	15.0
56M	KENN 119R	08-19-88	Clethrionomys gapperi	Redback vole	Control Area	M	116	28	19	13.00	9.8
57M	KENN 119S	08-19-88	Clethrionomys gapperi	Redback vole	Control Area	F	167	27	19	15.00	10.7
58M		08-19-88	Peromyscus maniculatus	Deer mouse	Control Area	M	173	76	22	17.00	16.4
59M	KENN 119T	05-20-88	Peromyscus maniculatus	Deer mouse	Control Area	M	172	75	23	16.00	25.2
60M		05-20-88	Peromyscus maniculatus	Deer mouse	Control Area	F	182	79	22	17.00	21.4
61M	KENN 119U	05-18-88	Peromyscus maniculatus	Deer mouse	Control Area	M	185	83	22	16.00	24.1
62M	KENN 119V	05-18-88	Peromyscus maniculatus	Deer mouse	Control Area	M	185	81	23	19.00	24.5
63M		05-18-88	Tamias striatus	Eastern chipmunk	Control Area	M	276	115	39	19.00	114.5
64M	KENN 119W	05-18-88	Peromyscus maniculatus	Deer mouse	Control Area	F	176	74	20	18.00	28.4
65M	KENN 119X	05-18-88	Peromyscus maniculatus	Deer mouse	Control Area	M	175	73	21	17.00	25.3
66M		06-07-88	Peromyscus maniculatus	Deer mouse	Mine Site - A	M	177	77	22	17.00	27.2
67M		06-07-88	Peromyscus maniculatus	Deer mouse	Mine Site - A	M	154	70	21	16.00	16.2
68M		06-09-88	Tamias striatus	Eastern chipmunk	Control Area	F	273	120	37	21.00	101.8
69M		05-13-88	Peromyscus maniculatus	Deer mouse	Mine Site - C	M	170	76	21	17.00	21.0
70M		05-13-88	Peromyscus maniculatus	Deer mouse	Mine Site - C	F	176	78	21	17.00	21.8

3.9.4.1.3 Small Mammals: Heavy Metal Analysis

Small mammal samples were collected from three specific areas (A, B, and C) within the project area and from several locations within the control area (Figure Nos. 3.9-1 and 3.9-2). Species sampled from Area B were selected for laboratory analysis because of their abundance and diversity, in addition to being collected from the portion of the project area that is hydrologically downgradient from the deposit. The control area is not hydrologically affected by the deposit.

Red-backed vole (*Clethrionomys gapperi*) and deer mice (*Peromyscus maniculatus*) were selected for analysis because they were abundant at both the project and control sites and thus represent an herbivore and omnivore respectively. No carnivorous species were collected in sufficient quantities from both the project and control area. Four red-backed voles and eight deer mice were analyzed from Area B and the control area for arsenic, nickel, copper, lead, cadmium, chromium, zinc, selenium, silver, and mercury. Selected composite samples were analyzed for uranium. The metal concentrations from each individual are summarized in Table No. 3.9-7. Table No. 3.9-8 compares findings in the present study to other similar studies.

The largest individuals within each species were selected for tissue analysis to achieve a representative value of each metal in adult individuals. Table No. 3.9-6 shows specific weights and measurements for the individuals analyzed.

Arsenic, Lead, Selenium, Silver, and Mercury

Concentrations of arsenic, lead, silver, and mercury in both species sampled from the control area and Area B were below the analytical detection limits. Smith and Rongstad (1981) recorded lead values of 0.48 ppm and <0.1 ppm in red-backed voles and deer mice sampled over the Flambeau deposit. They also reported levels ranging from 0.7 ppm to 20 ppm in samples taken at another site in northeastern Wisconsin (Exxon, 1982).

Smith and Rongstad (1981) reported arsenic and mercury in the project area at levels below the detection limit of the present study.

No literature was found on the subject of comparing concentrations of silver in small mammals.

Copper and Zinc

Both deer mouse (*Peromyscus maniculatus*) and red-backed vole (*Clethrionomys gapperi*) samples (as shown on Table No. 3.9-7) exhibited slightly higher levels of copper in the project area than in the control area. The mean copper value in deer mice was 4.1 ppm in the control area

TABLE NO. 3.9-7

Small Mammal - Metals Analysis

No.	Lab No.	Date Collected	Species	Sampling Site	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	(1) Hg
21M	KENN 119F	10-08-87	Clethrionomys gapperi	Area B	<0.25	0.6	2.9	<0.9	<0.1	<0.5	25	<0.25	<0.5	<0.05
9M	KENN 119B	10-09-87	Clethrionomys gapperi	Area B	<0.25	0.4	5.3	<0.9	0.2	<0.5	39	0.33	<0.5	<0.05
27M	KENN 119J	10-07-87	Clethrionomys gapperi	Area B	<0.25	0.4	3.7	<0.9	<0.1	<0.5	32	0.27	<0.5	<0.05
22M	KENN 119G	10-08-87	Clethrionomys gapperi	Area B	<0.25	0.7	4.5	<0.9	0.2	<0.5	40	0.34	<0.5	<0.05
					=====	===	====	====	====	====	===	=====	====	=====
					<0.25	0.5	4.1	<0.9	0.2	<0.5	34	<0.34	<0.5	<0.05
17M	KENN 119D	10-08-87	Peromyscus maniculatus	Area B	<0.25	1.7	3.3	<0.9	<0.1	<0.5	27	<0.25	<0.5	<0.05
1M	KENN 119A	10-09-87	Peromyscus maniculatus	Area B	<0.25	0.5	15.0	<0.9	<0.1	0.74	44	<0.25	<0.5	<0.05
15M	KENN 119C	10-07-87	Peromyscus maniculatus	Area B	<0.25	<0.3	5.6	<0.9	<0.1	<0.5	27	<0.25	<0.5	<0.05
24M	KENN 119H	10-07-87	Peromyscus maniculatus	Area B	<0.25	0.8	6.0	<0.9	<0.1	<0.5	25	<0.25	<0.5	<0.05
25M	KENN 119I	10-07-87	Peromyscus maniculatus	Area B	<0.25	0.5	6.9	<0.9	<0.1	<0.5	27	<0.25	<0.5	<0.05
18M	KENN 119E	10-08-87	Peromyscus maniculatus	Area B	<0.25	0.7	4.4	<0.9	<0.1	<0.5	34	<0.25	<0.5	<0.05
45M	KENN 119N	08-24-88	Peromyscus maniculatus	Area B	<0.25	0.4	3.6	<0.9	<0.1	<0.5	31	<0.25	<0.5	<0.05
46M	KENN 119O	08-24-88	Peromyscus maniculatus	Area B	<0.25	0.6	4.5	<0.9	<0.1	<0.5	26	<0.25	<0.5	<0.05
					=====	===	====	====	====	====	===	=====	====	=====
					<0.25	0.7	6.2	<0.9	<0.1	0.5	30	<0.25	<0.5	<0.05
33M	KENN 119K	05-20-88	Clethrionomys gapperi	Control	<0.25	0.8	3.8	<0.9	<0.1	<0.5	26	0.26	<0.5	<0.05
37M	KENN 119L	08-18-88	Clethrionomys gapperi	Control	<0.25	<0.3	4.2	<0.9	<0.1	<0.5	29	<0.25	<0.5	<0.05
56M	KENN 119R	08-19-88	Clethrionomys gapperi	Control	<0.25	0.7	2.5	<0.9	<0.1	<0.5	22	<0.25	<0.5	<0.05
57M	KENN 119S	08-19-88	Clethrionomys gapperi	Control	<0.25	<0.3	2.9	<0.9	<0.1	<0.5	19	<0.25	<0.5	<0.05
					=====	====	====	====	====	====	===	=====	====	=====
					<0.25	0.8	3.4	<0.9	<0.1	<0.5	24	0.25	<0.5	<0.05
51M	KENN 119Q	05-19-88	Peromyscus maniculatus	Control	<0.25	0.6	4.2	<0.9	<0.1	<0.5	29	<0.25	<0.5	<0.05
43M	KENN 119M	08-18-88	Peromyscus maniculatus	Control	<0.25	<0.3	5.9	<0.9	<0.1	<0.5	22	<0.25	<0.5	<0.05
49M	KENN 119P	05-19-88	Peromyscus maniculatus	Control	<0.25	1.3	3.4	<0.9	<0.1	<0.5	27	0.30	<0.5	<0.05
59M	KENN 119T	05-20-88	Peromyscus maniculatus	Control	<0.25	1.6	3.6	<0.9	<0.1	<0.5	30	0.26	<0.5	<0.05
61M	KENN 119U	05-18-88	Peromyscus maniculatus	Control	<0.25	0.4	4.1	<0.9	<0.1	<0.5	35	<0.25	<0.5	<0.05
62M	KENN 119V	05-18-88	Peromyscus maniculatus	Control	<0.25	<0.3	3.7	<0.9	<0.1	<0.5	27	0.27	<0.5	<0.05
64M	KENN 119W	05-18-88	Peromyscus maniculatus	Control	<0.25	<0.3	4.3	<0.9	<0.1	<0.5	26	0.26	<0.5	<0.05
65M	KENN 119X	05-18-88	Peromyscus maniculatus	Control	<0.25	0.4	3.6	<0.9	<0.1	0.67	28	<0.25	<0.5	<0.05
					=====	===	====	====	====	====	===	=====	====	=====
					<0.25	0.7	4.1	<0.9	<0.1	0.5	28	0.30	<0.5	<0.05

NOTES: Units are ug/g dry weight.
(1) - Units are ug/g wet weight.
Due to insufficient sample size in original analysis, four additional samples were tested for uranium on 2/9/89.
In these samples two individuals were composited. The results 0.02 ug/g for each sample.
Four composite samples of 2 male and 2 female deer mice each from the project area and control area contained 0.02 ppm uranium.

TABLE NO. 3.9-8

Comparative Analytical Small Mammal Results

	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	Hg
Site(1)										
Redbacked Vole	<.25	.5	4.1	<.9	.2	<.5	34	.3	<.5	<.05
Deer Mouse	<.25	.7	6.2	<.9	<.1	.5	30	<.25	<.5	<.05
Control(2)										
Redbacked Vole	<.25	.8	3.4	<.9	<.1	<.5	24	<.25	<.5	<.05
Deer Mouse	<.25	.7	4.1	<.9	<.1	.5	28	.30	<.5	<.05
Ladysmith, WI (3)										
Meadow Vole		.99	3.4	.45	<.1		32			
Deer Mouse		.77	3.9	<.1	<.1		33			
Redbacked Vole		.93	4.1	.48	<.1		32.3			
Crandon, WI (3)										
Meadow Vole		1.7	4.1	.7	<.1		32			
Deer Mouse	<.1	1.0	3.9	.9	<.1		31			<.1
Redbacked Vole	<.1	1.3	4.8	20	.2		40			<.1

Results given as mean values - ug/g dry weight except Hg reported as wet weight.

(1) Small mammals trapped 1987-1988 on pit area (2) Small mammals trapped 1987-1988 on control area.
(3) Smith and Rongstad (1981)

and 6.2 ppm in the project area, while values for red-backed vole were 3.4 ppm and 4.1 ppm, respectively. An abnormally high value of 15 ppm of copper was found in one mouse; this data point is probably anomalous. If this data point is removed from the data set, the mean copper value for deer mice in the project area is 4.9 ppm. Within the margin of error for this data set, the differences between project area and control area values for copper levels in small mammals do not appear to be significant. Smith & Rongstad (1981) reported copper values at Ladysmith and another site in Wisconsin of 3.9 ppm in deer mice, and values of 3.4 ppm (Ladysmith) and 4.1 ppm (other site) in meadow voles.

Zinc values were greater in red-back voles than in deer mice. Mean zinc concentrations in red-backed voles were 24 ppm in the control area and 34 ppm in the project area, while mean zinc values in deer mice from the same sample sites were 28 ppm and 30 ppm. Smith and Rongstad (1981) found similar concentrations of zinc (32 ppm to 40 ppm) in small mammals collected from the Flambeau and another site in Wisconsin.

Nickel

Mean nickel values were slightly higher in red-backed voles from the control area (0.8 ppm) than those from the project area (0.5 ppm). Mean nickel values in deer mice from the two areas were both 0.7 ppm.

Smith and Rongstad (1981) found higher nickel concentrations in deer mice and red-backed voles sampled over the Ladysmith and another site in northeastern Wisconsin; they reported mean nickel values of 0.77 ppm and 1.0 ppm in deer mice from Ladysmith and the other site respectively.

Cadmium

Cadmium levels remained below detection limits in all samples from the control area. Two red-backed voles from the project area recorded cadmium levels of 0.2 ppm--only slightly above the <0.1 ppm detection limit. Smith and Rongstad found similar concentrations in samples from Ladysmith and another site in northeastern Wisconsin. Taking into account the normal variability in analytical results, cadmium values in small mammals at the project area do not appear to be significantly different than the control area.

Chromium

Chromium concentrations in red-backed voles and all but 2 deer mice samples were below the analytical detection limit of <0.5 ppm. The two deer mice with measurable levels of chromium were from the project and control areas. The mouse from the project area contained 0.74 ppm chromium, whereas the mouse from the control area contained 0.67 ppm. Chromium concentrations noted

by Anthony (1982) in selected tissues from control areas were somewhat higher, ranging from 3.2 to 14.5 ppm in meadow voles and 2.2 to 8.0 ppm in white-footed mice.

Selenium

Levels of selenium in deer mice and red-backed voles were less than or slightly higher than the 0.25 ppm detection limit. Three of the four red-backed voles on the project area contained detectable levels of selenium, while only one of the four samples taken from the control area contained detectable selenium. No published data was found which would allow comparison of the selenium levels reported for this study to be compared to other environments.

3.9.4.1.4 Soil Invertebrates: Heavy Metal Analysis

Three composite soil invertebrates samples (earthworms, *Lumbricus* sp.) were collected for heavy metal analysis from four locations on the study area, illustrated on Figure No. 3.9-2, in August 1988. Fourteen earthworms were gathered from Location 1 over the east end of the open pit. This sample area contained dry organic soils in a small hummocky depressional area within a drainageway. Sample Location 2 was located within Wetland Areas 1 and 2, where sixteen earthworms were gathered from moist organic soils along the eastern edge of the wetlands.

Earthworms were sampled on the control area south and north of Meadowbrook Creek at locations not hydrologically influenced by the deposit. Fifteen earthworms were collected from south of Meadowbrook Creek in a small, upland depressional area. The hummocky sample area contained moist organic soils. Another control site was located north of Meadowbrook Creek along groundwater seeps. Sixteen earthworms were sampled from the moist organic soils in this area.

Following sample collection the invertebrates were washed with distilled water, labeled, and placed in a sealed polyethylene bag overnight so the soil in their gut could be voided. Samples remained frozen prior to lab analysis.

Analytical results for nickel (Ni), copper (Cu), and chromium (Cr), listed on Table No. 3.9-9, are similar among the four sites, except for the sample from Location 1 at the east end of the proposed open pit site, which showed levels for Ni and Cr below detection limits. Copper levels for this sample were less than half of the levels in the remaining three samples.

Earthworms from the east end of the proposed open pit site show levels of lead (Pb) at 8.0 ppm; other samples show significantly

TABLE NO. 3.9-9

Soil Inverts - Metals Analysis and Comparative Results

	As	Ni	Cu	Pb	Cd	Cr	Zn	Se	Ag	Hg
14 Inverts - Site	--	<.3	.91	8.0	2.6	<.5	98	--	<.61	.25
16 Inverts - Site	--	1.0	2.5	1.6	2.0	2.3	61	--	<1.2	.26
15 Inverts - Control	--	1.3	3.3	<.9	.8	2.2	58	--	<.69	.12
16 Inverts - Control	--	1.1	3.0	2.6	1.2	2.6	82	--	<.78	.07
Mean Site	--	.7	1.7	4.8	2.3	1.4	79.5	--	<.91	.25
Mean Control	--	1.2	3.15	1.8	1.0	2.4	70.0	--	<.74	.095
Gish (1973)										
Mean Site		34.6		273.6	12.7		580.3			
Mean Control		25.2		12.0	3.0		223.8			

NOTES: Units are ug/g as dry weight except for Hg reported as wet weight.
-- Insufficient sample for analysis.

lower levels. This sample is the closest to STH 27 of all four samples. Gish (1973) correlated Pb levels in earthworms with distance from roads.

Cadmium and mercury concentrations were slightly higher in earthworms collected from the project area. There appeared to be little difference between zinc values in the project area and the control area. There was insufficient sample to obtain meaningful silver concentrations.

3.9.4.2 Birds

3.9.4.2.1 Regional Bird Populations

The Wisconsin Society of Ornithology (pers. comm., Robbins, 1988) recognizes 381 species that have been recorded in Wisconsin in recent times. Buss and Mattison (1955) studied bird species on the lower Chippewa River Valley and recorded 162 species in that region. Although this data is not recent, it is considered to be an accurate account of birds that may be present in the region. In comparison, the most recent records of the Wisconsin Society of Ornithology recognize 173 species identified in Rusk County (pers. comm., Robbins, 1988). The list includes avian species that occupy a wide range of habitats found in Rusk County.

The 1972-1973 surveys in the environmental study area formed part of the original environmental impact report. They identified 84 bird species. Additional surveys done in 1987-1988 identified 75 species on the study area. Table No. 3.9-10 presents a comprehensive list inclusive of 1972-1973 and 1987-1988 surveys and shows those species observed on the environmental study area.

Following Peterson (1988), avian species found on the study area can be categorized into four groups: summer breeding resident, winter resident, year-round resident, and migrant. Sixty-four percent of the birds utilizing the environmental study area are summer residents, 30 percent are permanent residents five percent are migrants, and one percent are winter residents.

Summer Residents

The majority of the birds found on the environmental study area are summer residents. These species migrate to a region which includes northern Wisconsin to nest and raise young. In general, summer residents are found from approximately April to October; they then return to wintering areas. Four species subdivisions will be discussed: songbirds, raptors, waterfowl, and other birds.

TABLE NO. 3.9-10

Bird List
Kennecott Flambeau Project Field Observations for Study Area - September 1987 to August 1988

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Common Loon																					
Grebe, Horned																					XX
Grebe, Pied Billed																					XX
Heron, Green Backed					1	1								2							XX
Heron, Grt Blue							1	2													
Least Bittern																					
Bittern, American																					XX
Swan, Tundra																					
Swan, Mute																					
Goose, Snow																					
Goose, Canada																					
Crane, Sandhill																				X	
Duck, Wood							2														XX
Duck, American Black																					
Mallard		6			1	4	2					2									
Northern Pintail																					
Goldeneye, Common																					XX
Bufflehead																					XX
Redhead																					
Duck, Ringneck																					
Scaup, Lesser																					
Merganser, Hooded																				X	
Merganser, Common																				X	
Duck, Ruddy																					
Teal, Blue Winged																				X	
Vulture, Turkey																					
Osprey																					
Eagle, Bald																				X	
Hawk, Sharp Shinned																					XX
Hawk, Cooper's																					
Goshawk, Northern																					
Hawk, Red Shouldered																					
Hawk, Broadwinged																					XX
Hawk, Red Tailed											1				1				1		
Hawk, Rough Legged																					

TABLE NO. 3.9-10 (Cont.)

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Harrier, Northern			1				2					1		1	2			1			
Kestrel, American																				X	XX
Merlin																					XX
Owl, Great horned				1																	
Owl, Snowy																					
Owl, Barred																					
Owl, Great Grey																					
Owl, Great Horned																					
Sora																					XX
Coot, American																					
Killdeer																				X	XX
Yellowlegs, Lesser																					
Sandpiper, Spotted																					
Sandpiper, Least																					
Sandpiper, Baird's																					
Woodcock, American		3																		X	
Snipe, Common																					XX
Gull, Herring																					
Tern, Common																					
Tern, Black																					XX
Dove, Rock																					XX
Dove, Mourning						2						1				1		2	2		XX
Grouse, Ruffed	4	1	1					1			2		1								
Grouse, Sharp-tailed																					
Partridge, Gray																					
Pheasant, Ringnecked																					
Cuckoo, Blackbilled																					XX
Cuckoo, Yelowbilled																					
Whip-poor-will																					
Nightwawk																					XX
Swift, Chimney																					XX
Hummingbird, Rubythroated																					
Kingfisher, Belted		1																			XX
Flicker, Northern				1	1						1					2		1			
Woodpecker, Redheaded																				X	XX
Woodpecker, Redbellied																					
Woodpecker, Pileated																					

TABLE NO. 3.9-10 (Cont.)

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Sapsucker, Yellowbellied								1			1						1	2			XX
Woodpecker, Hairy	1			1													1	1			XX
Woodpecker, Downy		1																			
Woodpewee, Eastern																					
Kingbird, East.																				X	XX
Flycatcher, Great Crest.					1																XX
Flycatcher, Yellowbellied																					
Flycatcher, Alder																					
Flycatcher, Least																					
Phoebe, Eastern									1		1										XX
Lark, Horned																					
Swallow, Tree									1			2		1					1		XX
Swallow, Roughwinged																					
Swallow, Bank																					
Swallow, Barn																				X	XX
Swallow, Cliff																					XX
Martin, Purple																					XX
Blue Jay	3	3		3	4	6	8			2	1	5	3	2	3		2	3	5		XX
Grau Jay																					
Crow	7	5		4	2	8	8	1		4	2	7	4		1	6	4	6	11		XX
Raven, Common																					
Chickadee, Blackcapped	6	A		7	7		5	5			2			1					2		XX
Chickadee, Boreal																					
Nuthatch, Whitebreasted		1		3																	XX
Nuthatch, Redbreasted	1																				
Creeper, Brown																					
Wren, House																					XX
Wren, Shortbilled															3						XX
Wren, Sedge																					
Wren, Winter		1																			
Gray Catbird	2				2						3		1		1		1	3	2		XX
Mockingbird, Northern																					
Brown Thrasher					2										1						XX
Thrush, Swainson's																					
Thrush, Hermit																					
Thrush, Wood																					
Robin, American	1	6	7	12		3			2	2	3	2			1	5	7		7		XX
Veery														2	5			6			XX

TABLE NO. 3.9-10 (Cont.)

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Bluebird, Eastern			15																	X	XX
Kinglet, Goldencrowned																				X	XX
Kinglet, Rubycrowned																					
Waxwing, Cedar	5		3	3			1														XX
Waxwing, Bohemian																					
Water Pipet																					
Shrike, Northern																					
Starling						2					1										XX
Vireo, Yellowthroated																					
Vireo, Redeyed															3				1		XX
Vireo, Warbling																					XX
Vireo, Philadelphia																					
Warbler, Yellow																				X	XX
Warbler, Blk-Th Green	5						1														
Warbler, Goldenwinged																					
Warbler, Tennessee																					
Warbler, Orangecrowned																					
Warbler, Nashville																					
Warbler, Magnolia																					
Warbler, Cape May																					
Warbler, Blackthroated Blue																					
Warbler, Blackburnian																					
Warbler, Pine																					
Warbler, Palm																					
Warbler, Baybreasted																					
Warbler, Blackpoll																					
Warbler, Canada																					
Warbler, Yellowthroated																					XX
Warbler, Blk & White	2																		1		
Warbler, Yellow-rumped		1																			
Warbler, C-nut-sided				1		3	2	1		3	1		2								XX
Yellowthroat, Common	3						1		1	1									4		
Waterthrush, Northern																					
Oven-bird					5	3	16	11	3		4		8	5	2	9	1		3		XX
American Redstart																					XX
Sparrow, House																				X	XX
Bobolink																					XX

TABLE NO. 3.9-10 (Cont.)

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Meadowlark, Eastern																					XX
Meadowlark, Western																					XX
Blackbird, Redwinged	6	20		2	11			5	2		2	1			3			1			XX
Oriole, Northern								4													XX
Oriole, Orchard																					
Blackbird, Rusty									1				1		1						XX
Blackbird, Brewer's																					XX
Blackbird, Yellowheaded																					
Grackle		16								1	1										XX
Cowbird										1	1			1							XX
Tanager, Scarlet																					XX
Cardinal, Northern																					
Grosbeak, Pine																					
Grosbeak, Rosebreasted	2	3	3																2		XX
Bunting, Indigo																				X	XX
Bunting, Snow																					
Grosbeak, Evening																					XX
Crossbill, Red																					
Crossbill, Whitewinged																					
Common Redpoll																					
Finch, Purple	1	8	2	1																	XX
Goldfinch		9			3			3	3			1	2	3	3	4		6	2		XX
Dickcissel																					
Rufus Sided Towhee																				X	XX
Sparrow, Savannah																					XX
Sparrow, Le Conte's																					XX
Sparrow, Vesper																					XX
Junco, Darkeyed			A	A																	XX
Sparrow, Tree													2			2	5		2		XX
Sparrow, Chipping																7	4		7		XX
Sparrow, Whitecrowned																					
Sparrow, Harris'																					
Sparrow, Clay-colored															3			3	4		XX
Sparrow, White-throated			3													3			4		XX
Sparrow, Field															2						
Sparrow, Fox		1						2							1	1		1			XX

TABLE NO. 3.9-10 (Cont.)

	Results of Bird Observation Transec																			(1)	(2)
Month	9	10	10	10	5	5	5	5	5	6	6	6	6	6	6	8	8	8	8	Other	
Day	9	6	7	8	12	17	18	19	20	6	7	8	9	10	30	17	18	19	23	Observ	1973
Sparrow, Swamp								3					1	1		11			9		XX
Sparrow, Grasshopper																					XX
Sparrow, Lincoln's																					
Sparrow, Song					3	8	9		1	3	3		7	10			5				XX
Sparrow, Sharp-tail		1																			
Siskin, Pine		1																			

A = Abundant
(1) Species observed during other field activities by field biologists.
(2) Species reported by Piotowski, 1972 (See BCMC, 1974).

Note: Common Name after American Ornithologist's Union, 1983.

There are 42 songbird species that are summer residents on the study area. The most abundant songbirds are robin (*Turdus migratorius*) and ovenbird (*Seiurus aurocapillus*).

Peterson (1988) clearly identifies one raptor species, the broad-winged hawk, as a summer resident in northern Wisconsin. Temple (1987) states that the broad-winged hawk can be found in northern Wisconsin from April through November before it migrates south to the tropics in large flocks. The other raptors in the study area may remain in the region and will be discussed as permanent residents.

Five summer resident waterfowl species--wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), blue-winged teal (*Anas discors*), hooded merganser (*Lophodytes cucullatus*), and common merganser (*Mergus merganser*)--were observed on the study area, primarily on the Flambeau River. Waterfowl utilize the Flambeau River as nesting, brood rearing, and staging areas. The Flambeau River is not a major waterfowl breeding area because of the lack of grasses required for ground nesting birds. Hooded merganser and wood duck use cavity nests that were observed on the study area. The Flambeau River has adequate nesting habitat for cavity-nesting waterfowl because of the wooded areas along the river.

Other summer residents found on the study area are primarily shorebirds. These include sora (*Porzana carolina), Wilson's snipe (Capella gallinago*), upland plover (*Bartramia logicacida*), American woodcock (*Philohela minor*), and killdeer (*Charadrius vociferus*). Wetlands on the environmental study area and exposed river bottom flats caused by fluctuations of the Flambeau River provide habitat for shoreland birds.

Permanent Residents

Approximately 30 percent of the birds found on the study area are permanent residents (Peterson, 1987).

Six raptor species can be found throughout the year on the study area. These species comprise the bald eagle (*Haliaeetus leucocephalus*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), american kestral (*Falco sparverius*), and great horned owl (*Bubo virginianus*) (Peterson 1987). According to Temple (1987), the great horned owl is the only raptor that is truly permanent to the region. The remaining raptors are near the northern edge of their permanent range and summer range.

Year-round game species found on the study area include one waterfowl species--common goldeneye (*Bucephala clangula*)--and two upland game birds--ruffed grouse (*Bonasa umbellus*) and ringneck pheasant (*Phasianus colchicus*). Common goldeneye nest in northern Wisconsin and the Canadian provinces. Southern migration of the species is limited to the availability of open water in the northernmost wintering areas. Therefore, open water associated with the Flambeau River during winter months would allow common goldeneye to remain on the study area.

Ruffed grouse and ringneck pheasant occupy two different niches as year-round resident upland game birds. Ruffed grouse favor mixed woodlands, and their preferred food is aspen buds. The ringneck pheasant's preferred habitat is agricultural fields, brush, and marsh edges. Due to winter severity and predation, there is minimal natural reproduction of ring-neck pheasants on the study area.

The majority of the permanent species found in the study area include those identified as other species. Of the 22 species identified, the most familiar species are blue jay (*Cyanocitta cristata*), American goldfinch (*Carduelis tristis*), common crow (*Corvus brachyrhynchos*), and black-capped chickadee (*Parus atricapillus*).

Winter Species

Tree sparrow was the only winter species observed on the study area. According to Peterson (1988), tree sparrows nest near Hudson Bay and migrate to wintering areas in the northern states. Temple (1987) observed tree sparrows in northern Wisconsin beginning in late August. 1987-1988 survey observations noted tree sparrows on the study area during middle to late August.

Migrants

Five migratory species were observed on the study area. According to Peterson (1988), fox sparrow (*Passerella iliaca*), horned grebe (*Podiceps auritus*), bufflehead (*Bucephala albeola*), and rusty blackbird (*Euphagus carolinus*), are known to migrate through the study area between nesting and wintering areas. These species are primarily observed during the spring and fall but less frequent observations have been documented in summer months in northern Wisconsin (Temple, 1987).

3.9.4.2.2 Site Populations

Approximately 30 manhours were spent walking bird transects on the site area as shown on Figure No. 3.9-2. The habitats

surveyed include floodplain meadow, mixed lowland forest, northern hardwood forest, and old field communities. Fifty-seven species were observed on the site during surveys conducted in September and October 1987, May, June, and August 1988. Previous studies done in 1973 as part of the preliminary environmental impact report identified 51 species. Twelve additional species were identified in 1987-1988 surveys; therefore, 69 species were identified, inclusive of the two studies on the site area and as shown on Table No. 3.9-10.

Raptors

Six raptor species identified as using the study site were: sharp-shinned hawk, broad-winged hawk, red-tailed hawk, northern harrier, great horned owl, bald eagle, and american kestral. The six species are within their range and commonly nest in northern Wisconsin.

Northern harrier and red-tailed hawk were the most abundant raptor species observed during surveys on the site area. Sharp-shinned hawk and broad-winged hawk were observed in 1972-1973 surveys, but not identified in 1987-1988 transects, though Rusk County is within the range for the species. According to Temple (1987), the great horned owl is the only permanent resident raptor in northern Wisconsin. Sharp-shinned hawk, northern harrier, american kestral, and red-tailed hawk populations decrease in northern Wisconsin during winter, indicating southward migration. Broad-winged hawks commonly nest in northern Wisconsin and migrate south to the southern tip of Florida (Peterson, 1988).

A pair of bald eagles use an active nest located 1.75 miles southwest of the project area. They and their young were observed using the Flambeau River near the project area during the field investigations. Mathison (1968) concluded that human disturbance near active nests showed no measurable affect on nesting success of bald eagles. See Section 3.9.6.2.

Game Species

Four waterfowl species and two upland game species were observed on the site area during 1972-1973 and 1987-1988 surveys. Wood duck, mallard, american goldeneye, and bufflehead were observed using the Flambeau River. Three additional waterfowl species, hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*) and blue- winged teal (*Anas discors*) were identified near the site while performing nonsurvey activities on the Flambeau River. Ruffed grouse (*Bonasa umbellus*) and american woodcock (*Philohela minor*) are upland game birds commonly observed on the site.

The major nesting species on the Flambeau River are mallard, wood duck, and hooded merganser (pers. comm., Vanasac, 1988).

Mallards were the most abundant waterfowl species observed using the study site and the Flambeau River during the 1987-1988 field survey. Nesting habitat is marginal on the Flambeau River for ground nesting waterfowl because of the lack of nesting cover and the slight flooding hazard due to fluctuations of the Flambeau River. A female mallard with a brood of two ducklings approximately one week old were observed on the Flambeau River between the pit area and Meadowbrook Creek on May 19, 1988. There is abundant nesting habitat for cavity-nesting waterfowl along the Flambeau River because of the forested banks, although no broods were observed.

Ruffed grouse were commonly observed in northern hardwood/aspen and mixed lowland habitats on the site, which is their preferred habitat. Ruffed grouse populations are cyclic and fluctuate approximately every ten-year period (Buss, 1955). The WDNR does not conduct ruffed grouse density surveys in Rusk County, but Frank Vanasac, the Wildlife Manager for the district, noted that ruffed grouse populations in northern Wisconsin are presently near their cyclic peak. Moulton (1977) estimated population during the peak cyclic period to be greater than 2.66 drumming males per 100 acres.

American woodcock is the only migratory upland game bird found on the project area. Woodcock winter in approximately the southeastern one-third of the United States (Peterson, 1988). Migration peaks in April and October (Temple, 1987). The preferred habitat is wet thickets, moist woods, brushy swamps, and openings (Peterson, 1988).

Nongame Birds

Nongame bird surveys were conducted in three habitats on the project area during November through February 1972-1973, March through July 1973, September and October 1987, and May, June, and August 1988. The habitats surveyed were northern hardwood/aspen, old field early successional, mixed lowland, and floodplain meadow. Sixty-six nongame species were observed on the project area.

The most abundant nongame species on the project area during the 1987-1988 surveys were bluejay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Parus atricapillus*), American robin (*Turdus migratorius*), ovenbird (*Seiurus aurocapillus*), red-winged blackbird (*Agelaius phoeniceus*), and song sparrow (*Melospiza melodia*). These species were common to abundant in 1972-1973 surveys and are within the range for the species (Temple, 1987).

Bluejay, crow, and black-capped chickadee are permanent residents of northern Wisconsin. Resident species are

ecologically and aesthetically important to the region. The most abundant nonpermanent resident species are robin, ovenbird, red-winged blackbird, and song sparrow. These species migrate from northern Wisconsin in November and December and return in March, with the exception of the ovenbird, which migrate northward in May and returns south in October (Temple, 1987).

Eight hundred birds were identified during 13 days of walking bird survey routes on the project area. The largest population existed in the northern hardwood/aspen field habitat directly over the proposed open pit site. This habitat is a diverse intermix of open areas, shrubby areas, early successional tree species, mature tree species, and pine plantations. This provides a favorable mix of roosting, nesting, and feeding areas for many nongame species.

3.9.4.3 Amphibians and Reptiles

There are 59 species of reptiles and amphibians indigenous to Wisconsin. Each is an important facet of its ecological community.

Documented observations in Rusk County include 10 species; five frogs, one salamander, three turtles, and one snake (Vogt, 1981). Twenty-two additional species possess ranges which include Rusk County (Casper, 1988). Field herpetological studies completed during 1973-1974 and 1987-1988 identified 11 species on the study area (Wetlands Inventory and Assessment, Appendix 3.8-C).

Blanding's turtle (*Emdoidea blandingi*), which has been documented in Rusk County, and wood turtle (*Clemmy's insculpta*), which is probable in Rusk County, are considered threatened by the Wisconsin Heritage Program. Neither of these species were observed on the project area. Detailed discussion of rare species will be addressed in a later section.

Most amphibians live their adult life in moist terrestrial habitats and migrate to water for spring breeding rituals. American toad (*Bufo terrestris*) and spring peepers (*Hyla crucifer*), were "very common" on the study area during 1973-1974 and also observed during 1987-1988 field work. Although neither of these species were observed in Rusk County by Vogt (1981), the project area is within their range. Grey tree frog (*Hyla veisicolor*) and mink frog (*Rana septentrionalis*), were not observed during 1987-1988 field work but were "commonly" found in 1973-1974. Grey tree frogs migrate to uplands following the breeding season to forage in trees and shrubs. Mink frogs, on the other hand, remain in wetlands throughout the summer months. Both species have been documented to occur in Rusk County. Pickeral frogs (*Rana palustris*) are also documented in Rusk

County and were "uncommonly" observed on the study area in 1973-1974. The preferred year-round habitat of pickeral frogs is spring-fed wetlands with good water quality. None were observed during field investigations on the project area.

Three salamander species were observed on the study area during 1973-1974 and one was observed during 1987-1988 field work. Red-backed salamander (*Plethedon cinereus*), were "fairly commonly" observed on the study area during 1973-1974 field work and also observed during 1987-1988 field work. It was the only salamander species found during both study periods. Vogt (1981) determined the species to be independent of standing water, and not present in Rusk County, but Casper (1988) lists Rusk County within the range for the species. Tiger salamander (*Amlystoma tigrinum*), was commonly observed during 1973-1974 field work on the study area. It breeds in a variety of water body types ranging from marshes to sewage treatment ponds (Vogt, 1981). Vogt did not observe tiger salamanders in Rusk County but they would be within the range for the species according to Casper. Blue-spotted salamander (*Ambystoma laterale*) was determined to be "probably common" on the study area during 1973-1974 field work. Vogt has not documented this species in Rusk County but does report an undocumented occurrence. Casper believes Rusk County is within the species range. This species is more tolerant of dry conditions than other Wisconsin salamander species and is often found in areas with very sandy soil (Vogt, 1981). Neither the blue salamander or tiger salamander were observed in 1987 or 1988.

The orders Teredines (turtles) and Squamata (snake and lizards) were identified on the study area. The snapping turtle (*Chelydra serpintina*), and painted turtle (*Chrysemys picta*) were observed during 1973-1974 field work on the study area and are documented to occur in Rusk County. Snapping turtles have been observed in Wisconsin in every conceivable aquatic habitat from rivers to roadside ditches; polluted water does not generally affect them (Vogt, 1981). The painted turtle is similar to the snapping turtle in that it lives in a variety of water systems and does not appear to be affected by pollution (Vogt 1981). The primary habitat on the study area is the Flambeau River.

Eastern garter snake (*Thamnophis sirtalis*) was the only snake observed on the study area during 1973-1974 and 1987-1988 field work. The preferred habitat of this species is forest edge communities. According to Pope (1944), frogs, toads, salamanders, and earthworms compose more than 90 percent of their diet. Vogt (1981) considers this species to be the most abundant snake in Wisconsin. It is one of eight probable species of snake in Rusk County. Of these eight species, only the northern water snake (*Nerodia sipdon*) has been documented in Rusk County according to Casper (1988).

3.9.5 Threatened and Endangered Species

Threatened and endangered species are recognized by low populations in areas where habitat exists within the range for the species. Endangered species are recognized on both the federal and state level. These species are those which are in danger of extinction throughout all or a significant portion of their range. Threatened species are those which are likely to become endangered unless measures are taken to restore the population. The WDNR has no documented records of any endangered or threatened animal or plant species, nor any protected natural areas or plant communities on the project area (pers. comm., Nicotera, 1988).

3.9.5.1 Vegetation

There are 107 threatened and endangered plant species recognized by the Wisconsin Natural Heritage Inventory (WDNR, November 1988). Fifty-seven species are determined to be endangered and fifty are classified as threatened. Appendix 3.9-A shows 355 plant species identified from 1972-1973 and 1987-1988 field observations. The 1972-1973 site work by Matson (1974) as part of his masters thesis reported purple milkweed (*Asclepias pupurascens*) and hoplike sedge (*Carex lupuliformis*) from the larger study area. Purple milkweed is considered endangered in Wisconsin, whereas hoplike sedge is threatened. Neither of these species nor any other endangered or threatened species were observed on the project area during the 1987 and 1988 field work.

According to Hill (pers. comm., 1988), purple milkweed and hoplike sedge were probable misidentifications in Matson's report. Recent studies on the voucher specimens from 1974 confirm that the purple milkweed and the hoplike sedge (Appendix 3.9-C) were misidentified. Rusk County is out of the range of each of these species. Purple milkweed occurs in southern Wisconsin in dry field and thickets. Hoplike sedge occurs in swamps and is a doubtful occurrence in Rusk County because the County is at northeasternmost extreme of its range. No other endangered or threatened plant species have ever been identified on the site.

3.9.5.2 Mammals

The timber wolf (*Canis lupus*) and Indiana bat (*Myots sodalis*) are mammals which are federally designated as endangered species. The timber wolf is also recognized as an endangered species by the state of Wisconsin, along with other endangered species such as lynx (*Lynx canadensis*) and American marten (*Martes americana*). Neither state nor federal governments designate any mammals as threatened species in Wisconsin. No threatened or endangered mammals are known to use the site.

3.9.5.3 Birds

As of November 1988, there are five federally designated endangered or threatened avian species occurring in Wisconsin, bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrine*), piping plover (*Charadrius melodus*), Kirtland's warbler (*Dendroica kirtlandia*), and whooping crane (*Grus americana*). Bald eagles are known to nest in northern Great Lake States and were observed on the study area along the Flambeau River. The peregrine falcon and whooping crane are migrants through the 48 contiguous states because they nest in northern Canada and winter south of the United States. Piping plover and Kirtland's warblers nest in the Great Lakes region, but not in the northwest part of the Wisconsin, and were not observed on the study area (Peterson, 1988).

There are 15 endangered and threatened bird species listed in the State of Wisconsin (Appendix B to the Wetlands Inventory and Assessment, Appendix 3.8-C). According to Peterson (1988), seven of these species--bald eagle, red- shouldered hawk (*Buteo lineatus*), osprey (*Pandion haliaetus*), cooper's hawk (*Accipiter cooperii*), common tern (*Sterna hirundo*), great egret (*Casmerodius albus*), and loggerhead shrike (*Lanius ludovicranus*)--have ranges and habitat requirements that include Rusk County. Red-necked grebe (*Policeps grisegina*), and Foster's tern (*Sterna Fosteri*) may occur in the region as migrants. Red-necked grebe, common tern, and bald eagle are the only endangered or threatened species observed in Rusk County (pers. comm., Robbins, 1988). Of these, only the bald eagle was observed near the project area. There is one active bald eagle nest located 1.75 miles downstream from the project area. The proposed open pit site is within the eagles' hunting territory. An adult and immature bald eagle were observed hunting along the Flambeau River west of the pit area in November 1988. Mathison (1983) has shown that human activity in the vicinity of active eagle nests does not affect nesting success.

Bald eagles formerly nested throughout Wisconsin. Early studies by Broley (1947) documented a population decline in bald eagles which extended into the 1960s. This decline was attributed to habitat destruction, human disturbance, and pesticide use--particularly DDT. The majority of the nesting is now in the northern half of the state near preferred habitat along rivers and lakes (Peterson, 1988). Eagle populations have increased because of protective actions taken in the 1960s and 1970s.

3.9.5.4 Amphibians and Reptiles

There are no federally designated threatened or endangered reptiles or amphibians found in Wisconsin. As of November 1988

the Wisconsin Natural Heritage Inventory identified seven endangered and three threatened species. One of the threatened species, the Tremblay's salamander, is no longer considered a species, but merely a hybrid species. Legislation is pending to drop Tremblay's salamander from the inventory (pers. comm, Casper, 1988). Of the remaining nine species, two threatened species may occur in Rusk County--the wood turtle (*Clemmy's insculptor*), and Blandings turtle (*Emdoidea blandingi*). Vogt (1981) documented the Blandings turtle in Rusk County. Casper (1988) lists the wood turtle as probable in the county. Neither were observed on the study area during field work conducted in 1972-1973 or 1987-1988.

The wood turtle's preferred habitat is restricted to forested areas along fast-moving streams. They are omnivorous, feeding aquatically on insects and mollusks, and terrestrially on blackberries, dandelions, and mullein. Due to habitat destruction and widespread collection, populations were reduced to the point where they needed protection (Vogt, 1981). The project area has habitat available although no wood turtles were observed.

Unlike the wood turtle, Blandings turtle prefers slow-moving water and marshy areas. It is rarely found in forested regions along fast-moving rivers. This species feeds aquatically on snails, crayfish, insects, frogs, fish, and plants. Terrestrially, it feeds on earthworms, slugs, grubs, and grasses. Because of the absence of suitable habitat on the study area, it is unlikely this species occurs on the project area.

3.9.6 Sensitive Receptors

3.9.6.1 Agricultural Crops and Native Plant Species

The study area supports a combination of natural communities and recently disturbed areas. The natural communities on the study area include alder thicket, northern mesic forest, northern sedge meadow, northern wet forest, northern wet-mesic forest, and open bog. Past disturbances have caused some reestablishment areas to become a combination of several communities. For example, a former northern sedge meadow may become reestablished as an alder thicket and northern sedge meadow following the disturbance.

One community, Wetland Area 3c, (Wetlands Inventory and Assessment, Appendix 3.8-C) consists of 0.5 acres of northern sedge meadow. This community will not be directly disturbed by the project. It is considered a rare community in Wisconsin, although it is not recognized as threatened or endangered. The

remaining communities are listed as secure in the state. In a letter dated March 29, 1988, the WDNR reported no occurrence of Natural Areas or Plant Communities on the project area (Appendix 3.9-C).

Agricultural lands on the study area include local crops of corn, wheat, alfalfa, and pasture. These areas were scattered within the study area. No agricultural lands in the region are identified as sensitive receptors.

3.9.6.2 Wildlife

The documented active bald eagle nest located 1.75 miles downstream from the project area is the only sensitive wildlife species observed in the vicinity of the project area. At present, bald eagles are listed by the federal government as endangered species in part of its range and it is an endangered species in Wisconsin.

The impact of human disturbances on nesting bald eagles was studied by Mathisen (1968) on the Chippewa National forest in central Minnesota. Mathisen studied 115 bald eagle nests and concluded that nesting success was not measurably influenced by human activities. Observations made at nests in very isolated parts of the forest (no road within 1/4 mile and no timber cutting within 1/2 mile of site) were occupied 78 percent of the time and successful 54 percent of the time. Nests in areas of frequent human presence were similarly occupied 79 percent of the time and successful 48 percent of the time.

3.9.7 Ecological Relationships

3.9.7.1 Comparative Relationships

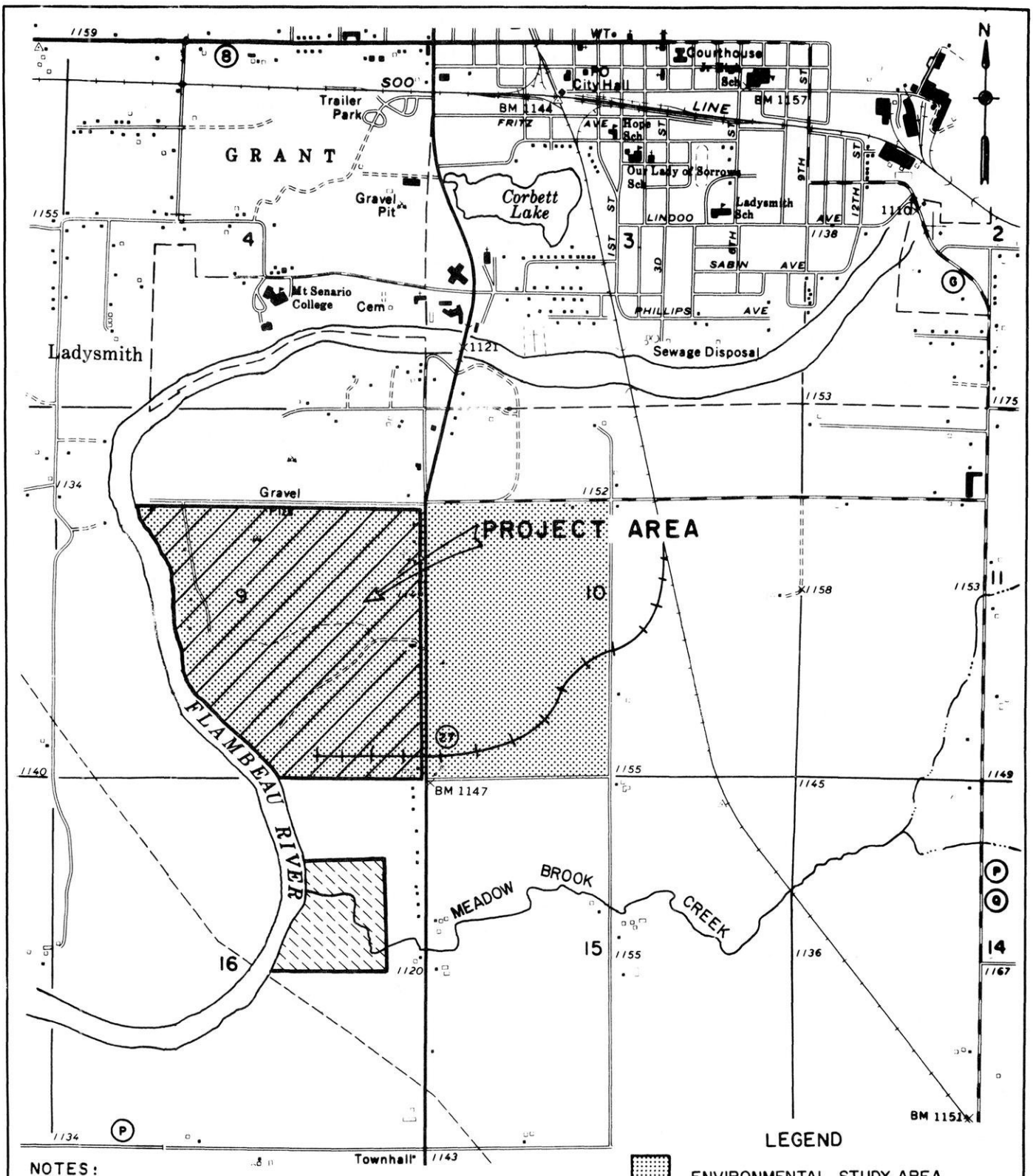
The study area is similar to the region within which it is located, in terms of topography, soils, flora, and fauna.

The entire region has been glaciated and was formerly forested with hardwood-coniferous forest. Presently the majority of northern Wisconsin forests is in second-growth timber and agriculture. The entire northern part of the state, including Rusk County, provides important recreational opportunities such as hunting, fishing, snowmobiling, and sight-seeing.

Wildlife species observed on the project area are similar to those of the surrounding region because of similar land uses and forest habitats. Whitetail deer, snowshoe hare, and ruffed grouse are the commonly hunted species in northern Wisconsin. Ruffed grouse and whitetail deer were commonly present on the study area. Snowshoe hare were not observed due to lack of suitable habitat but are expected to occur in suitable habitats in the region.

The inventory of the regional wetlands indicated that the wetlands in the study area, which are listed in Table No. 1 in the Wetlands Inventory and Assessment, Appendix 3.8-C, are similar in abundance to others in Rusk County. The six wetland types described by the Wisconsin Wetland Inventory (included in Appendix A of the Wetlands Inventory and Assessment, Appendix 3.8-C) are generally common throughout the county. The one community that is not common in the county, persistent-wet meadow-wet soil-disturbed area (ELKa) accounts for 0.2 percent of the acreage in the County. The same community accounts for 9.7 acres of the total wetland area on the study area. This wetland will not be affected by the project. No natural or endangered or threatened plant communities are known to be present on the project area.

Figures for Section 3.9



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
NOTES	APPROVAL	DATE	FIGURE NO. 3.9-1 LOCATION OF STUDY AREAS
	DESIGNED BY		
	DRAWN BY SJL	2/89	
	CHECKED BY TJW	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 2000'		Job No / Dwg No / REV



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 CORPORATON, 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. 8087 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.

LEGEND

- 1100 — EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- F-1 CONTROL MONUMENT
- (B) SOIL SAMPLE LOCATIONS
- (3) VEGETATION SAMPLE LOCATIONS
- (2) SOIL INVERTEBRATE LOCATIONS
- (1) ANURAN VOICE SURVEY POINTS
- C SMALL MAMMAL TRAPPING AREAS
- BIRD OBSERVATION ROUTES

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'S W.A.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'S W.A.

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

	BY	DATE
DESIGN		
DRAWN	MJO	3/89
CHK'D	TJW	3-89
DES. ENG'R		
SECT ENG'R		

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LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 3.9-2
TERRESTRIAL SAMPLE LOCATIONS

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

3.10 Ambient Noise and Vibration

3.10.1 Field and Laboratory Methods

3.10.1.1 Survey Locations

A total of 27 ambient noise monitoring sites were included in the field survey work for this project. Each site was chosen on the basis of the typicality or noise sensitivity of adjacent land uses. Wherever possible, sites were chosen to correspond with prior testing performed during the 1970s. The final set of monitoring sites incorporates 11 locations not previously monitored, and excludes a large number of sites no longer relevant due to changes in project scope during the intervening years.

The selected ambient noise monitoring locations are shown on Figure No. 3.10-1 and listed on Table No. 3.10-1.

3.10.1.2 Measurement Program

Two series of background measurements were made at sites 1 through 19. Information for noise levels with normal vegetation conditions was gathered on September 29 and 30, 1987. Noise levels under winter (bare branch) vegetation conditions were measured on December 8 and 9, 1987.

Another monitoring effort was conducted at 14 sites around the active gravel pit north of Blackberry Lane during June 1988. This monitoring effort obtained data during the peak of a major construction activity, involving gravel pit operations and a major road construction project. Sites 1 through 7 and 21 through 27 were monitored for this activity.

Measurements were made using A-weighted and C-weighted scales. The C-weighted scale provides a generally uniform response within the frequency range of 30 Hz to 8 KHz. This characteristic allows the determination of the real intensity of sound without emphasizing any special frequency. It is useful for some acoustical studies, and to compare the "loudness" of high-level sounds, i.e., 90 decibels and over. Use of the C-weighted scale was determined in part by a desire for compatibility with prior testing at the sites.

The A-weighted scale offers considerably reduced response at low frequencies, and a slightly increased response in the high frequencies, within the overall 30 Hz to 8 KHz frequency range. The A-weighted scale was originally designed to allow a crude "loudness" measurement at relatively low levels of sound intensity, around 40 dB, and approximates the response of the normal human ear at that sound level. It has also been found useful in expressing both the annoyance factor and the hazard (danger of hearing loss) of a wide variety of noises. Because of this, the A-weighted scale is specified by the U.S.

TABLE NO. 3.10-1

Background Sound Monitoring Locations for
Mining and Transportation Related Noise Survey

Site No.	Description
1	Rest Home Parking Lot
2	SE Corner Hospital
3	S of Convent
4	NE of College
5	S of College
6	N of College
7	NW of College
8	STH 27 at Bridge (South)
9	STH 27, Blackberry Lane
10	STH 27, E of Pit
11	STH 27, Entrance Road (proposed)
12	STH 27, S of Site
13	RR at Doughty Road
14	RR at E of Jansen Road
15	W of River, NW of Pit
16	W of River, W of Pit
17	W of River, S of Pit
18	STH 27 at CTH P
19	STH 27 at College Avenue
20	Center of Gravel Pit
21	Residence immediate north of Blackberry Lane
22	Residence on Tiews Road near River
23	Highway 27 South of Bridge
24	Residence Immediately Northeast of Gravel Pit
25	Residence Immediately Northeast of Gravel Pit
26	Residence Immediately Northeast of Gravel Pit
27	Residence Immediately Northeast of Gravel Pit

Department of Transportation (USDOT) and by the Occupational Safety and Health Administration (OSHA) to determine both highway and aviation noise-related impacts. Approximately 90 measurements of sound intensity were performed for each monitoring series, on both the A-weighted and C-weighted scales.

Vibration measurements were taken in the region in October of 1987, using a GMS 4 seismograph. Sites selected for background vibration included along STH 27, the mainline railroad in Ladysmith, and traffic locations in and out of the Rusk County Memorial Hospital and Mt. Senario College.

3.10.1.3 Analytical Procedures

The collected noise monitoring data was analyzed according to five parameters for each location and survey condition (scale). The parameters were:

Max - The peak noise level measured.
Min - The lowest noise level measured.
L_{10} - The sound level that was exceeded 10 percent of the time.
L_{50} - The sound level that was exceeded 50 percent of the time.
L_{eq} - The equivalent or energy-averaged mean sound level.

All results were shown in decibels according to the A-weighted (dBA) or C-weighted (dBC) scales as appropriate.

All analyses used simple mathematical procedures, including the logarithmic mean in the instance of L_{eq}.

3.10.1.4 Quality Control

Data collection was conducted in accordance with the standards of ASTM E-1014, *Standard Method for Measurement of Outdoor A-Weighted Sound Levels*. The basic requirements for this specification include:

- Use of a sound-level meter meeting the requirements of ANSI S1.4, *Specification for Sound-Level Meters*.
- Use of a microphone windscreen.
- Measurement accuracy within 1 dB.
- Calibration before and after each measurement set.
- No measurements when the wind speed exceeds 20 Km/h (12 mph) on a steady basis.
- Limited measurements during precipitation.
- Use of representative time periods for measurement.

These procedures were followed at all times. In addition, battery levels were checked on a daily basis. The instrument used was a Scott Instrument Laboratories Type 452 Sound Meter meeting ANSI S1.4 Type 2 specifications. A "slow" response setting was employed for all readings.

In the absence of an applicable standard, identical procedures were employed to monitor C-weighted scale noise levels.

3.10.2 Background Ambient Sound and Vibration Levels

The survey results for 1987 are reported in Table No. 3.10-2. They are shown in matrix form--correlating the A and C scales, summer and winter vegetation conditions, and the five analysis parameters previously discussed (Max, Min, L_{10}, L_{50}, and L_{eq}).

In addition to the tabular summary, survey results are shown in graphic form. Figure No. 3.10-2 shows noise contours corresponding to A-scale noise levels with normal summer vegetation, while Figure No. 3.10-3 shows A-scale noise levels with bare-branch winter vegetation. Figures 3.10-4 and 3.10-5 show C-scale noise levels with summer and winter vegetation. The maps provide a graphic indication of the patterns of sound distribution in the project vicinity and facilitate estimations of sound levels at intermediate locations.

In general, noise levels are strongly influenced by the proximity to State Highway 27 (STH 27), the principal noise generator in the vicinity. Noise levels adjacent to STH 27 exceed levels for compatible residential occupancy (65 dBA). Sound levels at other locations are at lower levels. There is a substantial correlation between dBA and the higher dBC levels at each location, although the differences range from 2 to 20 decibels.

Noise levels at most locations are somewhat higher during the winter months due to greater noise propagation resulting from the absence of deciduous vegetation. The difference at these locations is usually only one to three decibels due, in part, to the sparse to moderate vegetation prevalent in the project vicinity. At some locations (e.g., 15 and 16), noise reductions were noted; these locations are all at a considerable distance from the highway and are most strongly influenced by noise generated by the wind passing through the nearby vegetation. Therefore, bare-branch conditions result in a significant drop in ambient noise levels at these locations in winter months.

A direct comparison of the 1973 monitoring results with the 1987 data is not possible due to quality control deficiencies in the conduct of the previous survey. However, it appears that noise levels have increased slightly adjacent to STH 27, and decreased slightly adjacent to the college campus (locations 4-7). One

TABLE NO. 3.10-2

1987 Noise Monitoring Summary

Location	A-Scale Max	Min	L_{10}	L_{50}	L_{eq}	C-Scale Max	Min	L_{10}	L_{50}	L_{eq}
01-Normal	64	49	56	52	53.8	85	68	74	71	72.6
Winter	68	52	60	55	58.6	81	64	77	70	73.6
02-Normal	70	42	56	49	55.5	80	57	71	63	68.1
Winter	66	51	61	57	59.1	81	59	72	65	70.4
03-Normal	51	41	46	43	44.4	67	58	65	61	62.3
Winter	52	43	50	46	46.9	74	63	68	65	66.1
04-Normal	61	39	51	46	48.5	79	48	66	61	64.0
Winter	59	42	58	55	54.4	81	67	79	73	75.3
05-Normal	49	40	45	42	43.1	65	52	59	55	57.1
Winter	50	41	46	43	44.0	67	55	63	59	60.7
06-Normal	49	40	46	43	43.8	70	52	60	55	58.1
Winter	60	42	48	44	47.5	69	53	63	59	60.9
07-Normal	59	39	51	46	47.9	70	51	63	56	59.6
Winter	65	35	55	52	53.4	79	53	76	73	73.1
08-Normal	79	46	71	56	66.2	86	56	77	65	73.3
Winter	85	45	71	59	69.4	85	53	71	61	69.7
09-Normal	76	46	66	55	62.5	77	54	71	64	67.8
Winter	71	38	67	58	62.1	79	51	70	59	65.4
10-Normal	81	44	62	52	68.0	81	53	70	60	70.1
Winter	70	36	62	54	62.5	81	52	71	58	70.1

TABLE NO. 3.10-2 (Cont.)

Location	A-Scale Max	Min	L_{10}	L_{50}	L_{eq}	C-Scale Max	Min	L_{10}	L_{50}	L_{eq}
11-Normal	72	36	64	47	59.9	80	46	71	59	68.1
Winter	71	35	62	49	59.1	74	49	68	60	64.0
12-Normal	71	46	64	51	64.2	73	50	71	63	68.8
Winter	68	35	61	53	60.4	74	43	65	54	64.9
13-Normal	79	51	63	56	61.7	81	52	73	63	69.9
Winter	80	42	65	49	63.2	83	61	72	68	70.3
14-Normal	54	41	49	45	46.5	66	47	59	54	55.9
Winter	48	36	46	41	42.8	57	53	56	55	55.1
15-Normal	46	39	44	40	41.7	59	50	56	54	54.1
Winter	50	38	42	40	41.0	56	49	54	51	51.7
16-Normal	59	46	55	51	52.5	61	51	58	56	56.2
Winter	46	38	41	40	40.2	66	49	56	51	55.0
17-Normal	80	41	56	49	61.5	88	51	79	72	75.2
Winter	70	35	49	40	52.6	90	50	71	67	68.8
18-Normal	75	48	64	56	61.7	89	60	80	74	76.6
Winter	70	35	63	50	58.8	86	43	71	60	68.4
19-Normal	76	46	69	59	63.7	83	66	80	77	77.8
Winter	79	46	69	62	65.7	80	61	76	70	72.1

factor present in 1973 ambient noise levels, no longer existent, was the operation of a sand-and-gravel crusher. This crusher was owned by the Rusk County Highway Department and was located on the project area. Its absence has lowered noise levels on and near the project area.

Results of the 1988 supplemental noise survey are presented on Table No. 3.10-3.

Maximum ground velocites were measured at six sites as follows:

Mt. Senario College	L = 0.04, V = 0.04, T = 0.05
Rusk Co. Memorial Hospital	L = 0.04, V = 0.05, T = 0.05
Blackberry Lane/STH 27	L = 0.04, V = 0.04, T = 0.04
Soo Line Railroad/STH 27	L = 0.07, V = 0.10, T = 0.06
Flambeau River Bridge at STH 27	L = 0.04, V = 0.04, T = 0.06
Jansen Road/STH 27	L = 0.06, V = 0.07, T = 0.06

(L = longitudinal axis, V = Vertical axis, T = Transverse axis)

Appendix 3.10-A presents the background study and report addressing vibration under pre-project conditions.

3.10.3 Summary and Conclusions

The effects of noise on people fall into three general categories:

- Subjective effects of annoyance, nuisance, dissatisfaction.
- Interference with activities such as speech, sleep, learning.
- Physiological effects such as startle, and hearing loss at prolonged exposure to 85 decibels or more.

There is no satisfactory objective measure of the largely subjective effects of noise. While laboratory studies of noise impacts have been conducted, social surveys have proven much more effective in quantifying the variance in the general response of a community to noise. This, in turn, allows the development of criteria for noise exposure as shown in Table No. 3.10-4. These criteria specify maximum noise levels that would be considered by the average individual to be acceptable with respect to speech, radio and television interference, sleep interference, and annoyance. Nonetheless, numerous situations exist where people are now living with frequent exposure to noise levels in excess of those specified in Table No. 3.10-5.

Applying these criteria to the pre-project noise environment in the project vicinity, it can be seen that a significant area adjacent to STH 27 is already subjected to noise levels in

TABLE NO. 3.10-3

1988 Supplemental Ambient Noise Survey Summary

Location	A-Scale Max	Min	L_{10}	L_{50}	L_{eq}	C-Scale Max	Min	L_{10}	L_{50}	L_{eq}
1	60	46	58	55	54.6	70	60	67	65	65.2
2	68	55	65	62	62.3	79	72	78	76	75.8
3	56	46	54	49	50.3	73	61	67	64	65.0
4	51	42	47	45	45.1	66	60	64	62	62.3
5	50	45	49	47	47.2	67	60	66	65	64.5
6	55	47	53	51	50.9	68	63	67	65	65.4
7	55	42	52	48	49.2	75	56	67	63	64.5
20	84	75	81	79	79.4	88	84	87	86	86.1
21	60	41	53	49	50.7	72	58	66	61	62.9
22	50	42	48	45	45.9	69	57	56	60	62.0
23	58	41	50	46	47.9	75	56	69	62	65.2
24	77	60	70	66	68.0	80	66	74	70	71.3
25	62	49	58	55	55.8	75	61	69	65	66.4
26	60	47	51	49	50.0	75	59	65	62	63.7
27	56	47	54	52	51.8	66	58	65	62	62.3

TABLE NO. 3.10-4

Impact Evaluation When Predicted Noise Levels Exceed Criteria

Ambient Noise Level (dB)	Predicted Noise Level - Criterion Level in dB																					
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	>10
0	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
1	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
2	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
3	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
4	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
5	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
6	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
7	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
8	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
9	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
10	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
11	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
12	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
13	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
14	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
15	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	GI	GI	GI	GI	GI	GI
>15	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI	GI

Key: NI = No Impact
SI = Some Impact
GI = Great Impact

Source: National Cooperative Highway Research Program Report 117: Highway Noise, A Design Guide for Highway Engineers.

TABLE NO 3.10-5

Land Use/Noise Compatibility Matrix

Land Use	Decible Levels Over 75	65 - 75	Under 65
Residential -			
Mobile homes	C.U.	N.A.	C.A.
Single family (a/c)	C.U.	N.A.	C.A.
Single family (w/o a/c)	C.U.	N.U.	N.A.
Multi-family	C.U.	N.A.	C.A.
Commercial -			
Retail	N.U.	N.A.	C.A.
Wholesale	N.A.	C.A.	C.A.
Office	N.U.	N.A.	C.A.
Schools	C.U.	N.U.	N.A.
Institutional - (a/c)	N.U.	N.A.	C.A.
Industrial -			
Light	N.A.	N.A.	C.A.
Heavy	N.A.	C.A.	C.A.
Transportation/Utilities	N.A.	C.A.	C.A.
Recreational -			
Golf courses	N.A.	C.A.	C.A.
Parks	N.U.	N.A.	C.A.
Open Land/Wildlife Habitat	N.A.	C.A.	C.A.
Agricultural	N.A.	C.A.	C.A.

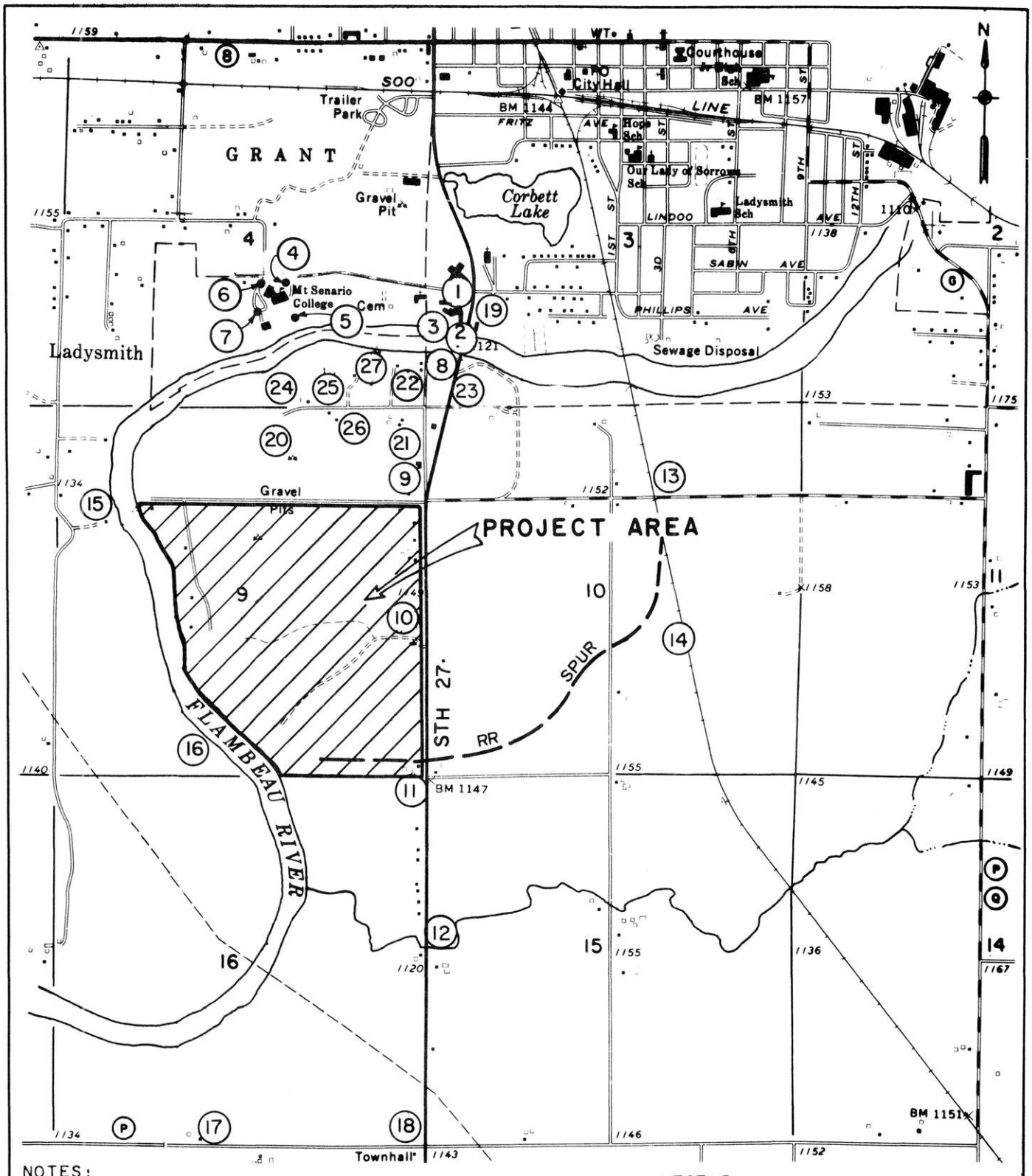
Note: a/c = Air conditioning
C.A. = Clearly acceptable
N.A. = Normally acceptable
N.U. = Normally unacceptable
C.U. = Clearly unacceptable

Source: U.S. Department of Housing and Urban Development.

access of 65 decibels (see Figure Nos. 3.10-2 through 3.10-5). A total of five residences are located in an area where average noise levels (L_{eq}) range from 65 to 75 decibels during winter conditions. A single residence is adversely affected during summer conditions. No nonresidential structures or sites are subjected to noise levels in excess of the criteria.

In summary, the results of the 1987-1988 ambient noise monitoring program show the significant impact of STH 27 on the local noise environment, and the difference in noise propagation characteristics between summer and winter conditions. Existing noise levels near STH 27 appear to exceed levels recommended for satisfactory residential occupancy, but noise levels elsewhere seem to be within acceptable limits.

Figures for Section 3.10



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

LEGEND

(12) READING LOCATION AND NO.

(4) READING LOCATION AND NO.

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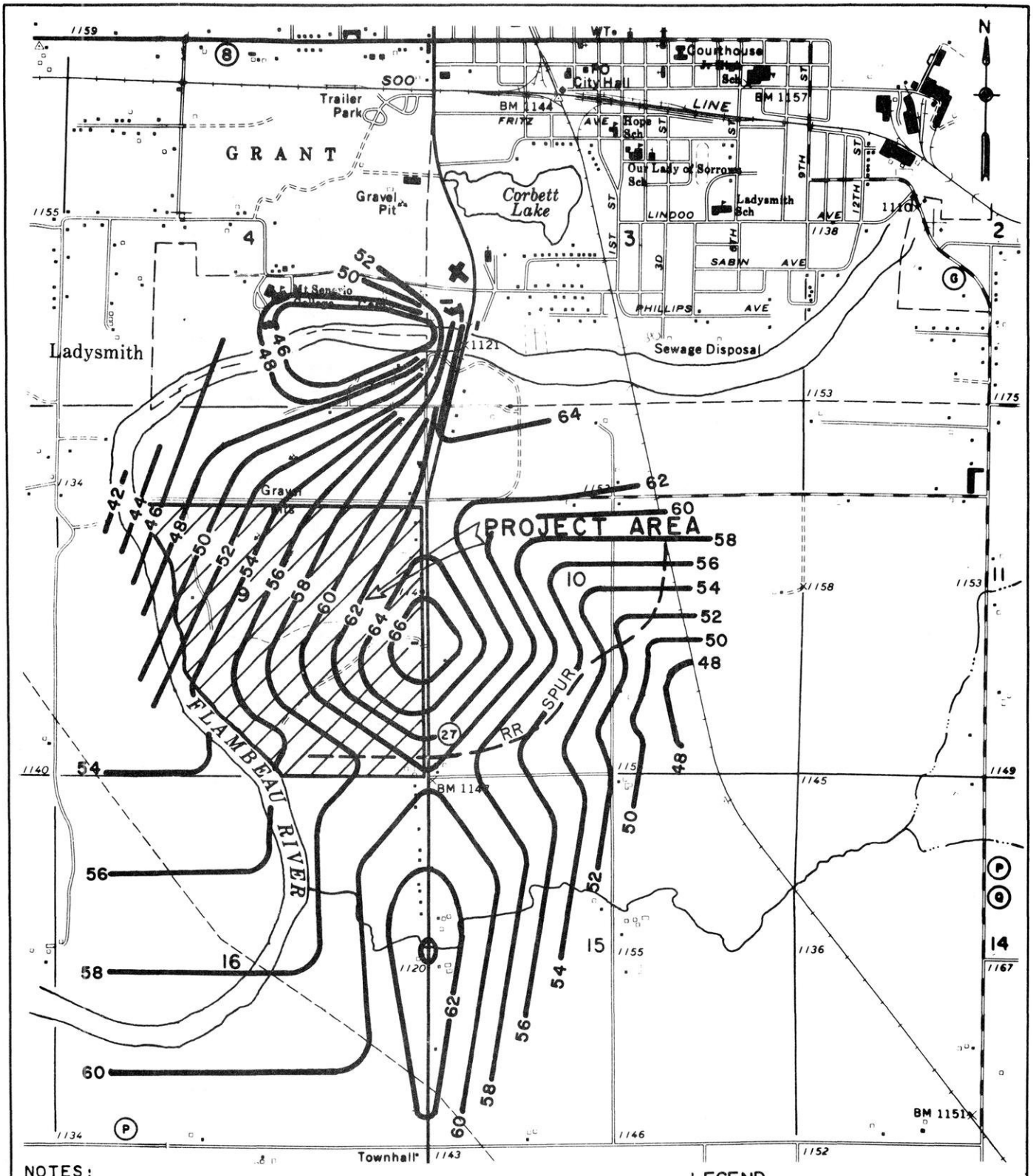
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.10-1
AMBIENT NOISE MONITORING STATIONS

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	MWB	1/89
	CHECKED BY	TJW	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

Job No	Dwg No	REV



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

LEGEND

54 — NOISE CONTOURS IN DECIBELS

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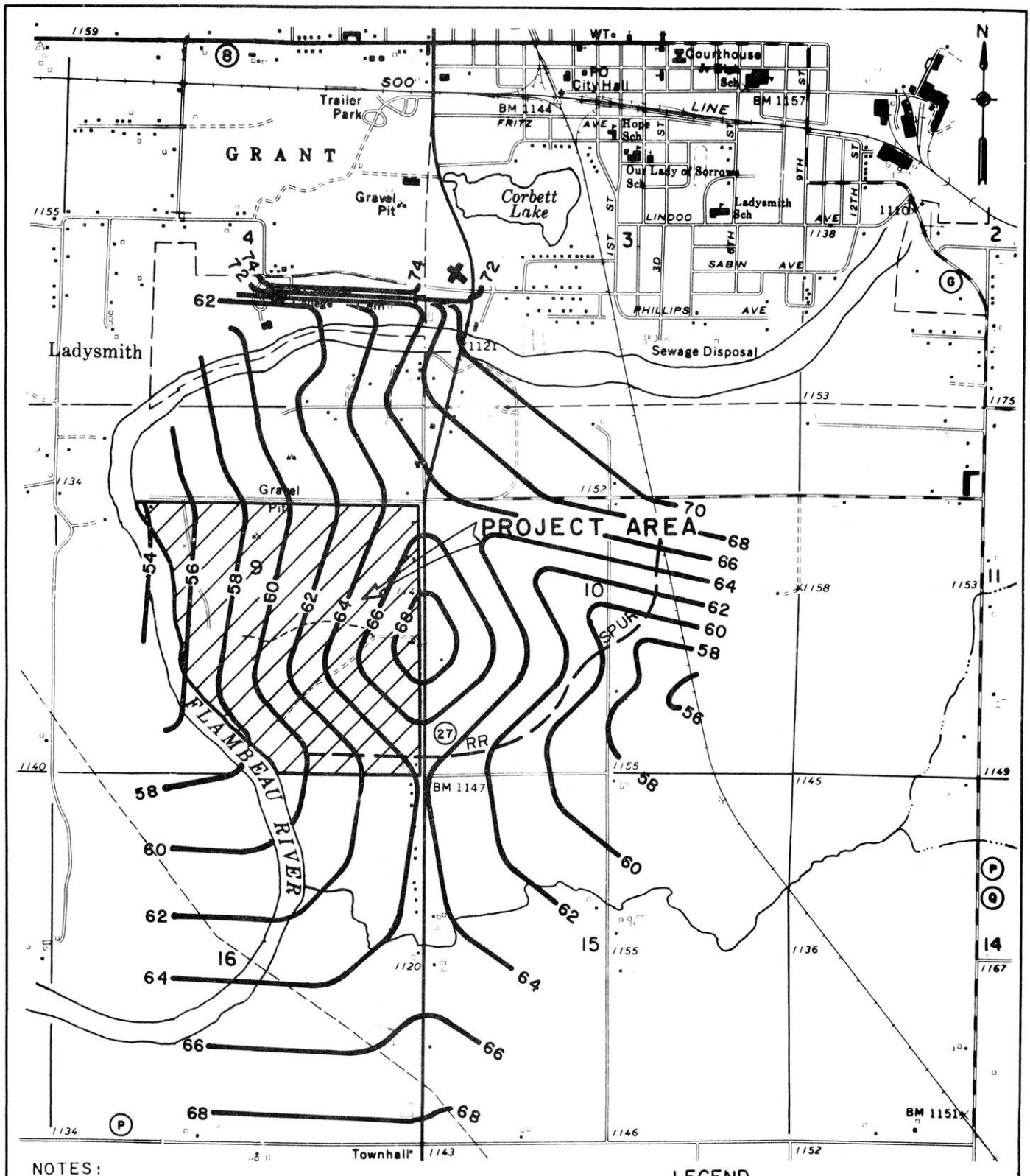
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.10-2
BACKGROUND NOISE LEVELS IN STUDY AREA
A-SCALE, SUMMER CONDITIONS

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

Job No	Dwg No	REV



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

LEGEND

66 — NOISE CONTOURS IN DECIBELS

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GREEN BAY, WISCONSIN

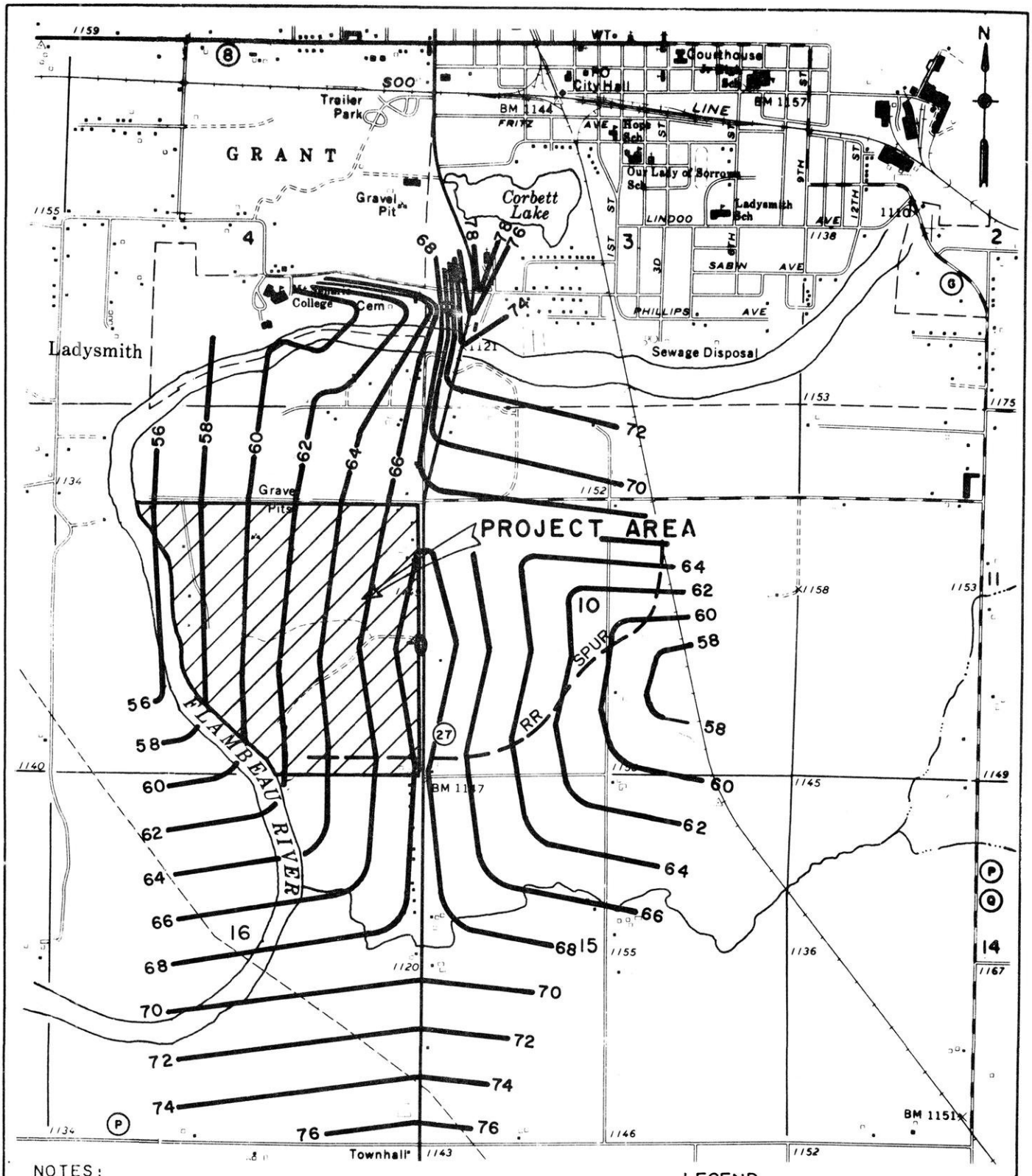
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.10-3
BACKGROUND NOISE LEVELS IN STUDY AREA
A - SCALE, WINTER CONDITIONS

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

Job No	Dwg No	REV



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

LEGEND

72 NOISE CONTOURS IN DECIBELS

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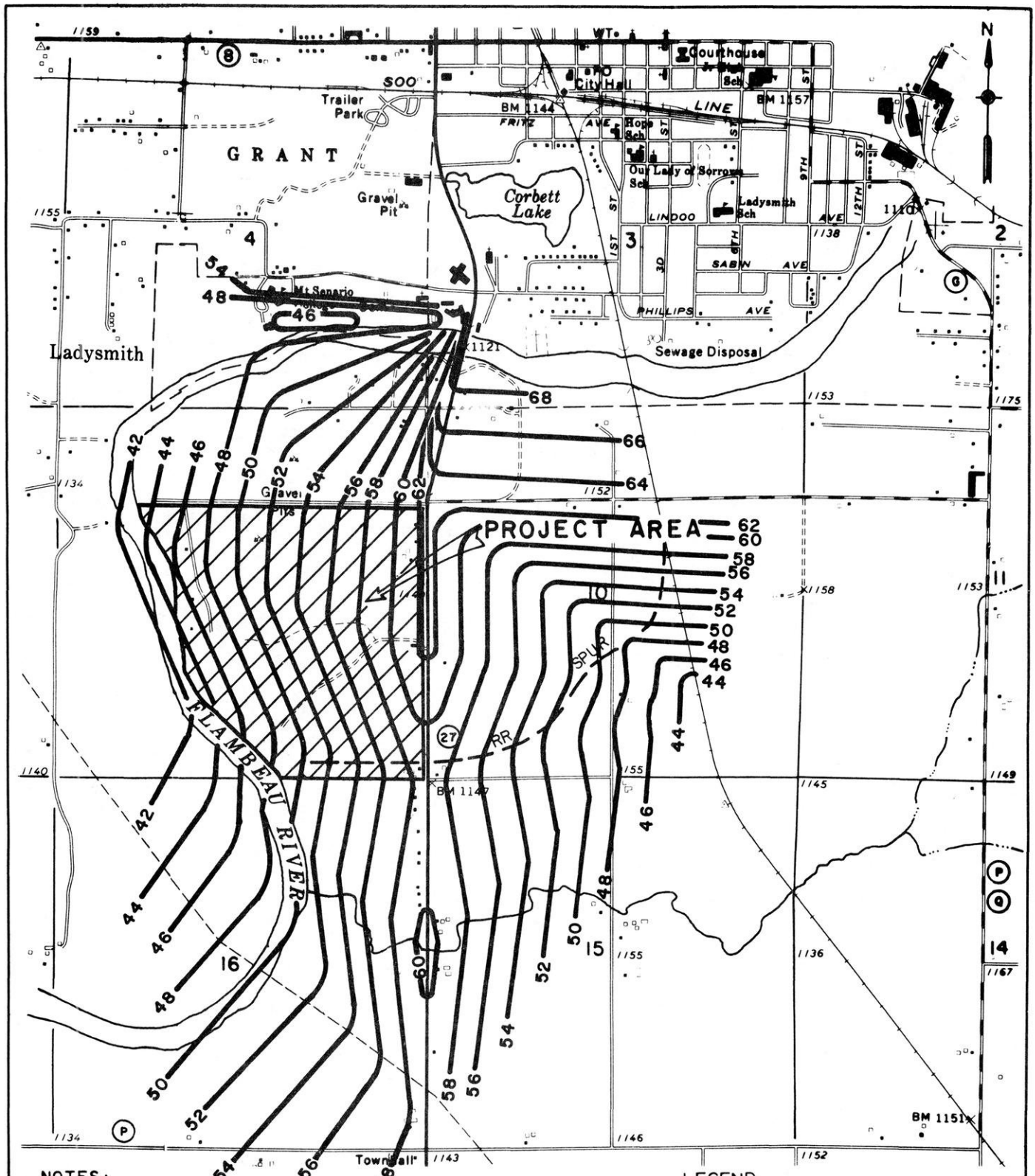
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FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.10-4
BACKGROUND NOISE LEVELS IN STUDY AREA
C-SCALE, SUMMER CONDITIONS

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

Job No	Dwg No	REV



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

LEGEND

48 — NOISE CONTOURS IN DECIBELS

FOTH & VAN DYKE
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GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.10-5
BACKGROUND NOISE LEVELS IN STUDY AREA
C-SCALE, WINTER CONDITIONS

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

Job No	Dwg No	REV

3.11 Land Use

3.11.1 Introduction

Land use data were collected for four (4) specific land use planning areas. The four land use planning areas are: 1) Rusk County (590,295 total acres), 2) Grant Township (23,013 total acres), 3) the study area enclosing the project area (3,354 total acres), and 4) the project area as described under the Conditional Land Use Permit (300 total acres). Figure No. 3.11-1 shows the location of the four land use planning areas.

3.11.2 Methods

The process used to analyze the land use characteristics of the planning areas consisted of the steps outlined in the following three subsections. Together these methods can be used to help project future land uses in and adjacent to the project area.

3.11.2.1 Inventory of Existing Land Uses Within Planning Areas

Rusk County and Grant Township data were obtained from 1987 assessment records compiled by the Department of Revenue (1988). Land use data for the study area and project site were obtained through the use of a land use inventory conducted by Foth & Van Dyke planning consultants.

3.11.2.2 Identification of Developable Land

This task was undertaken for only the study area and project area since these would be the only land use planning areas affected directly by the proposed mine site. Developable land was determined by the ability of a soil to accommodate on-site septic tank absorption fields. This information was obtained from the Rusk County Soil Survey as assembled by the Soil Conservation Service, U. S. Department of Agriculture. Ownership of developable lands was obtained from the *County Land Atlas and Plat Book* (RMPI, 1988).

3.11.2.3 Zoning and Land Use Controls

Existing zoning and land use controls were evaluated as to their role in restricting or encouraging future development. Unincorporated lands within Rusk County and Grant Township fall under the jurisdiction of the Rusk County Zoning Ordinance. Lands within the study area fall under the jurisdiction of either the Rusk County Ordinance or the City of Ladysmith Ordinance. Lands within the project area are controlled by a Local Agreement executed between Rusk County, the Town of Grant, City of Ladysmith, and Kennecott on August 1, 1988, and a Conditional Land Use Permit.

3.11.3 Description of Land Use Planning Areas

3.11.3.1 Rusk County Land Use

Only two percent (11,806 acres) of the 590,295 total acres in Rusk County is incorporated as villages or cities. According to the Wisconsin Department of Revenue (1988) land use statistics, by far the largest land use classification in the county is forest land. Table No. 3.11-1 reveals that 217,393 acres of land within the county is assessed as forest land. In addition, another 162,696 acres (Table No. 3.11-2) can be added to this category, because it is forest land under state, county, or forest crop management (Table No. 3.11-2). Therefore, 380,089 acres within the county, (64 percent), is classified as forest land.

The second-largest land use classification is agricultural land, which includes pasture land. According to Table No. 3.11-1, which shows land use within Rusk County for 1987, 147,174 acres (25 percent) of the land is in agricultural use. Further analysis of crop types in the county, utilizing information from the Wisconsin Agricultural Statistics Service (WASS,1987) reveals that hay is the most common crop, followed by field corn, oats, and barley. Rusk County is not a major producer of specialty or cash crops. According to the 1987 WASS report, milk cows constitute the primary livestock. A total of 309 dairy herds were reported in 1985, which accounted for 18,600 head of dairy cattle. Beef cattle were the second largest livestock type, accounting for only 1,100 head.

Developed areas account for 11,976 acres (two percent) of the county total. However, this total acreage includes Kennecott land holdings which have not been actively developed. Approximately 20,690 acres (3.5 percent) is nonassessed public acreage. Subtracting the 162,696 acres of nonassessed forest land (Table No. 3.11-2) from the 183,386 acres of nonassessed land in Table No. 3.11-1, there is a difference of 20,690 acres. This acreage represents other nonassessed public acreage such as rivers and lakes, parks, roads, railroad and transportation rights-of-way, and other public and semipublic lands.

3.11.3.2 Town of Grant Land Use

Of the 23,013 acres in Grant Township, 19,682 acres (86 percent) were assessed in 1987. Of the assessed total, forest lands are the largest land use classification, accounting for 8,043 acres (35 percent) of the total land area in the township.

The second largest land use classification category is agriculture. This category includes both tillable and pasture acreage, and accounts for 7,450 acres in the township, or 32 percent.

TABLE NO. 3.11-1

Rusk County 1987 Land Use

Class	Category Description	1987 Acres	Number of Buildings
A Land	Residential acres adjacent buildings	7,909	
A Imp.	Number of buildings		5,469
B Land	Commercial acres adjacent buildings	696	
B Land	Number of buildings		383
Manu. Land	Industrial lands, includes Kennecott land holdings	3,371	
TOTAL	Incorporated	11,976	5,852
1 Land	Class 1 crop land	12,844	
2 Land	Class 2 crop land	50,354	
3 Land	Class 3 crop land	25,383	
IRRIG	Irrigated land	245	
Subtotal Tillable		88,826	

TABLE NO. 3.11-1 (Cont.)

Class	Category Description	1987 Acres	Number of Buildings
Primary Pasture	High quality pasture	21,729	
Secondary Pasture	Average quality pasture	31,299	
Residual Pasture	Low grade pasture	3,046	
Pasture w/f	Pasture in forest	37	
Subtotal Pasture		56,111	
D IMP	# Farmstead buildings		1,103
D Sites	Acres adjacent farmstead units	2,170	
Other D	Speciality ag. acres	67	
Subtotal Adjacent & Other		2,237	
TOTAL D	Agricultural	147,174	
E-Swamp	Wetlands	27,590	
E-Waste	Abandoned gravel pits, quarries	2,776	
TOTAL E		30,366	

TABLE NO. 3.11-1 (Cont.)

Class	Category Description	1987 Acres	Number of Buildings
Primary F	High quality forest lands	67,642	
Secondary F	Class 2 forest lands	106,916	
Residual F	Low quality forest lands	41,004	
Cutover F	Slashed forest lands	282	
Waterfront F	Undeveloped forest land along lakes and rivers	1,549	
TOTAL F		217,393	
	TOTAL land assessed in county	406,909	
	TOTAL land not assessed in county	183,386	
	TOTAL land in Rusk County	590,295	

Source: Department of Revenue, 1988.

TABLE NO. 3.11-2

Forest Land Ownership (Nonassessed Land)
Rusk County, Wisconsin

Category	Acres
State-owned (Flambeau River State Forest and Wildlife Areas)	18,400
County-owned	87,881
Privately Owned Under Forest Crop Law	56,415
TOTAL	162,696

Source: Rusk County Forestry Department, 1988.

A total of 3,331 acres was not assessed throughout the township in 1987. These areas include state and county-owned forest lands, lakes and rivers, roads, and other tracts used for public purposes. A complete breakdown of each land use category in the Town of Grant is presented in Table No. 3.11-3.

3.11.3.3 Study Area Land Use

As a means to assess project impact, a "study area" was established for an area encompassing the project area. The first step in determining the project site study area was the utilization of natural buffer areas already established. Natural buffers north and west of the project area include the Flambeau River and adjoining vegetation. Existing buffers to the east include the City of Ladysmith Industrial Park and a large forested area located east of STH 27. In addition, a large forested area immediately south of the project area acts as a buffer as well.

Using the buffers as a guide, an evenly manageable study area was established (Figure No. 3.11-2). The outside boundaries of the study area consist of existing roads, section and quarter-section lines.

The land use inventory for the study area was conducted by analyzing 1" - 500' scale aerial photos taken on September 14, 1987 by Mark Hurd Corporation, Minneapolis, Minnesota. The land use classification system consisted of 11 major categories as indicated by Table No. 3.11-4.

The study area contains 3,354 acres, including portions of the City of Ladysmith and Grant Township. A breakdown of acreage by land use category is presented in Table No. 3.11-4. A graphic representation of land use within the study area is shown in Figure No. 3.11-3. According to the analysis, approximately 374 acres (11 percent) of the study area has been actively developed. Of this total, the largest single developed land use is residential (including farmsteads), which comprises 183 acres.

A majority of the developed acreage, excluding the gravel pit, is found north of the Flambeau River within the Ladysmith city limits. With the exception of the Ladysmith Industrial Park, this is the only portion of the study area served by public sewer and water.

The largest land use category in the study area is upland mixed forest, which accounts for 925 acres (27.6 percent) of the area. Agriculture is the second-largest category found within the study area, accounting for 754 acres or 22.5 percent. Other land use categories which contribute significantly to the composition of the study area include pasture and old fields

TABLE NO. 3.11-3

Town of Grant 1987 Land Use

Class	Category Description	1987 Acres	Number of Buildings
A Land	Residential acres, adjacent buildings	949	
B IMP	Number of buildings		246
B Land	Commercial acre, adjacent buildings	60	
B IMP	Number of buildings		7
Manufactured Land	Real property in manufacturing	2,783*	
TOTAL		3,792	
1 Land	Class 1 crop land	336	
2 Land	Class 2 crop land	3,552	
3 Land	Class 3 crop land	774	
Subtotal Tillable		4,662	
Primary Pasture	High quality pasture	1,049	
Secondary Pasture	Average quality pasture	1,202	
Residual Pasture	Low grade pasture	390	
Subtotal Pasture		2,641	

TABLE NO. 3.11-3 (Cont.)

Class	Category Description	1987 Acres	Number of Buildings
D IMP	Number farmstead buildings		76
D Sites	Acres adjacent farmstead units	147	
Other D	Specialty agriculture acres	0	
Subtotal Adjacent and Specialty		147	
TOTAL D	Total Acres of Agricultural Land in District	7,450	
E Swamp	Wetlands	397	
E Waste	Abandoned gravel pits, quarries	0	
TOTAL E		397	
F Primary	High quality forest lands	2,973	
F Secondary	Class 2 forest lands	2,995	
F Residual	Low quality forest lands	1,994	
F Cutover	Slashed forest lands	0	
F Waterfront	Undeveloped forest land along lakes and rivers	81	
TOTAL F		8,043	
TOTAL Land Assessed in Township		19,682	
TOTAL Land Not Assessed In Township		3,331	
TOTAL Land in Township		23,013	

Source: Department of Revenue, Eau Claire, WI. 1988.
* Includes Kennecott Land Acreage.

TABLE NO. 3.11-4

Study Area Acreage Totals

Symbol	Existing Land Use Category	Acres
A	Agriculture	754
F	Upland Mixed Forest	925
OF	Pasture/Old Field	585
W	Wetlands	546
Developed Areas		
R	Residential	183
QP	Quasi-public	37
IND	Industrial	26
REC	Active Recreation	8
M	Gravel Pits	60
	Transportation (highways, roads, RR)	60
	Flambeau River	170
TOTAL		3,354

Source: Foth & Van Dyke Inventory, 1988.

(17.5 percent) and wetlands (16.3 percent). Approximately 1,648 acres (49 percent) of the land within the study area is owned by the Kennecott Mining Company (Figure No. 3.11-4).

3.11.3.4 Project Site Land Use

The land use inventory for the project area was determined utilizing the same procedures outlined in the study area analysis. The project area land use planning area is consistent with the boundaries established under the Conditional Land Use Permit and is approximately 300 acres in size. An acreage breakdown by land use category for the project area is presented in Table No. 3.11-5.

The largest land use category on the project area is upland mixed forest, which accounts for 89.8 acres (29 percent) of the project area. Pasture/old fields is the second-largest land use category, accounting for 82 acres (26.4 percent) of the project area. Only 45 acres (14.4 percent) of project area is considered developed.

3.11.4 Available Developable Land

Developable land within the study area is extremely limited, primarily due to the unsuitable soils found within the planning area, according to the Rusk County Soil Conservation Survey (U.S. Department of Agriculture, unpublished soil survey information). Land within the Ladysmith city limits is served by municipal sewer and water and could be developable. Growth is expected to continue within the portion of land under city jurisdiction. This land includes the recently improved Industrial Park site located on Doughty Road east of the railroad tracks, and the area west of Mount Senario College which is only partially occupied.

Land under the jurisdiction of the Town of Grant is not served by any public water or sewer systems; hence, any development would require individual on-site systems or hook-up to the existing Ladysmith systems. The latter would only apply to lands adjacent to the existing city limits. Approximately 234 acres of land in Grant Township found within the study area is zoned R-1 (Single-Family Residential). However, none of the land zoned R-1 is suitable for on-site septic systems according to Soil Conservation Survey data, which will discourage development. Figure No. 3.11-5 shows soil suitability for on-site septic systems in that portion of the study area for which up-to-date soils information is available. Based on existing soils data, it is very likely that the remaining soils within the study area possess severe limitations for on-site septic systems, as well.

Figure No. 3.11-5 shows that only a 41-acre area located west of the Flambeau River contains "slight" limitations for on-site systems. However, all of this acreage is under Kennecott

TABLE NO. 3.11-5

Project Area Acreage Totals

Symbol	Existing Land Use Category	Acres
A	Agriculture	59
F	Upland Mixed Forest	90
OF	Pasture/Old Field	82
W	Wetlands	25
Developed Areas		
R	Residential	18
QP	Quasi-public	0
IND	Industrial	0
REC	Active Recreation	0
M	Gravel Pit	25
	Transportation (highways, roads, RR)	1
TOTAL		300

Source: Foth & Van Dyke Inventory, 1988.

ownership (Figure No. 3.11-4). Approximately 68 acres located in two areas west of the Flambeau River and a small area located immediately south of the river (east of the existing gravel pit) have "moderate" limitations for on-site systems. Kennecott owns 40.1 acres (59.1%) of the moderate-limitation area. Areas containing slight or moderate limitations are considered developable. Developable soils are Amery Silt Loams with varying degrees of slope.

In general, the study area has only a very small percentage of land available for active development, unless adequate waste water treatment facilities are provided. In addition, only 28 acres of developable land are not under Kennecott ownership.

3.11.5 Zoning and Land Use Controls

A majority of the study area is located in Grant Township. Existing development within the study area falls under the jurisdiction of the Rusk County Zoning Ordinance. A small portion of the study area falls within the city limits of Ladysmith. The City of Ladysmith does have a zoning ordinance and a comprehensive plan (NWRCP, 1984) in place. Both publications address land use within the City's corporate limits and touch on the issue of extraterritorial zoning and mining as an industrial use.

The Rusk County Comprehensive Zoning Ordinance was adopted on April 20, 1971 (Rusk County Zoning Committee, 1971). Since then, several revisions have been made. The most significant changes to the Rusk County ordinance include the addition of Section 6.3 (Mining) and Section 8.0 (Shoreland - Wetlands). The type of development which could occur in the study area will be directly influenced by the zoning ordinances and other land use controls. Specifically, there are certain land use controls which may limit or discourage specific types of developments from taking place within the study area. These controls are:

1. Minimum lot area requirements
2. Existing zoning districts
3. Land preservation policies
4. Conditional use permits

3.11.5.1 Minimum Lot Area Requirements

Minimum lot area requirements help regulate density of future development. Hence, an analysis of these requirements is important, especially in the study area.

Wisconsin Shoreland Protection regulations (WDNR, 1985), require that all residential lots located within unsewered shoreland areas (land located within 1,000 feet of a lake or 300 feet of a river or stream) must contain a minimum of 20,000 square feet (sq. ft.). This requirement applies to all shoreland areas within the study area. Outside of shoreland areas, minimum lot

sizes within the study area are set by the Rusk County Zoning Ordinance or the City of Ladysmith Zoning Ordinance. The Rusk County Zoning Ordinance requires a 20,000 sq. ft. minimum lot size for unsewered areas under R-1 or RR-1 districts. Minimum lot areas for remaining districts, including agriculture, which is the predominant zoning district in the study area, are set at one acre. There are no areas with public sewer under the jurisdiction of the Rusk County Zoning Ordinance. The minimum lot area for sewered areas under the City of Ladysmith Zoning Ordinance is 8,000 square feet.

Mobile home parks are allowed as a conditional use only under districts R-1, RR-1, and A-1 of the Rusk County Ordinance. No mobile home intended for occupancy can be located within the City of Ladysmith or Rusk County except in a mobile home park.

In general, minimum lot area requirements for most zoning districts within the City of Ladysmith are considerably less than the Rusk County Ordinance. This is due to the city's ability to provide public water and sewer to new developments.

3.11.5.2 Existing Zoning Districts

The locations of existing zoning districts within the study area are shown on Figure No. 3.11-6. Agriculture A-1 is the predominant zoning district in the study area.

3.11.5.3 Preservation Policy

The Rusk County Board of Supervisors, with assistance from the Northwest Regional Planning Commission, developed a county-wide Farmland Preservation Plan in 1982 (Rusk County Farmlands Preservation Committee, 1982). The plan addresses the need to preserve high-value agricultural land and environmentally significant areas. The Farmland Preservation Plan designated lands that would be made eligible for farmland preservation tax credits, as well as other lands of significance in Rusk County. The plan classified each township into four distinct categories as follows.

- Urban and Exclusion Areas

  These are areas which are not used for farm or agricultural activity and which do not have any potential for this type of use.

- Transitional Areas

  These are areas where some nonagricultural urban growth will occur on lands presently in agricultural production. An example would be farmland and undeveloped lands within incorporated city or village limits

- Environmentally Significant Areas

  These are areas that should be protected for their cultural, aesthetic, and scenic values, as well as for their natural environmental benefits. They exhibit characteristics such as storage and transmission of flood waters, water-cleansing properties, valuable fish and wildlife habitat, and unique flora and fauna. Environmentally significant areas are lands which are sensitive to improper use and poor management.

- Agricultural Preservation Areas

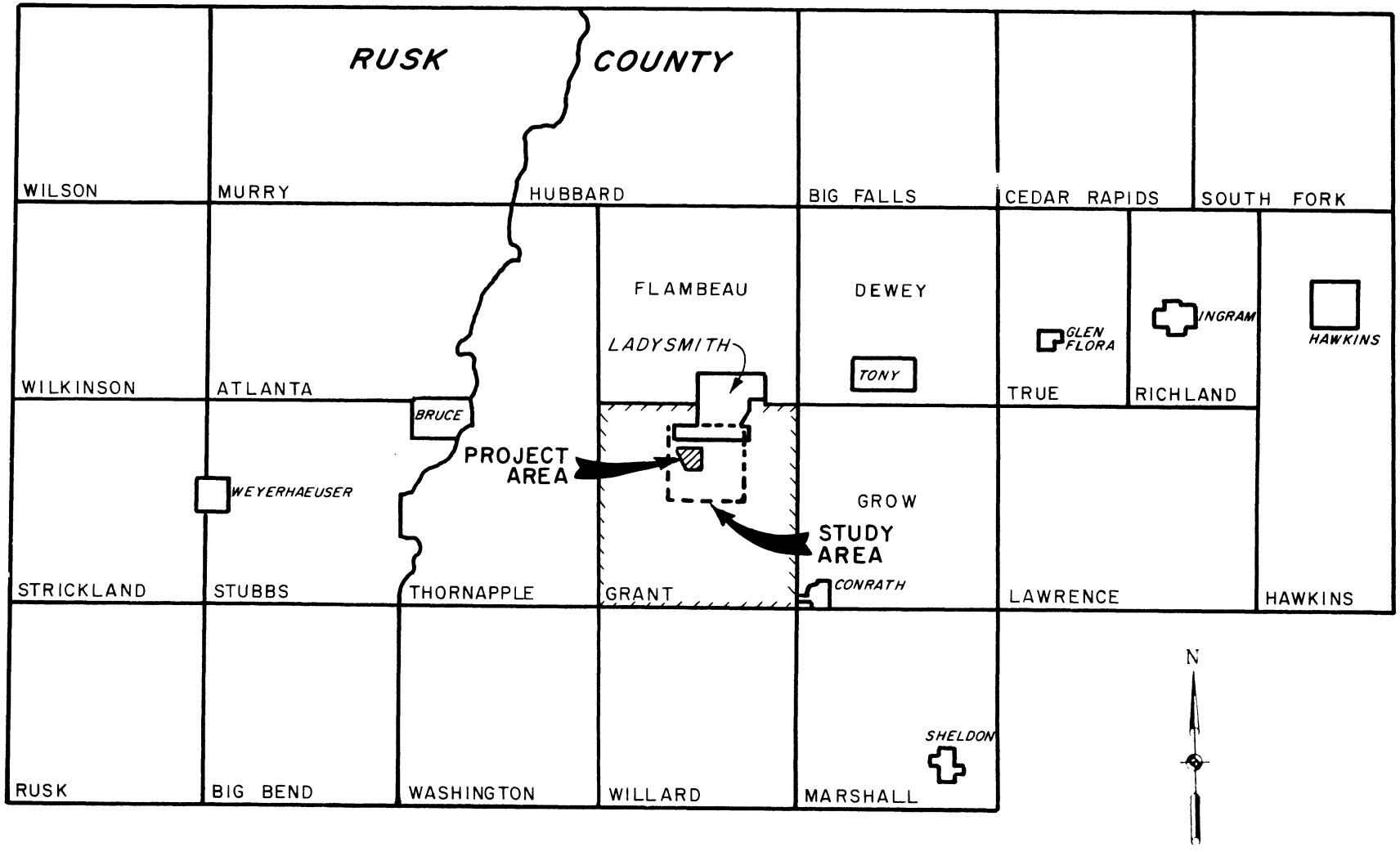
  These are areas that are mapped for preservation in agriculture and were made eligible for farmland tax credit programs.

In respect to the study area, only two categories exist: urban exclusion areas and agriculture (Figure No. 3.11-7). Excluded areas, including the project area, are targeted for development - not preservation. The agricultural zone south of the project area is eligible for farmland tax credits. As of the date of this report, no farmland owners within the study area have signed up for any farmland tax credits.

3.11.5.4 Conditional Land Use Permit

A Conditional Land Use Permit was granted to Kennecott. The Conditional Land Use Permit is comprehensive in scope and should be consulted for specific inquiries. The project area is zoned I-1 (Industrial). The area covered by the conditional land use permit coincides with the project area.

Figures for Section 3.11



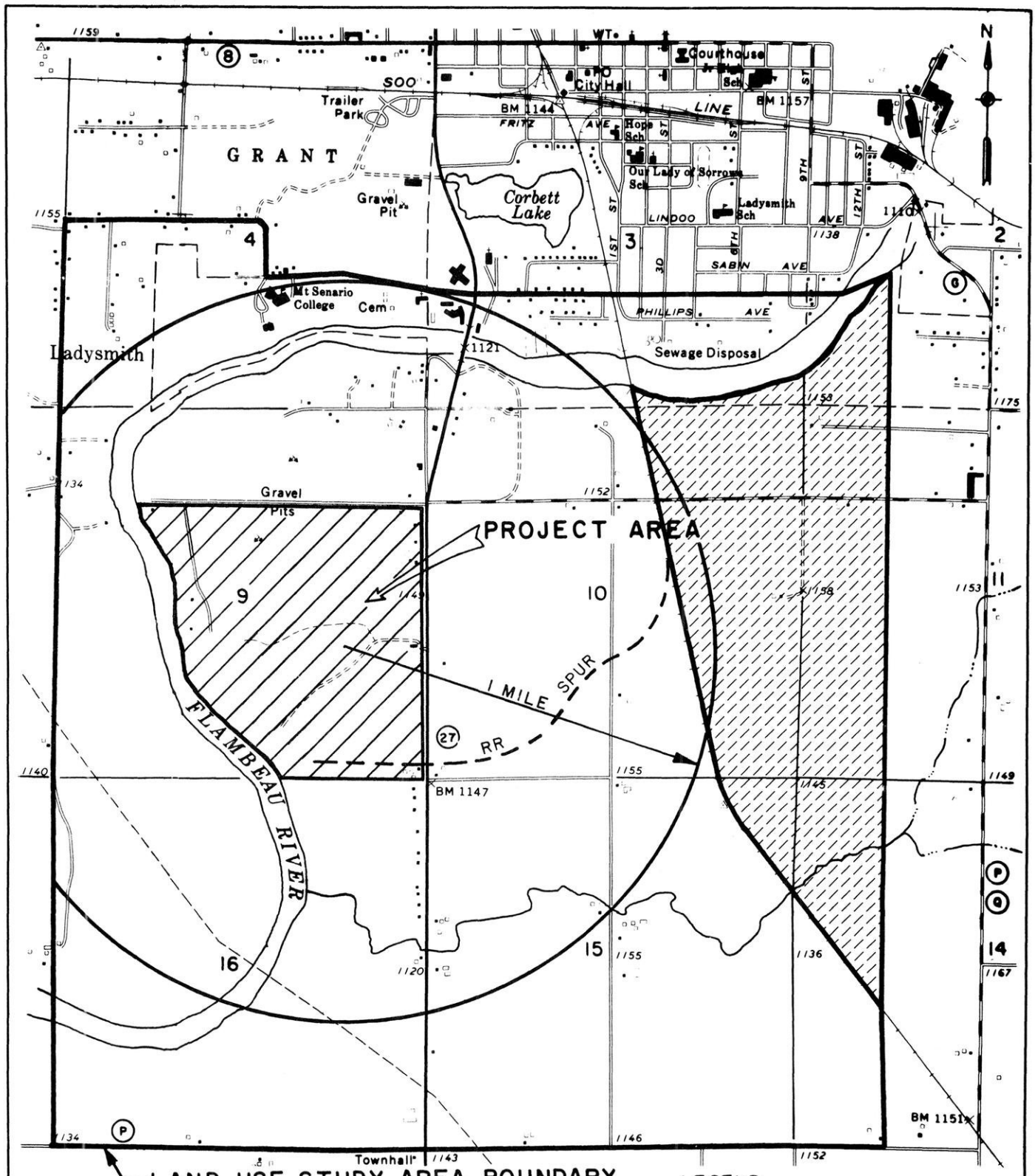
FOTH & VAN DYKE
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GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.11-1
LOCATION OF LAND USE PLANNING AREAS
RUSK COUNTY, WISCONSIN

No	REVISIONS	NOTES	APPROVAL	DATE
			DESIGNED BY	
			DRAWN BY SJL	2/89
			CHECKED BY KAJ	3/89
			APPROVED BY	
			CAD No.	SCALE 1" = 5 MI.

Job No | Dwg No | REV



NOTE: 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.

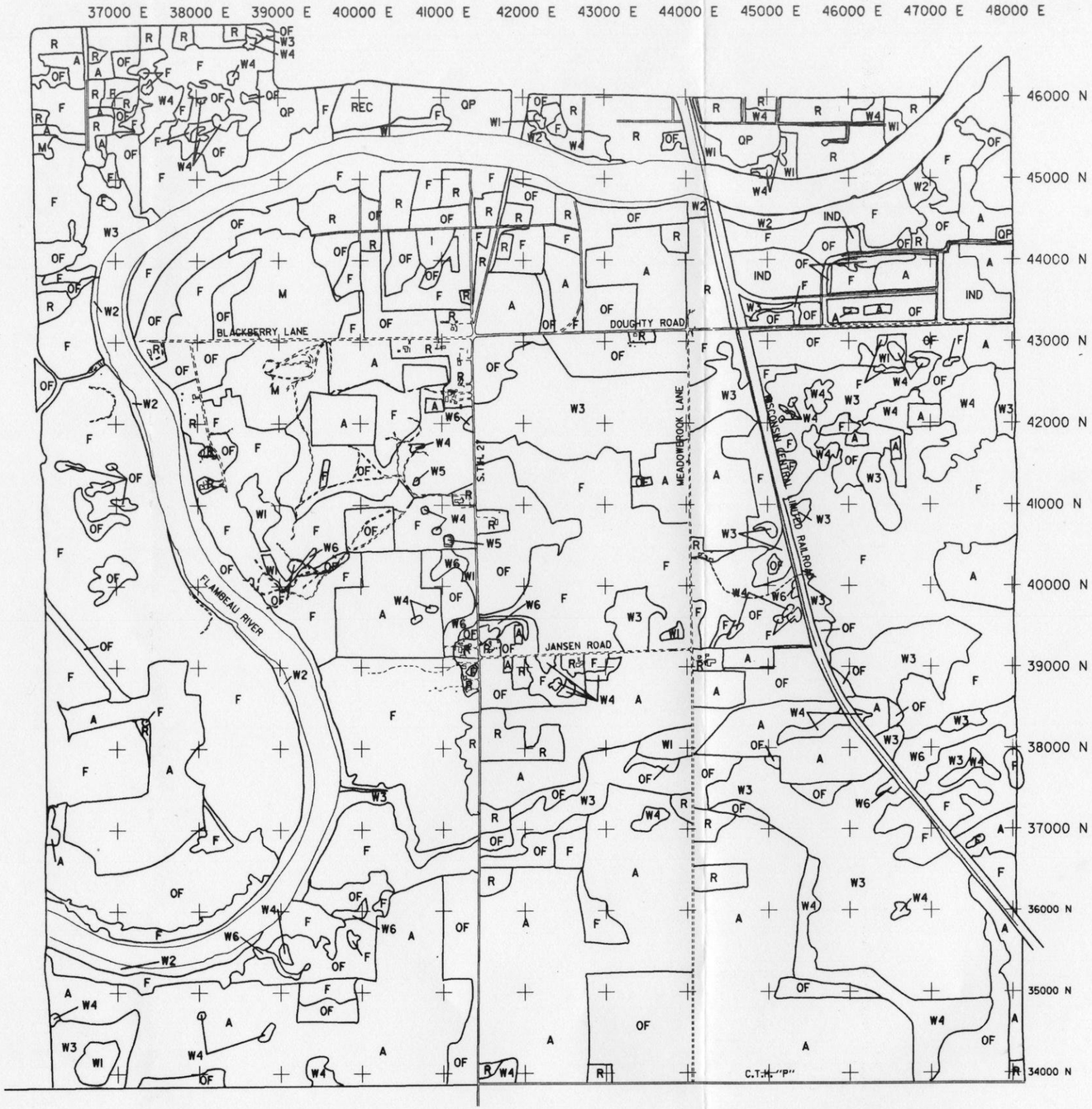
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GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.11-2
LAND USE STUDY AREA BOUNDARY

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

Job No	Dwg No	REV



N

LAND USE STUDY AREA
ACREAGE TOTALS

LAND USE CLASSIFICATION		ACRES
A	AGRICULTURE	754.3
F	UPLAND MIXED FOREST	924.8
OF	PASTURE / OLD FIELD / MEADOW	585.3
R	RESIDENTIAL / DISTURBED	183.1
W	WETLANDS	545.5
	WI NORTHERN WET MESIC FOREST	34.1
	W2 RIVERINE FLOODPLAIN MEADOW	59.4
	W3 ALDER THICKET; BOG	336.7
	W4 NORTHERN SEDGE MEADOW, ALDER THICKETT	93.1
	W5 DUG PONDS	0.4
	W6 NORTHERN SEDGE MEADOW	21.8
REC	RECREATION	8.3
QP	QUASI PUBLIC	37.4
IND	INDUSTRIAL	25.7
M	GRAVEL PIT	59.5
	TRANSPORTATION (HWY'S,ROADS,RR)	60.0
	FLAMBEAU RIVER	169.8
	TOTAL	3353.7

NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. HORIZONTAL DATUM BASED ON WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH ZONE. SITE GRID COORDINATES DERIVED AS FOLLOWS:

SITE GRID- CONTROL MONUMENT F-1	STATE PLANE
40000 N =	587,357.8087 N
40000 E =	1,713,516.229 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.

0 800' 1600'
SCALE

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

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

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

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

	BY	DATE
DESIGN		
DRAWN	MJD	3/89
CHK'D	KAJ	3/89
DES. ENG'R		
SECT ENG'R		

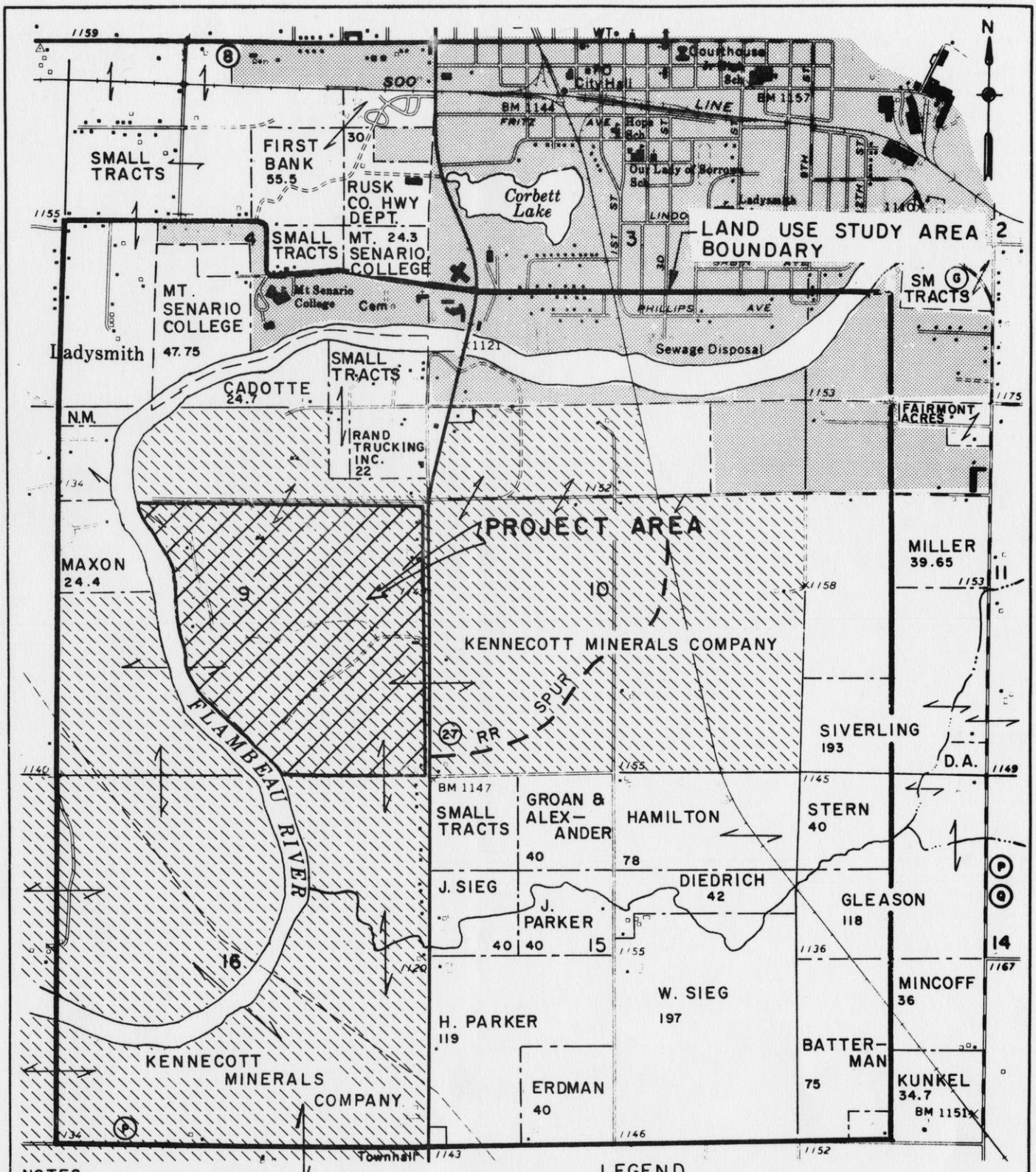
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GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
165 MINERAL SQUARE
SALT LAKE CITY, UTAH 84102

FIGURE NO. 3.11-3
STUDY AREA LAND USE

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



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

LEGEND

KENNECOTT PROPERTIES

CITY OF LADYSMITH

FOTH & VAN DYKE

GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY

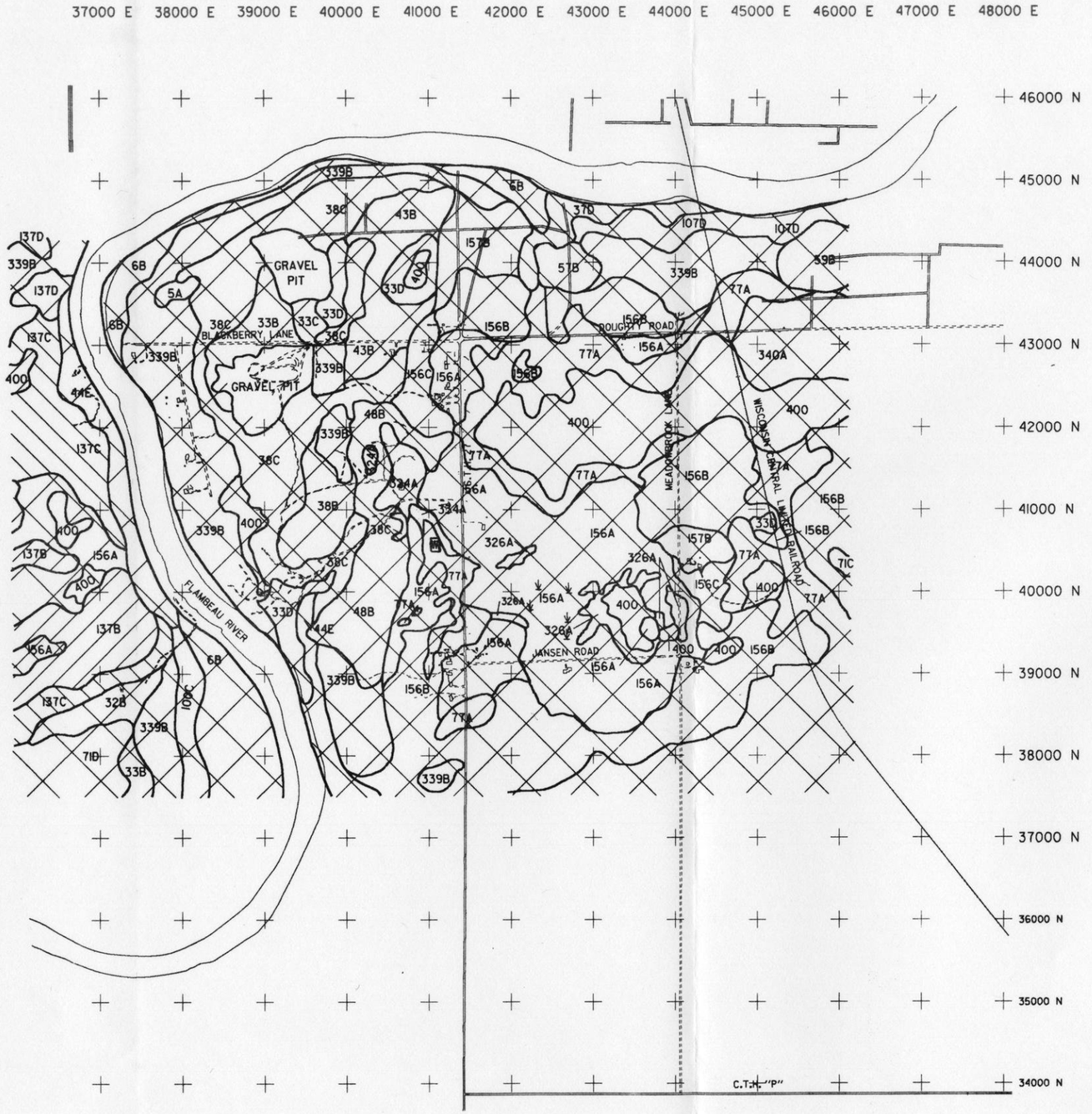
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.11-4

PROPERTY OWNERSHIP

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

Job No	Dwg No	REV



LEGEND

- EXISTING PAVED ROAD
- EXISTING TRAIL/GRAVEL SURFACE
- 77A — SOIL UNIT BOUNDARY
- 156B — SOIL UNIT SYMBOL - % SLOPE
- ISOLATED WET SOIL AREA

SOIL LEGEND

5	•FORDUM LOAM, VERY POORLY DRAINED
6	STURGEON FINE SANDY LOAM, SOMEWHAT POORLY DRAINED
32	ROSHOLT LOAM, WELL DRAINED
33	CHETEK SANDY LOAM, SOMEWHAT EXCESSIVELY DRAINED
37	SANTIAGO SILT LOAM, WELL DRAINED
38	ROSHOLT SANDY LOAM, WELL DRAINED
43	ANTIGO SILT LOAM, WELL DRAINED
44	TERRACE ESCARPMENT, WELL DRAINED
48	BRILL SILT LOAM, MODERATELY WELL DRAINED
57	SPENCER SILT LOAM, MODERATELY WELL DRAINED
59	ALMENA SILT LOAM, SOMEWHAT POORLY DRAINED
71	EMMERT GRAVELLY LOAM, EXCESSIVELY DRAINED
77	•AUBURNDALE SILT LOAM, POORLY DRAINED
100	OMEGA LOAMY SAND, SOMEWHAT EXCESSIVELY DRAINED
107	AMERY SILT LOAM, WELL DRAINED
137	AMERY LOAM, WELL DRAINED
156	MAGNOR SILT LOAM, SOMEWHAT POORLY DRAINED
157	FREEON SILT LOAM, MODERATELY WELL DRAINED
324	POSKIN VARIENT SILT LOAM, SOMEWHAT POORLY DRAINED
326	CABLE SILT LOAM, VERY POORLY DRAINED
334	PLOVER SANDY LOAM, SOMEWHAT DRAINED
339	BEVENT LOAMY FINE SAND, WELL DRAINED
340	•BRUCE SILT LOAM, POORLY DRAINED
400	•SEELYVILLE, MARKEY AND CATHRO-MUCKS, VERY POORLY DRAINED

•HYDRIC SOIL

NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.

2. HORIZONTAL DATUM BASED ON WISCONSIN STATE PLANE COORDINATE SYSTEM, NORTH ZONE. SITE GRID COORDINATES DERIVED AS FOLLOWS:

SITE GRID-CONTROL MONUMENT F-1	STATE PLANE
40000 N =	587,357.8087 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.

3. ALL SOILS INFORMATION OBTAINED FROM RUSK COUNTY SOIL CONSERVATION SERVICE AND LAND CONSERVATION DEPARTMENT, LADYSMITH, WISCONSIN.
   - SOIL MAP BOUNDARIES OBTAINED FROM STATE SOILS MAPS DEVELOPED 1964 - 1966
   - UPDATED MAPPING CONDUCTED JUNE 1988 BY USDA, SOIL CONSERVATION SERVICE.
   - SOIL UNIT NAMES CURRENT AS OF JUNE 20, 1988.
   - HYDRIC SOIL DATA PREPARED BY K. LUBICH OF SOIL CONSERVATION SERVICE - NOVEMBER 1986.

4. SLOPE GROUPS ARE DESIGNATED BY THE FOLLOWING LETTERS:
   A = 0-2%
   B = 2-6%
   C = 6-12%
   D = 12-20%
   E = 20-30%
   F = 30% AND OVER

5. SOIL SUITABILITY FOR ON-SITE SEPTIC SYSTEMS.

	ACRES
SLIGHT	41.0
MODERATE	67.8
SEVERE LIMITATIONS	1473.6
GRAVEL PITS	29.4
	1696.3•

• TOTAL ACRES IN STUDY AREA CONTAINING SOILS INVENTORY.

0 800' 1600'
SCALE

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

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

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

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

	BY	DATE
DESIGN		
DRAWN	MJD	3/89
CHK'D	KAJ	3/89
DES. ENG'R		
SECT ENG'R		

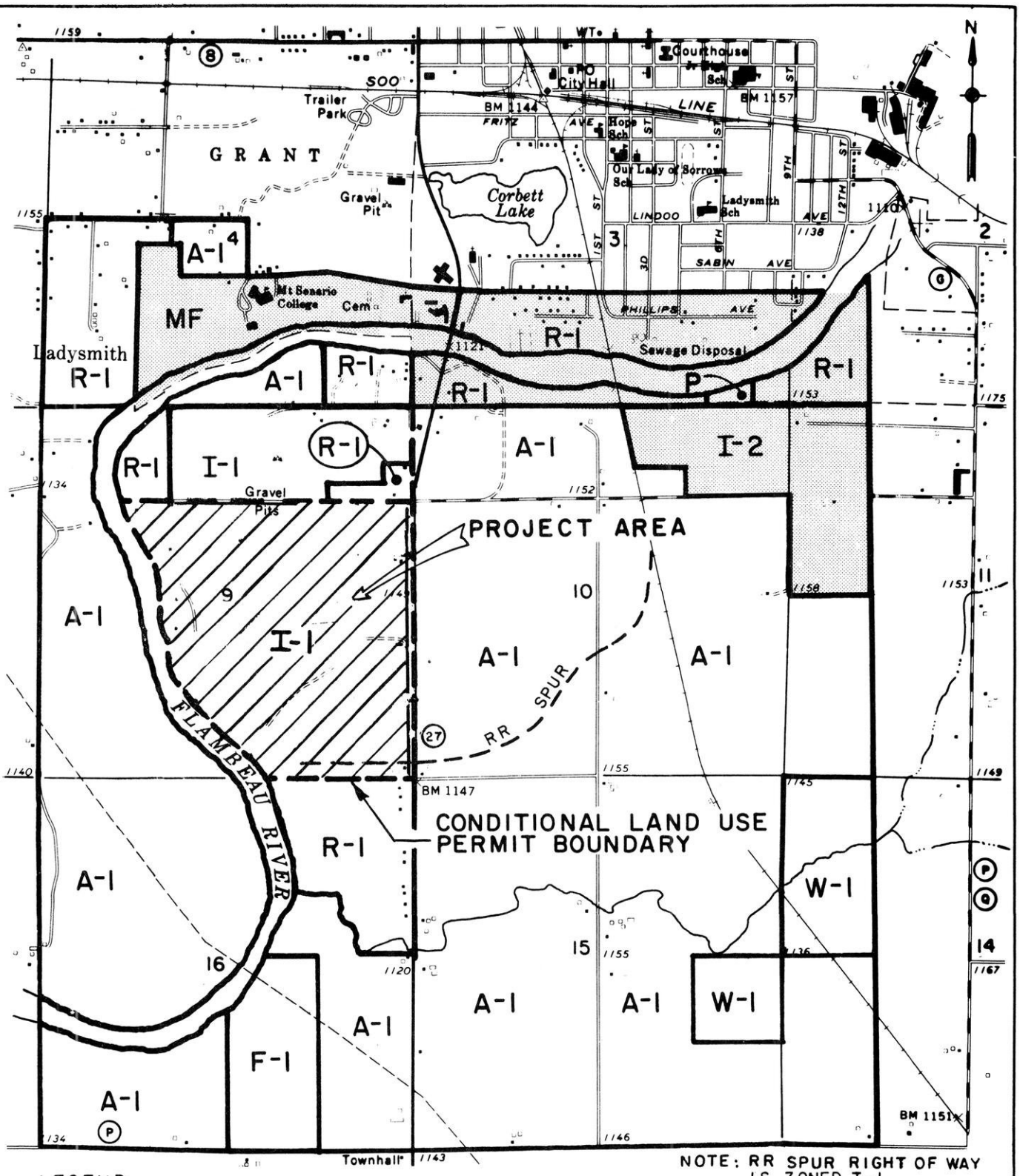
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 3.11-5
SOIL SUITABILITY FOR ON SITE SEPTIC SYSTEMS

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



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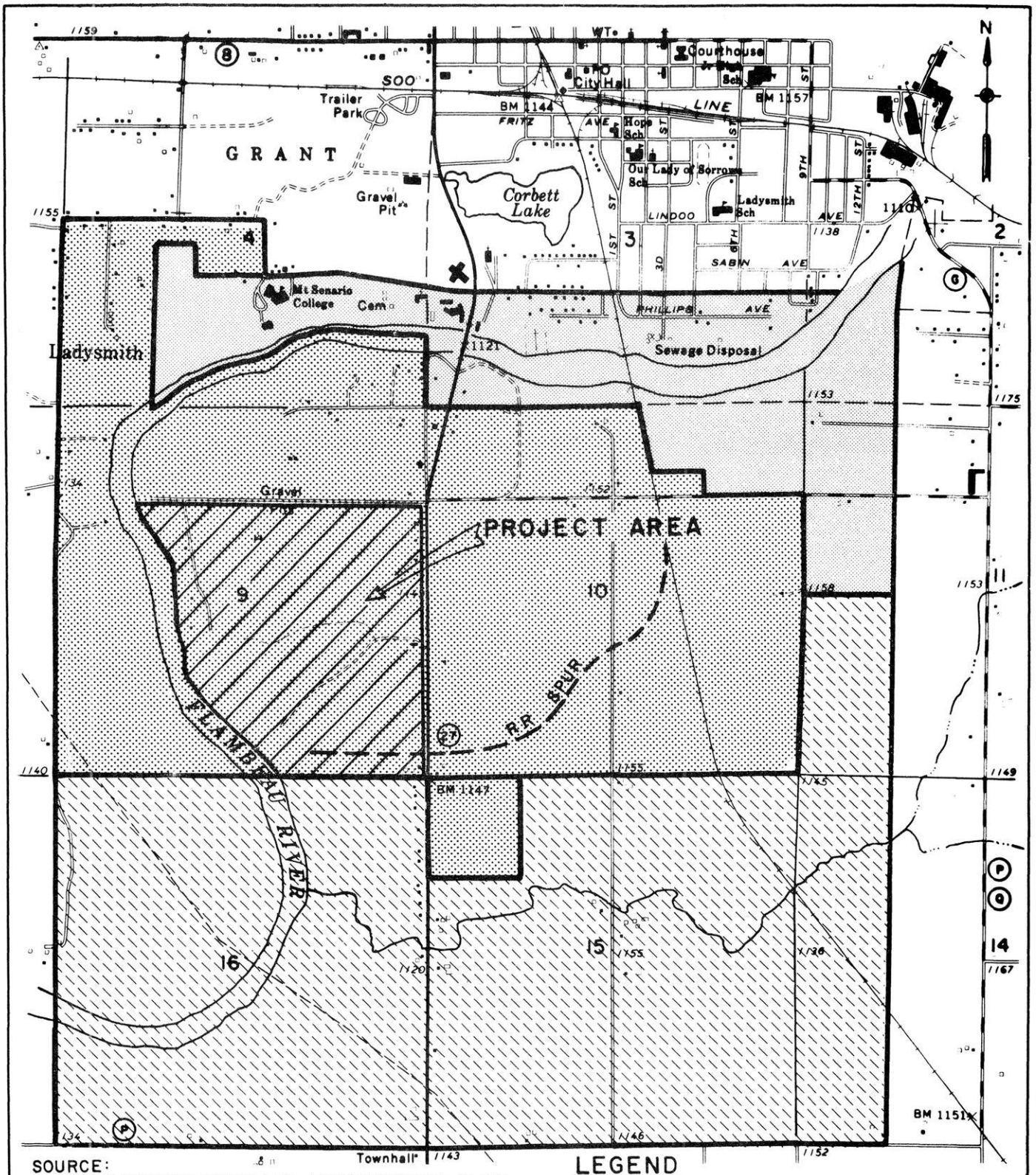
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.11-6
ZONING MAP

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	MWB	1/89
	CHECKED BY	KAJ	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

Job No	Dwg No	REV



SOURCE:
RUSK COUNTY FARMLAND PRESERVATION PLAN

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

LEGEND

- CITY OF LADYSMITH
- EXCLUDED
- AGRICULTURAL

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LADYSMITH, WISCONSIN

FIGURE NO. 3.11-7
FARMLAND PRESERVATION PLAN

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

Job No	Dwg No	REV

3.12 Aesthetics

The extent of aesthetic impact that the Kennecott Flambeau Project will have on the community is a function of the number of facilities that will be seen from strategic viewpoints by residents and visitors. The existing environment can be described, and the impact can be quantitatively measured and assessed, using procedures outlined in the following sections.

3.12.1 Methods

The nature and extent of potential aesthetic impacts which the Kennecott Flambeau Project will have on the community can be estimated by using visual simulation. Basically, visual simulation consists of taking photographs of the project viewsheds from strategic viewpoints, and then superimposing the proposed facilities on them. The potential visual impact can be accurately assessed by carefully scaling the proposed facilities. This technique has been successfully used on similar projects, and is an accepted procedure (Exxon, 1982).

3.12.1.1 Theory

This visual simulation technique is a three-step process. First, project facilities are simulated on-site by tethering helium balloons at appropriate heights and locations. Second, photographs of the project area are taken from strategic locations around the community. These locations are representative of areas where the project site is most visible to the general public. Lastly, the panoramic photographs are inspected to determine whether the tethered balloons are visible. Where the balloons are visible, the proposed project facilities would be visible, and the balloons are then used as reference points to superimpose the proposed project facilities onto the photographs. The resulting composite photographs depict a representation of the visibility of proposed facilities to the general public.

This technique is accurate as long as reasonable care is exercised in preparing the simulation.

This study was accomplished under the best conditions available. Photographs were taken during periods of relative calm. Also, potential viewsheds from the community to the proposed project were explored prior to selecting the final viewpoints. This ensured that all the appropriate viewsheds were accounted for in the simulation process.

3.12.1.2 Field Application

Visual simulation techniques were used to evaluate the potential aesthetic impact of the Kennecott Flambeau Project. The three-step process was implemented at the proposed site in May 1988.

Multicolored helium balloons were inflated on-site on May 29, 1988, and tethered in locations that simulated the crusher ramp and structure, the highest portions of Type I and Type II waste rock stockpile based on line-of-sight from the established viewpoints, and the topsoil stockpile. Figure No. 3.12-1 shows the location of each helium balloon group, and Table 3.12-1 lists the height, color code, description, and relative state plane coordinates (horizontal location) of each helium balloon group.

Nine strategic viewpoints were selected which could potentially provide a view of the proposed project. These viewpoints include locations of intense land use, such as roads, homes, schools, or hospitals; locations with elevations similar to or higher than the project facilities; and locations on the edges of the project site where openings in the foreground vegetation might afford a view of the project.

Viewpoint locations and visual simulation methodology were selected in cooperation with Wisconsin Department of Natural Resources (WDNR) staff. Nine main viewpoints, with a total of 16 subviewpoints, were eventually evaluated. One additional subviewpoint was added in the field. All viewpoints and subviewpoints are shown on Figure No. 3.12-2. All of the subviewpoints were selected because of their potential views of the project.

Viewpoint 1 is from the west bank of the Flambeau River directly west of the proposed pit. It is at water level, and represents a view from the Flambeau River east towards the mine site.

Viewpoint 2 is at Mt. Senario College and is subdivided into 2a--from the lounge on the top floor of the College dormitory building; 2b--at the top of the slope behind McLaughlin Hall; and 2c--at the highest vantage point in the vicinity, about 500 feet west of the campus. All subviewpoints were chosen to maximize the view of the proposed area. Figures 3.12-3 through 3.12-10 represent those viewpoints that offer any view of a project feature based on the visual simulation study described earlier.

Viewpoint 3 is located at the Sisters of St. Mary Convent to the north of the project site. It consists of three subviewpoints on the north bank of the Flambeau River, east of Mt. Senario College, and in the southwest corner of the City of Ladysmith. It has a view of forest in the direction of the proposed Type I waste rock stockpile. Subviewpoint 3A is located directly behind the convent building and near the river bank. This location is relatively low, and affords a view of the Flambeau River. Subviewpoint 3B is located in the cemetery, about 400 feet west of Subviewpoint 3A. It has a view of the Flambeau River and the forest to the south of it. Subviewpoint 3C is

TABLE NO. 3.12-1

Description of Balloon Scaling Locations

Number	Coordinates	Color	Height	Site Description
B-1	N39,800 E39,850	Red/ Blue	52'	Approximate location of crusher ramp and coarse ore stockpile
B-2	N41,800 E39,430	Yellow/ Blue	84'	Southwest end of Type I stockpile
B-3	N41,370 E39,000	Pink/ Green	78'	Alternate topsoil stockpile location
B-4	N39,360 E40,600	Red/ White	40'	Crushed ore stockpile alternate location
B-5	N40,600 E40,930	Orange/ Pink	70'	East side of Type II stockpile
B-6	N42,540 E40,100	Yellow/ Green	84'	North end of Type I overburden stockpile
B-7	N40,050 E40,470	Orange/ White	70'	West side of Type II overburden stockpile
B-8	N39,730 E40,900	Blue/ Pink/ Orange	70'	Southeast corner of Type II stockpile
B-9		Green/ Yellow/ Red	25'	Corner of H&H Building as potential height of tree screen

located in the fourth-floor lounge of the St. Mary's Hospital. It has a limited view of the western portion of the project area.

Viewpoint 4 is located on the State Highway 27 (STH 27) bridge across the Flambeau River on the south side of the City of Ladysmith. It is situated in a relatively low-lying area along the river to the northeast of the project area, and consists of two subviewpoints. Subviewpoint 4A is located on the southwest corner of the bridge, while subviewpoint 4B is located on the northeast corner of the bridge. Both subviewpoints afford a view of the Flambeau River and the thick forest that rise up from the south bank of the river.

Viewpoint 5 is located on the intersection of STH 27 and Blackberry Lane, about 1/2 mile south of viewpoint 4. It is situated on a relatively flat area to the east of the Type I waste rock stockpile, and consists of only one subviewpoint. Viewpoint 5 faces a mature mixed hardwood forest to the west, and STH 27 on the north and south.

Viewpoint 6 is located on STH 27 directly east of the proposed Type II waste rock stockpile. It originally consisted of two subviewpoints. A third subviewpoint was added during the simulation procedure to improve documentation of the project area. It is situated on a relatively flat area about 1/2 mile due south of Viewpoint 5. Subviewpoint 6A is located on the east side of STH 27, about 250 feet south of the existing service road and building. It affords a view of a pine plantation to the west, and of STH 27 to the north and south. Subviewpoint 6B is located on the east side of STH 27, directly across from the service road and building. It affords a view of the service building and pine plantation to the west, and a view of STH 27 to the north and south. Subviewpoint 6C is located on the east side of STH 27, about 600 feet south of Subviewpoint 6B. It affords a view of an open field to the west, and a view of STH 27 to the north and south.

Viewpoint 7 is located on the centerline of Jansen Road, about 80 feet east of STH 27, and consists of only one subviewpoint. It is situated directly to the east of an existing farmstead owned by Kennecott, which is the general area of the project offices, crusher, and the proposed railroad spur and power transmission line. It affords a westerly view of the farmstead and surrounding crop fields, and a view of STH 27 to the south.

Viewpoint 8 is located on the east side of STH 27, about 150 feet south of Jansen Road, and consists of only one subviewpoint. It affords a northwesterly view of the existing farmstead and fields toward the project office area and Type II waste rock stockpile area, and a northerly view of a wooded area that will contain the railroad spur and power transmission line.

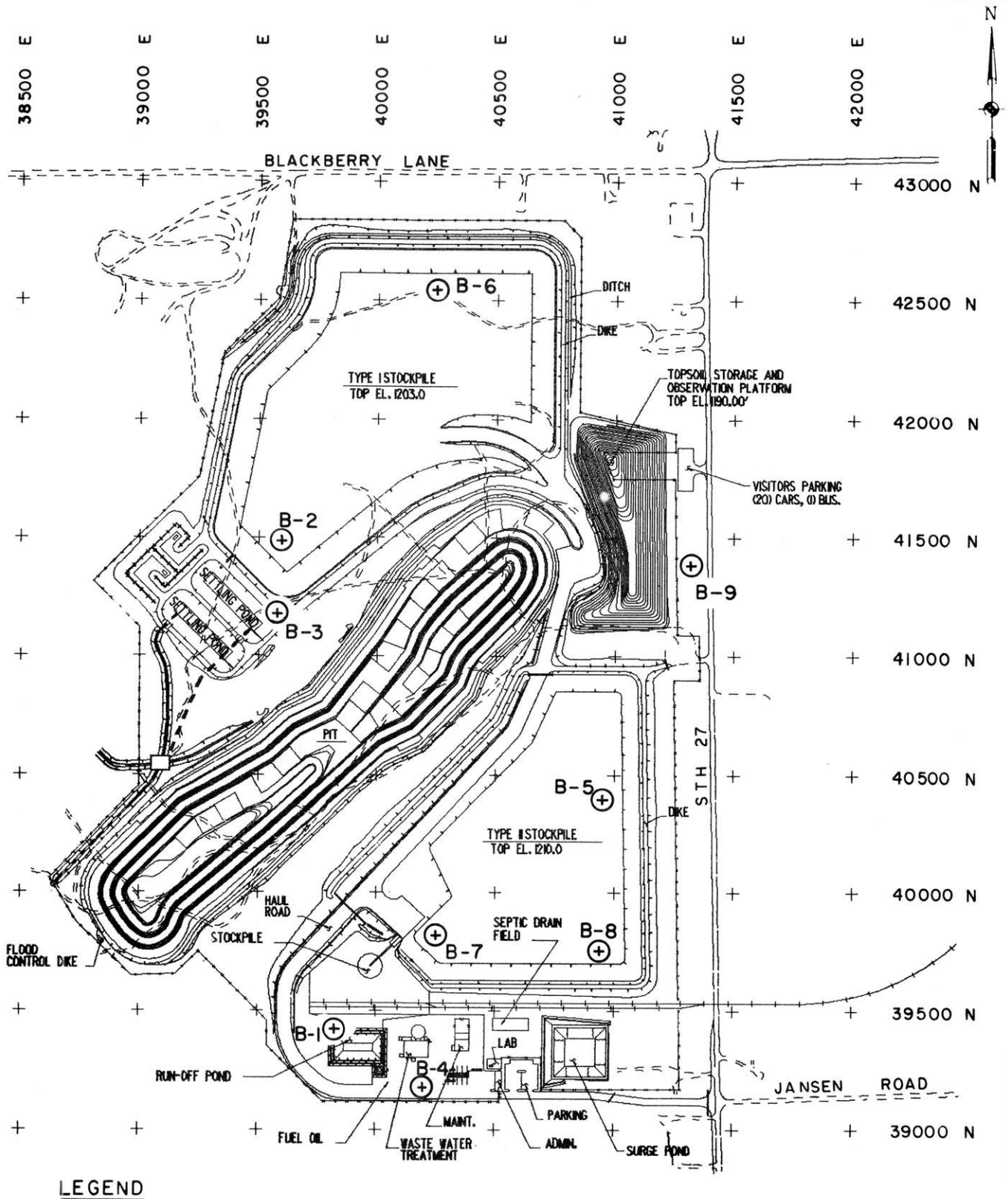
Viewpoint 9 is located in an isolated area on the crest of a hill on Blackberry Lane, about 1/2 mile west of STH 27. It is located due north of the proposed settling ponds, and northwest of the proposed Type I waste rock stockpile area. It consists of only one subviewpoint. Viewpoint 9 is situated in a relatively high area on top of a soil berm between two large gravel pits. It affords a southerly view of the abandoned gravel pit, and a general panoramic view of open fields and sparse woodlands on the north part of the project area.

These nine viewpoints and their associated subviewpoints represent the views that the general public could have of the proposed project area. Viewpoints 6, 7, and 8 represent views of the project area for individuals traveling north on STH 27 into the community. Viewpoints 4 and 5 represent views of the project area for individuals traveling south on STH 27 out of the community. Viewpoints 2 and 3 represent views of the project area from the most proximate developed areas. Viewpoint 1 represents a view from along the Flambeau River. Finally, Viewpoint 9 represents the view closest to the Type I waste rock stockpile. Selected perspectives of the project area are provided by Figures 3.12-3 through 3.12-10, which depict the views prior to any project activity.

3.12.2 Discussion of Results

Photographs depicting existing conditions were taken during each of the four seasons. Simulated visual impact of the proposed project from each subviewpoint were taken on May 29, 1988, and May 30, 1988. Section 4.0 will discuss the impacts of the proposed facilities using the composite panoramic viewsheds depicted on Figures 3.12-3 through 3.12-10.

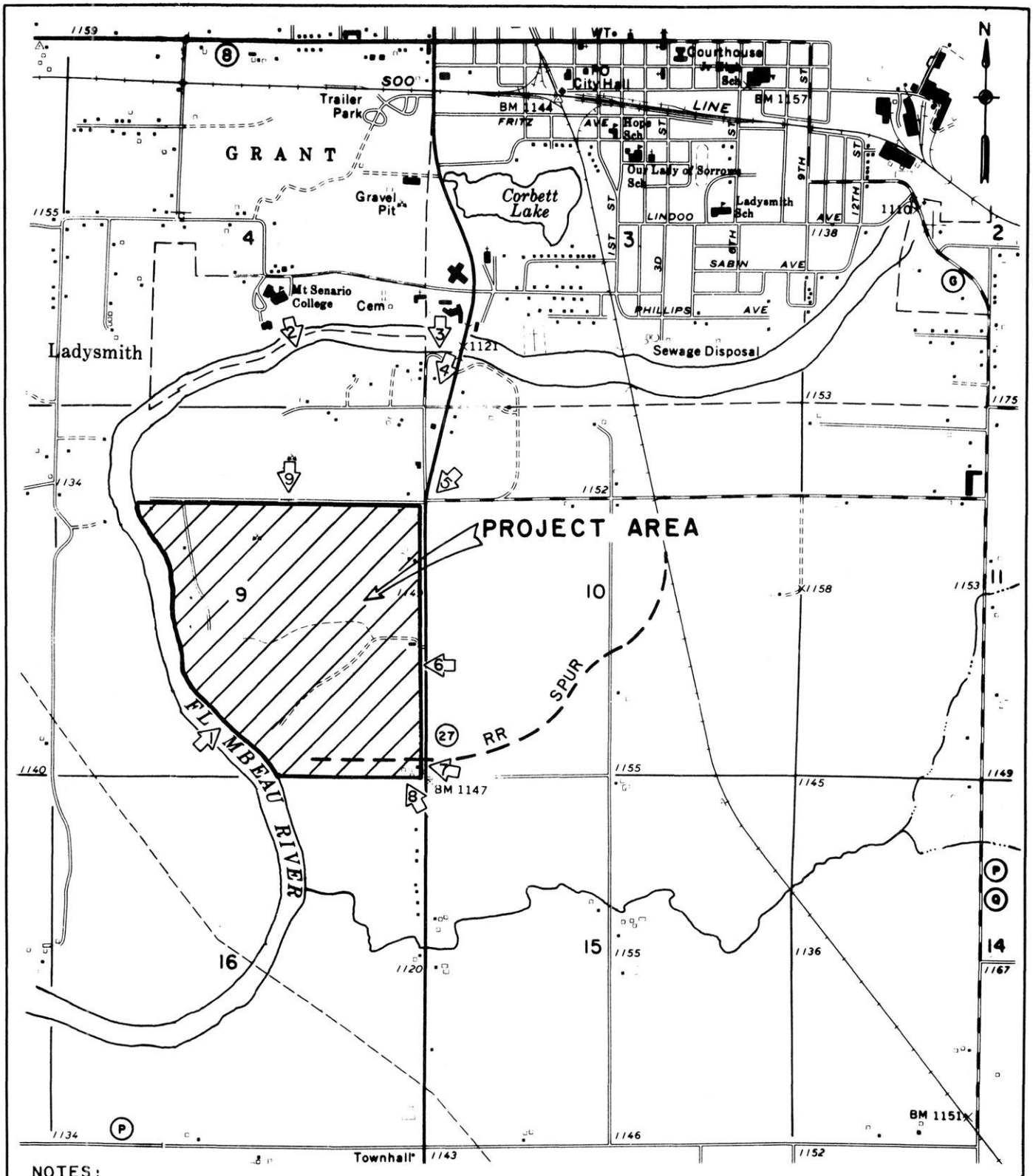
Figures for Section 3.12



LEGEND

⊕ B-7 BALLOON LOCATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 3.12-1 SCALING LOCATIONS
	DESIGNED BY		
	DRAWN BY SJL	1/89	
	CHECKED BY TJW	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 600'		Job No / Dwg No / REV



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

LEGEND

9 LOCATION AND DIRECTION OF PHOTOS

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GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

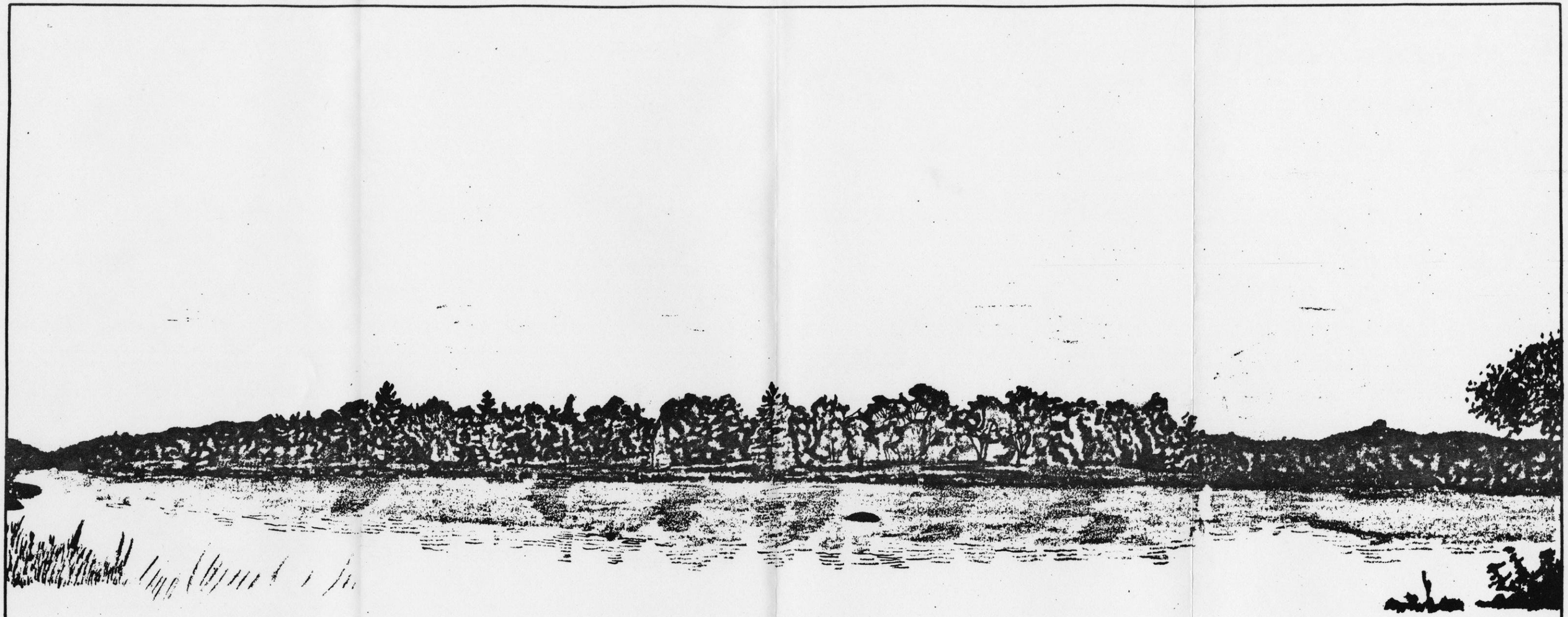
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.12-2
PHOTO DOCUMENTATION LOCATION

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

Job No	Dwg No	REV



P. P. Lewis

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FIGURE NO. 3.12-3
AESTHETICS
VIEWPOINT 1
EXISTING CONDITIONS

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'D	ENG'R	CHIEF ENG'R

NO.	DATE	REVISIONS	BY	CH'D	ENG'R	CHIEF ENG'R

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

	BY	DATE
DESIGN		
DRAWN	PDP	2/6/89
CH'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

BRONZELIN	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	NTS



P. Pleva

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

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

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

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

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

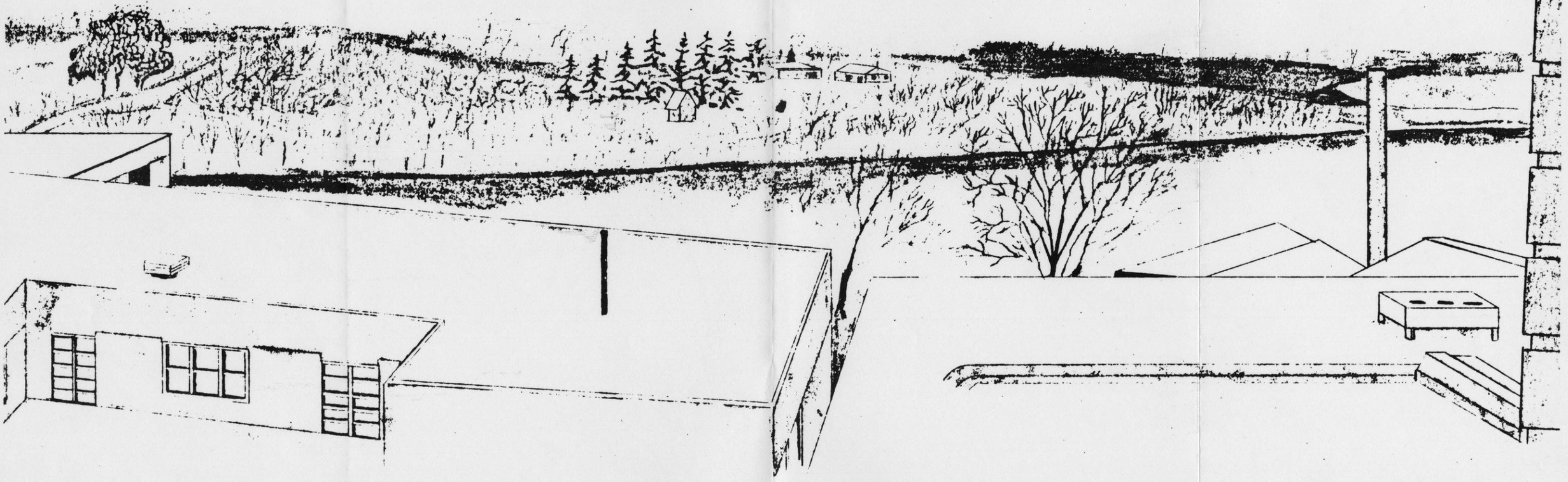
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FIGURE NO. 3.12-4
AESTHETICS
VIEWPOINT 2B
EXISTING CONDITIONS

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



P. P Lewis

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

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

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

	BY	DATE
PROJ. ENG'R		
MGR., PROCESS UNITS		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

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FIGURE NO. 3.12-5
AESTHETICS
VIEWPOINT 3C
EXISTING CONDITIONS

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



P Plewa

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FIGURE NO. 3.12-6
AESTHETICS
VIEWPOINT 5
EXISTING CONDITIONS

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE: N T S

REFERENCES	DWG. NO.	DESCRIPTION

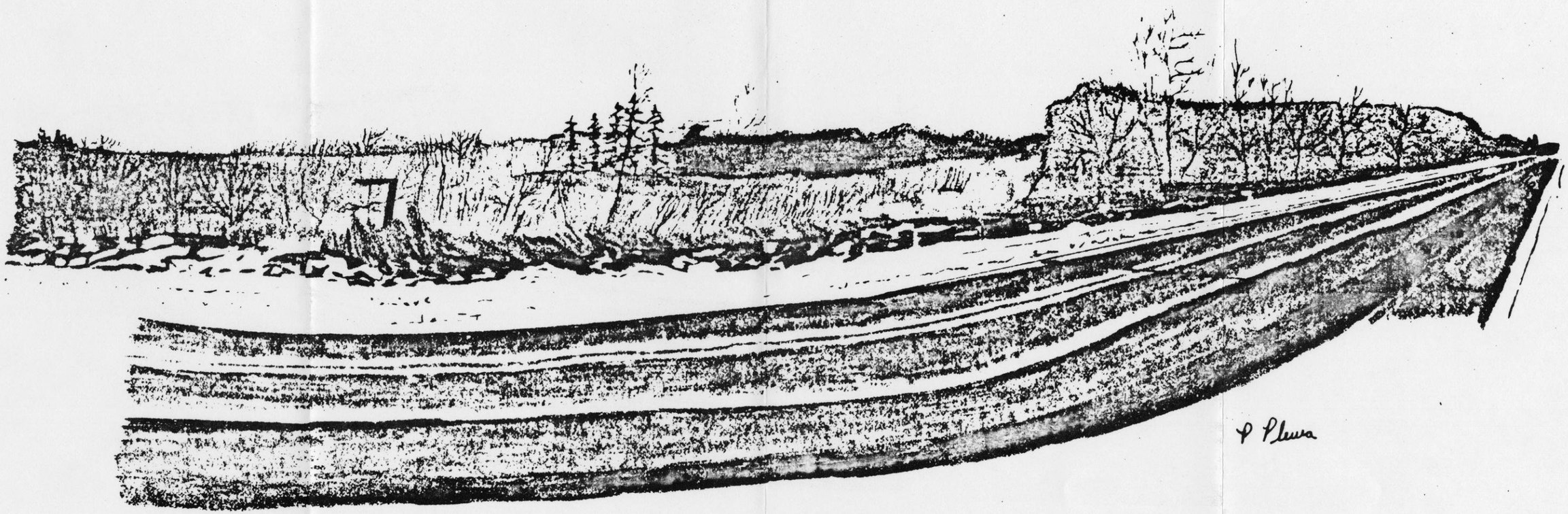
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NO.	DATE	REVISIONS	BY	CH'D	ENG'R	CHIEF ENG.

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

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CH'D	PES	3/89
DES. ENG'R		
SECT ENG'R		



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FIGURE NO. 3.12-7
AESTHETICS
VIEWPOINT 6A
EXISTING CONDITIONS

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

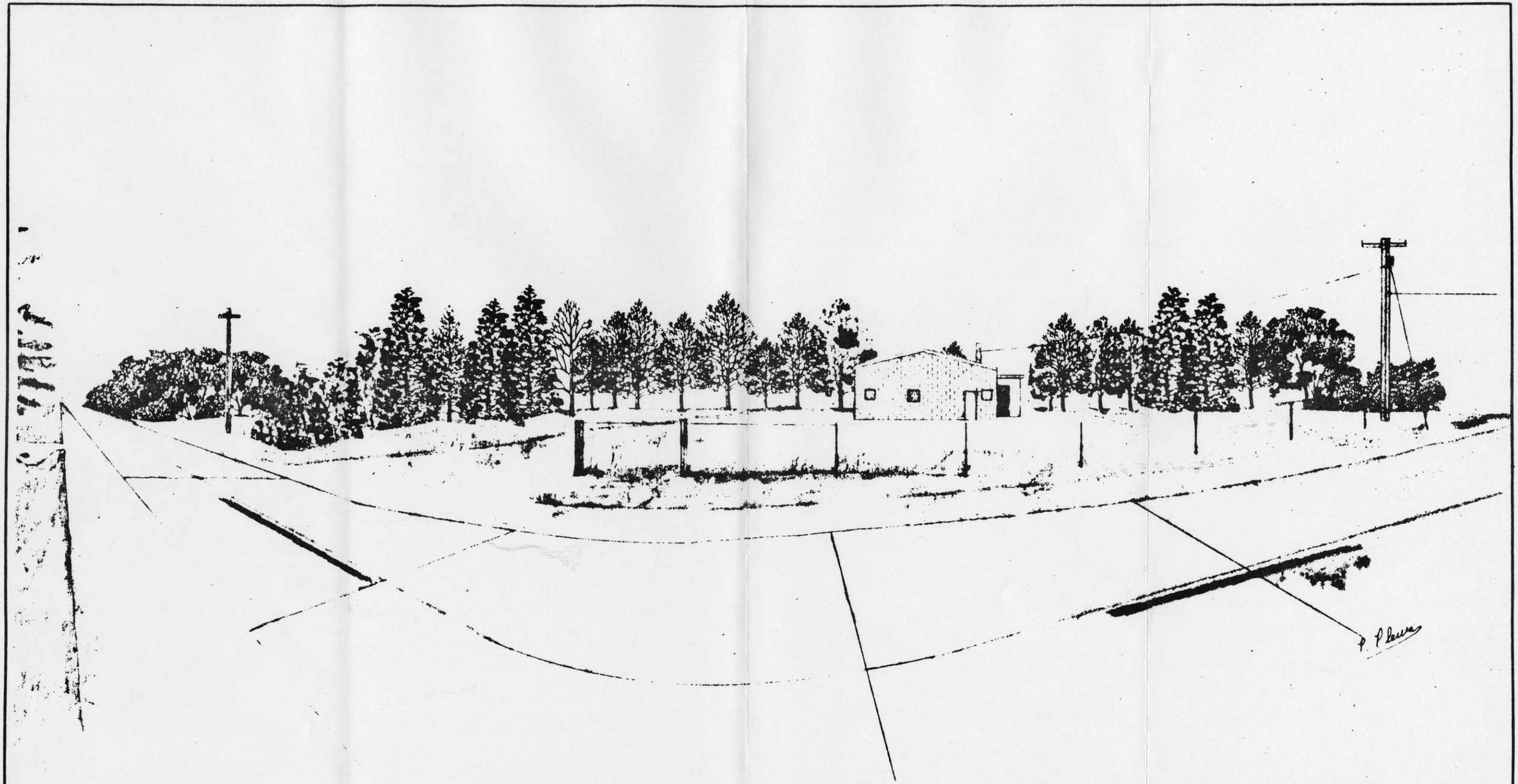
NO.	DATE	REVISIONS	BY	CH'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'D	ENG'R	ENG'R MGR.

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

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CH'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

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



REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

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

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

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

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SECT ENG'R		

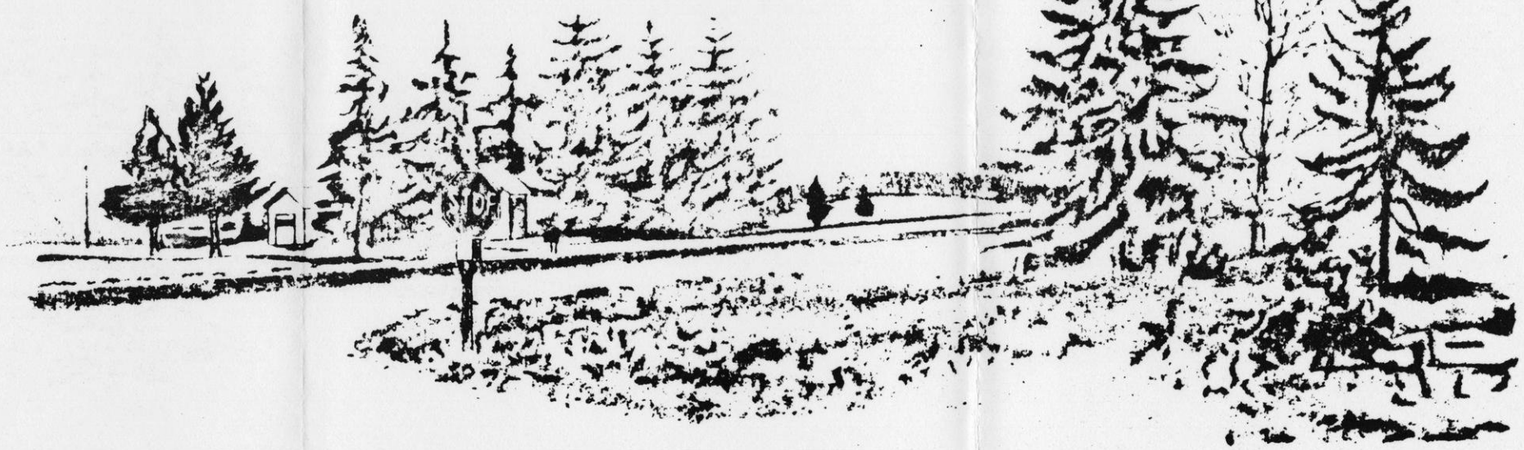
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FLAMBEAU PROJECT
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FIGURE NO. 3.12-8
AESTHETICS
VIEWPOINT 6B
EXISTING CONDITIONS

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



P Flewa

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FIGURE NO. 3.12-9
AESTHETICS
VIEWPOINT 7
EXISTING CONDITIONS

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

REFERENCES	DWG. NO.	DESCRIPTION

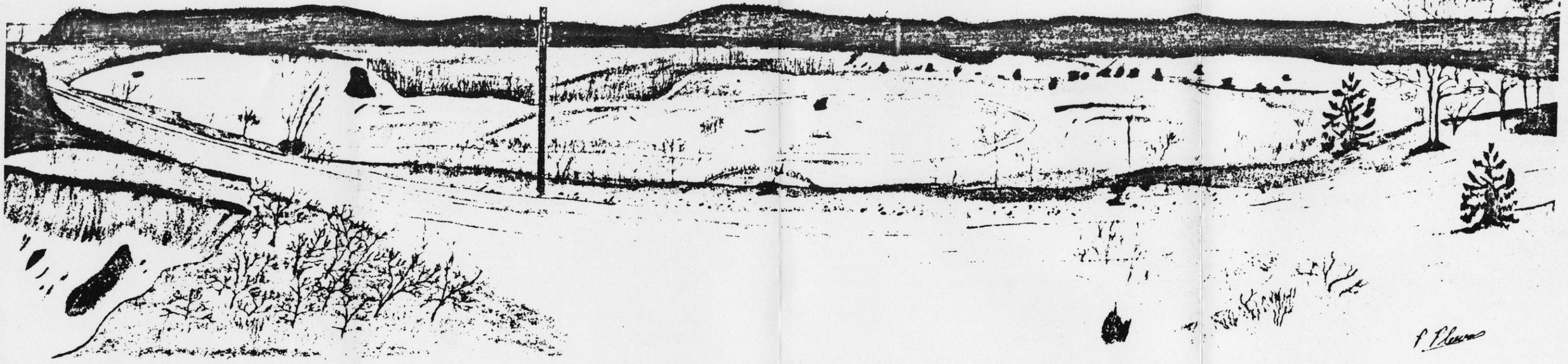
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	BY	DATE
PROJ. ENG'R		
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SECT ENG'R		



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

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 3.12-10
AESTHETICS
VIEWPOINT 9
EXISTING CONDITIONS

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

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

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3.13 Socioeconomics

3.13.1 Introduction

The socioeconomic analysis included a study of Rusk County, the Town of Grant, and the City of Ladysmith. The study area referred to in this section of the report consists of these three units of government unless otherwise noted.

The study area contains only one incorporated city, the City of Ladysmith. Ladysmith is the county seat of Rusk County. Because Ladysmith serves as a central trade area, the city offers a wide range of commercial and professional services. The Town of Grant encompasses an area south of the City of Ladysmith in Rusk County, and includes the proposed mine site. Interpretation of the socioeconomic data gathered during the study area analysis indicates the following trends and conditions. Population declines experienced from 1950 to 1970 have been arrested. Modest increases have been realized in the 1980s and population is projected to increase by 14 percent into the next century. Unemployment in Rusk County has been significantly higher than the average unemployment within the State of Wisconsin over the past six years. In 1988 the community lost over 100 jobs due to closure and restructuring of two manufacturing plants.

Sales in local recreational-related industries have also declined due to below-average local incomes and above-average age. Recreational income has also been hurt because of the travel time from major population centers.

According to the Northwest Regional Planning Commission, the Ladysmith/Hawkins Joint School District 1 facilities are in excellent condition. The study area schools are not overcrowded and, given the declining enrollment at most elementary schools, are not likely to be so in the near future.

The Rusk County Hospital, built in 1975, reports a 28 percent bed occupancy while containing more than adequate clinic, medical support equipment, and staff under the same roof.

The city has a class six fire insurance rating, which is very good for a community of this size. The supply and condition of existing fire fighting equipment are very adequate and the volunteer staff well-trained. A well-staffed police and sheriff's department is also present under one roof in the County Courthouse.

Ladysmith has excess water capacity and, as of May 1989, wastewater treatment plant capacity in excess of current and projected near-term needs.

It is concluded that the local economy needs additional stimulation to ease current high unemployment rates. There is

an excellent labor pool available for the mine due to an abundance of recent farm and industrial firm closures within the county. Infrastructure within the City of Ladysmith is more than adequate to handle a project the size of the Flambeau mine project.

3.13.2 Demographics

The demographics of the study area are analyzed in terms of the three levels of government identified within the study area. Rusk County is rural in nature with one city, eight villages, and 24 towns. The 1988 Wisconsin Department of Administration (WDOA, 1988) estimates the county's population at 15,456 people, residing on an area of 579,840 acres. This represents an average of about one person per 38 acres. About 38 percent of the people live in incorporated communities, while 62 percent live in towns.

Historically, the rural population was composed of loggers. The City of Ladysmith and villages of the county generally originated as lumber mill communities. The Villages of Weyerhauser, Bruce, Tony, Glen Flora, Ingram, and Hawkins and the City of Ladysmith were stations established along the Soo Railroad line. Farming became the dominant activity during the early twentieth century after the lumber supply dwindled (NWRPC, 1984, p. 13).

The county's largest community, Ladysmith, had an estimated population of 3,835 in 1988. Population increases due to seasonal influx are modest, particularly compared with some northern Wisconsin communities where tourism plays a more significant role. During the summer, the average population increases by about 15 to 20 percent over the permanent population (NWRPC, 1975, p. 13).

3.13.2.1 Population Trends

Trends in population are the result of two interrelated factors, the rate of natural increase, and the rate of net migration. The human population in and around the proposed mine project area has been analyzed at various levels and under various scenarios to provide a basis for impact assessment. Past, present, and future population trends were analyzed for the project area, City of Ladysmith, the Town of Grant, Rusk County, and the State of Wisconsin, given current conditions to provide baseline data.

Past and current populations of the various units of government being addressed are shown in Table No. 3.13-1. As shown in this table, while the State of Wisconsin experienced substantial population growth in the period between 1950 and 1970, Rusk County experienced a steady decline during that same period. By 1970, the populations in the City of Ladysmith and the Town of Grant had decreased to almost their lowest levels since 1930.

TABLE NO. 3.13-1

Summary of Historical Population Trends
for Selected Governmental Units
1930-1988

Place	1930	1940	1950	1960	1970	1980	1988 Estimates
State of Wisconsin	2,947,000	3,138,000	3,449,000	3,952,765	4,417,731	4,705,642	4,815,502
% Change		6.48	9.91	14.61	11.76	6.5	2.3
Rusk County	16,081	17,737	16,790	14,794	14,238	15,589	15,456
% Change		10.3	-5.34	-11.9	-3.8	9.5	-.9
City of Ladysmith	3,493	3,671	3,924	3,584	3,674	3,826	3,835
% Change		5.1	6.9	-8.7	2.5	4.1	.2
Town of Grant	1,074	1,049	983	1,049	931	998	929
% Change		3.5	-6.3	6.7	-11.3	7.2	-6.9

Source: U.S. Bureau of the Census, years noted. 1988 Estimates by Wisconsin Department of Administration, (WDOA), November 1988.

Between 1970 and 1980, the population in both Rusk County and the Town of Grant increased at a faster rate than the state. The City of Ladysmith also experienced growth, but at a rate slower than state growth levels. During the 1970s, rural uounties in the northern part of Wisconsin generally experienced growth as "out-of-area" residents converted seasonal housing units to year-round residences.

According to 1988 Wisconsin Department of Administration estimates, however, the growth in both Rusk County and the City of Ladysmith appears to have leveled off and the populations have stabilized. On the other hand, by 1988 the Town of Grant had experienced slight population growth.

The projected population of the study area and of the State of Wisconsin are shown in Table No. 3.13-2. As shown in this table, the state's population is projected to grow by about 10 percent over the next 30 years, while Rusk County is expected to grow by about 14 percent through the same period. Both the Town of Grant and the City of Ladysmith are expected to experience slower growth than the state through the year 2010.

3.13.2.2 Ethnic Composition

The ethnic composition of the project and surrounding area population are summarized in Table No. 3.13-3. As shown in this table, the most significant ethnic group represented in the general project vicinity is the American Indian. Rusk County, as well as the City of Ladysmith and the Town of Grant, have fewer black and other ethnic groups represented when compared to the State of Wisconsin.

3.13.2.3 Urban and Rural Populations

The urban/rural characteristic of Rusk County varies greatly from the state average. None of Rusk County is considered "urban" by Census Bureau definition. Over 75 percent of Rusk County is classified as "rural" in nature.

3.13.2.4 Population Distribution by Age and Sex

The age/sex distribution of the study areas compared to the State of Wisconsin is shown graphically in Figure No. 3.13-1.

These graphic representations of the study area's population suggests that Rusk County has a higher proportion of its population over age 60 than does the state overall. This greater representation of persons in Rusk County aged 55 to 64 is indicative of an influx of near-retirement-age persons settling in Rusk County and the flight of working-age residents to other areas in search of employment opportunities.

The population distribution of the Town of Grant suggests that this area has fewer elderly persons than Rusk County overall,

TABLE NO. 3.13-2

Population Projections
1980-2010

	1980	1990	2000	2010	% Change
State of Wisconsin*	4,705,642	4,876,821	5,047,190	5,156,438	+10
Rusk County**	15,589	16,501	17,230	17,731	+14
Town of Grant**	998	1,037	1,060	1,059	+ 6
City of Ladysmith**	3,826	2,919	3,936	3,884	+ 2

Source: * Wisconsin Estimates, WisconsinPopulation Projections. 1980-2020. Fifth edition, June 1988. Demographic Services Center.
** Wisconsin Small-Area Baseline Population Projections. Wisconsin State Data Center 80-1. March 1986.

TABLE NO. 3.13-3

Ethnic Composition in Selected
Governmental Units
1980

	% White	% Black	% American Indian	% Other
State of Wisconsin	94.5	4.0	0.6	1.0
Rusk County	99.4	0.05	0.4	0.2
City of Ladysmith	99.2	0.0	0.7	0.2
Town of Grant	99.4	0.0	0.2	0.0

Source: U.S. Bureau of the Census, 1980.

and that it also has a greater percentage of children under the age of ten than either the state or Rusk County. This is reflective of the agriculturally based population that makes up the Town of Grant.

The City of Ladysmith has a larger proportion of its population over age 60 and also proportionally fewer children age four and under than the state, Rusk County, or the Town of Grant. Figure No. 3.13-1 displays graphically the high proportion of elderly females living in the City of Ladysmith.

In summary, the Town of Grant has fewer elderly residents than the state, while Rusk County and the City of Ladysmith have a significantly higher proportion of their residents aged 65 or over. Rusk County and the Town of Grant both have percentages of school-age children higher than the state ratios. The City of Ladysmith, however, has fewer school-age children than Rusk County and the City of Ladysmith.

3.13.3 Sociocultural Profile

A sociocultural profile of the Rusk County area involves an analysis of various social and cultural factors that impact the population of the communities involved. These factors include marriage, divorce, birth rates, family size, and death rates.

3.13.3.1 Marriage

All marriages in Rusk County, including the City of Ladysmith and the Town of Grant, are recorded by the Rusk County Clerk. In 1987, the last year for which complete data was available, 131 marriages took place. This was a decline in the total number of marriages of 6.4 percent since 1983.

The annual number of marriages per 1,000 population in Rusk County in 1987 was 8.4. The number of marriages per 1,000 population has declined from 8.9 in 1983 to 8.4 in 1987 or a decrease of 5.6 percent (Rusk County Clerk, 1989).

3.13.3.2 Divorce

Divorces in Rusk County are tabulated by the County Clerk of Courts. The annual number of divorces filed per 1,000 population in 1987 was 2.8. The number of divorces per 1,000 population has declined from 4.3 in 1983 to 2.8 in 1987 or a decrease of 36 percent (Rusk County, 1989).

3.13.3.3 Birth Rates/Family Size

Birth rates for the Rusk County area are determined using an average over five years so that rather wide annual fluctuations are smoothed out.

The average annual number of births between 1982 and 1986 was 245, or a rate of 15.6 births per 1,000 population, according to the Wisconsin Bureau of Health Statistics, December 1988. Family size change in Rusk County and the State of Wisconsin in 1970 compared to 1980 is shown below.

	1970	1980	Percent Change
Rusk County Family Size	2.8	2.92	+4%
State of Wisconsin	3.12	2.85	-9%

Source: U.S. Bureau of the Census, 1970 and 1980.

3.13.3.4 Mortality

Death rates among Rusk County residents are also calculated averaging five years to level out any fluctuations that may occur in a given year.

The average annual number of deaths in Rusk County between 1982 and 1986 was 161 with a death rate per 1,000 population of 10.3 (Wisconsin Bureau of Health Statistics, 1988). According to this analysis, average annual births outnumbered deaths by 84 between 1982 and 1986.

3.13.3.5 Leisure

Leisure activity in the study area consists of both outdoor and indoor recreational activities. Almost 16 percent of the county's acreage is open to the public for leisure activities, and another 1.8 percent of the county's acreage is in the form of lakes and streams (NWRPC, 1975, p. 9).

Hunting, fishing, hiking, snowmobiling, skiing, and other outdoor recreation activities are permitted on most of this publicly owned land. Camp and picnic sites have been developed at some scenic areas in the county. There are three wayside picnic sites on the arterial highways with tables, toilets and water provided and isolated camping spots are numerous.

The Ladysmith area has several restaurants and supper clubs, plus taverns and clubs with live music and dancing. Ladysmith has a movie theater and library. Mount Senario College provides continuing education classes, music, and theater productions. The schools in the area also provide entertainment through sporting events and fine arts programs.

3.13.3.6 Transportation

Private automobiles are the dominant form of transportation in the study area. In June 1988, Rusk County had a total of 12,291 registered vehicles (Wisconsin Department of Transportation,

1988). That represents an increase of six percent since 1983. There is no mass public transportation in the City of Ladysmith except the service provided by the Indianhead Transit Service (ITS). ITS provides handicapped and elderly persons with transportation service throughout the county. ITS has four busses, two vans, and two automobiles. The service provided is demand-responsive and the charge for a one-way trip to town is $0.50 (ITS, 1988).

Rusk County has one airport, Rusk County Airport. However, the county is not served by regularly scheduled air service. No taxi service is available in the county.

The local study area is served by a good system of two-lane paved roads. The major roads are carefully maintained during the winter, and there is little disruption of travel due to snow conditions. Due to the dependence on private automobiles and the scattered location of much of the population in the study area, certain segments of the community are limited in their access to services, shopping and entertainment.

3.13.4 Economic Profile

3.13.4.1 Income

The adjusted gross income per capita by civil division is shown in Table No. 3.13-4. The adjusted gross income of the study area has grown over the ten-year period from 1976 to 1986. All civil divisions showed growth of more than 85 percent over that period.

The per capita income in 1976 and 1986 of the Town of Grant was about one-half of the per capita income for the state overall. In 1976, the Town of Grant's per capita income was also about one half that of the state's per capita income.

Likewise, Rusk County's per capita income is also only about one-half that of the state's per capita income and, like the township's per capita income, has not kept pace with the growth in the state's per capita income.

The City of Ladysmith's per capita income is about 27 percent lower than the state's per capita income. In 1976, the City of Ladysmith's per capita income was about 23 percent lower than the state's per capita income.

The median household income of the study area in 1980 was also analyzed. The Town of Grant had the highest median household income of the communities examined, at $13,508. The City of Ladysmith's median household income of $10,247 was the lowest. The median household income of the communities in Rusk County are significantly lower than the state's median household income at $17,680 (U.S. Bureau of the Census, 1980).

TABLE NO. 3.13-4

Adjusted Gross
Income Per Capita
1976, 1981, 1986

	1976	1981	1986	Increase Absolute	Increase Percent
City of Ladysmith	$3,708	$5,631	$7,022	$3,314	+89.4
Town of Grant	$2,581	$3,762	$4,842	$2,261	+87.6
Rusk County	$2,893	$4,325	$5,497	$2,604	+90.0
Wisconsin	$4,801	$7,333	$9,589	$4,788	+99.7

Source: Wisconsin Department of Revenue, years cited, Bureau of Fiscal Information and Analysis.

3.13.4.2 Employment

The employment pattern in the study area is very different from the employment pattern in the state overall. Rusk County has a much higher concentration of employment in the agriculture, forestry, fisheries, and gravel mining category than the state average. Rusk County, the Town of Grant, and the City of Ladysmith have somewhat smaller percentages of employment in durable manufacturing than the state overall.

In the Town of Grant, the two largest employment categories are durable manufacturing and retail trade. In the City of Ladysmith, retail trade and educational services are the two categories employing the greatest number of people. Only the Town of Grant had the same two largest employment categories as the state--durable manufacturing and retail trade (U.S. Bureau of the Census, 1980).

The study area has been affected by hard economic times over the last five years. Between 1980 and 1985, 120 farms were lost in Rusk County, accounting for a 12.8 percent decline in the number of operators and about an 11 percent decline in farm acreage. During that same period, however, only 50 nonfarm jobs were added to the labor market. This phenomenon resulted in an influx of farm labor into a static job market (NWRPC, 1986).

The unemployment history of Rusk County compared to the unemployment history of the State of Wisconsin and surrounding counties is summarized in Table No. 3.13-5.

As shown, Rusk County unemployment has consistently been higher than the state's unemployment figures over the last six years. The average size of the labor force in Rusk County in 1988, at 6,800, is about the same as it was in 1982. The number of unemployed--and consequently the unemployment rate--in Rusk County is lower today than it was six years ago. While Rusk County has shown a decline in the number of persons unemployed, it has not kept pace with state unemployment rates, which are currently under five percent.

Compared to selected counties surrounding Rusk County, Rusk County's unemployment rate has decreased at the fastest rate. However, this unemployment data suggests that Rusk County and its neighboring counties have not yet completely recovered from the devastating unemployment experienced in the early 1980s.

Rusk County has experienced some growth in jobs in manufacturing. Total nonfarm jobs grew at a modest 1.2 percent between 1980 and 1985, while jobs in the manufacturing sector increased by 11.9 percent over that time, as shown in Table No. 3.13-6. Among the manufacturing industries, the forest products-related sectors--furniture and fixtures, and lumber and wood products--grew by 61.8 percent and strengthened their hold as the number one manufacturing industry in the county.

TABLE NO. 3.13-5

Unemployment Trends

Rusk, Price, Sawyer, Taylor, Washburn Counties
and State of Wisconsin

Annual Average
1982-1988

County	1982	1984	1986	1988	% Change
Rusk	16.5	11.1	11.3	7.8	-52.7
Price	12.4	8.5	8.3	6.0	-51.6
Sawyer	18.4	13.3	12.9	9.1	-50.1
Taylor	15.9	10.9	10.8	8.0	-49.7
Washburn	13.8	10.7	9.3	7.7	-44.2
Wisconsin	10.7	7.3	7.0	4.9	-54.2

Source: Wisconsin Department of Industry, Labor, and Human Relations, Job Service Division, years cited. Personal Communication, January 1989.

TABLE NO. 3.13-6

Rusk County

Employees Covered Under Wisconsin's Unemployment Compensation Law
Employment and Wages by Industry
1980 and 1985

	1980			1985			% Change		
	Average Employed	Average Annual Wage	Number of Establishments	Average Employed	Average Annual Wage	Number of Establishments	Average Employed	Average Annual Wage	Number of Establishments
Total Sector	4,109	$ 9,286	341	4,278	$12,859	318	4.1	38.5	- 6.7
Construction	64	7,327	33	51	11,318	27	-20.3	54.5	-18.2
Manufacturing	1,377	11,540	42	1,435	17,147	36	4.2	48.6	-14.3
Trans. & Util.	141	14,276	22	121	17,774	22	-14.2	24.5	0
Wholesale Trd.	138	13,595	22	133	14,721	20	- 3.6	8.3	- 9.1
Retail Trade	496	6,712	93	602	8,260	84	21.4	23.1	- 9.7
Finance, etc.	146	10,605	21	129	12,705	19	-11.6	19.8	- 9.5
Service	503	6,419	54	507	8,496	56	.1	32.4	3.7
Government	1,215	7,832	48	1,246	11,353	47	2.6	45.0	- 2.1
Miscellaneous	29	12,030	6	54	12,111	7	86.2	.7	16.7

Source: Wisconsin DILHR, Unemployment Compensation Division, 1980.
NWRPC, Rusk County Statistics Summary, 1986 (1985 Data).

As the wood products industries grew, the county experienced major losses in the textile and paper products sectors. Employment declined from 180 in 1980 to 80 in 1986 as one company moved to a warmer climate and two others suffered from the national decline in domestic-produced apparel (NWRPC, 1986).

Recent closure of the Master Craft Casket Company in mid-1988 has resulted in the loss of another 80 jobs. Fiber Strong, a fiberglassing operation, was also closed in 1988, resulting in the loss of an additional 30 jobs. Fiber Strong has since reopened its operation, but at a greatly reduced level, with a work force of only five employees.

Unlike the state and national trend, the services industry has not expanded in Rusk County in recent years. However, the government sector has grown six percent since 1980 and contains a high distribution of payroll employment (Table No. 3.13-6).

Retail trade sales have declined over the last five years. The negative growth in retail trade sales is the result of county residents traveling beyond the county for some of their purchases (NWRPC, 1986).

3.13.4.3 Business and Financial Activity Summary

3.13.4.3.1 Business and Industrial Activity

Rusk County has shown modest growth in business and industrial activity over the last five years. According to the Department of Industry, Labor, and Human Relations, the average number of persons employed, and the average annual wage in the county increased between 1980 and 1985 (Table No. 3.13-6).

As shown in Table No. 3.16-6, the average number of persons employed increased modestly at about four percent between 1980 and 1985 and the average annual wage increased by almost 40 percent over that same time period.

The number of establishments in Rusk County declined by about seven percent between 1980 and 1985 overall. Only the number of miscellaneous establishments, which includes agriculture, forestry, fisheries, and mining of sand and gravel increased over that time period. This increase in establishments reflects the growth in the forestry industry in the county in recent years.

3.13.4.3.2 Financial Activity

Assets, loans, and deposits of financial institutions are used here as indicators of capital in Rusk County. Rusk County is served by three commercial banks and one savings and loan establishment. Both loan and deposit amounts increased for commercial banking institutions in Rusk County between 1980 and 1987 (Table No. 3.13-7).

TABLE NO. 3.13-7

Financial Activity ($000s)
1980 and 1987

Rusk County and Wisconsin

	1980			1980-1987			1980-1987 % Change	
	Loans	Deposits	Loan/Deposit Ratio	Loans	Deposits	Loan/Deposit Ratio	Loans	Deposits
Commercial Banks								
Rusk County	40,497	63,257	.640	49,661	89,047	.558	+ 22.6	+ 40.8
State of Wisconsin	8,739,239	13,309,849	.657	23,983,339	34,562,116	.694	+174.4	+159.7

Source: Office of Commission of Banking, Madison. December 31, 1980. Eighty-sixth Annual Report.
Office of Commission of Banking, Madison. December 31, 1987. Ninety-third Annual Report.

As shown in Table No. 3.13-7, the dollars in loans from Rusk County commercial banks increased by about 23 percent between 1980 and 1987. Deposits in Rusk County banks increased very slowly when compared to state averages. Loans and deposits in all Wisconsin banks increased by 174 and 160 percent respectively over that same time period. The slower growth in bank loans and deposits in Rusk County is reflective of the financial problems that have plagued the Rusk County economy recently.

3.13.4.4 Retail Trade

The number of retail establishments in Rusk County declined between the years 1977 and 1982, while retail sales in dollars increased (Table No. 3.13-8).

As shown in Table No. 3.13-8, the number of retail establishments declined by 19 percent between 1977 and 1982, while retail sales in dollars increased by 19 percent. However, per capita retail sales in Rusk County only increased by 12 percent, while per capita retail sales statewide increased by 35 percent.

Rusk County retail sales in dollars compared to Wisconsin retail sales by store group are shown in Table No. 3.13-9.

In Rusk County, sales in drugs, automotive, and general merchandise accounted for the growth in retail sales over the last four years. The state's retail sales figures showed growth in every sector, while in Rusk County sales in food and eating and drinking places actually declined. Retail sales for drugs in Rusk County increased by 150 percent, highlighting the large proportion of elderly persons in the county.

3.13.4.5 Agriculture

In recent years, the number of farms in Wisconsin has been decreasing. This trend has been more pronounced in Rusk County than statewide. Between 1978 and 1984, the number of farms in Rusk County declined by 18.8 percent compared to a decline in the number of farms statewide of 7.1 percent (U.S. Dept. of Commerce, 1978 and 1984).

Farm acreage has also declined, but not at as high a rate as the number of farms. Therefore, while the number of farms declined, average farm size increased in Rusk County and in the state overall. The average farm in Rusk County, at 237 acres, is larger than the average Wisconsin farm at 213 acres (U.S. Dept of Commerce, 1978 and 1984).

Agriculture remains an important component of Rusk County's economy even though it has declined as a proportion of the county's total economy. Agricultural employment in Rusk County declined by two-thirds between 1940 and 1980, from 3,378 workers

TABLE NO. 3.13-8

Retail Trade Expenditures
Rusk County and Wisconsin
1977 and 1982

	1977	1982	% Change
Number of Establishments	199	161	-19
Sales (1,000's)	$37,312	$44,247	+19
Percentage of State	0.25	0.22	-12
Rusk County Sales Per Capita	$ 2,519	$ 2,828	+12
Wisconsin State Retail Sales Per Capita	$ 3,226	$ 4,368	+35

Source: U.S. Department of Labor, 1977 and 1988.
Census of Retail Trade.

TABLE NO. 3.13-9

Rusk County and Wisconsin

Retail Sales by Store Group
1982, 1986 (000's)

	Rusk County			Wisconsin		
	1982	1986	% Change	1982	1986	% Change
Total Retail Sales	$46,759	$55,172	+ 18	$20,196,417	$25,888,544	+ 28
Food	13,108	13,054	- .5	4,879,125	5,036,149	+ 3
Eating & Drinking Places	3,892	2,874	- 26	2,407,686	2,680,810	+ 11
General Merchandise	2,377	3,087	+ 30	2,668,152	3,202,309	+ 20
Furniture/Appliances	1,058	1,215	+ 15	819,521	1,282,371	+ 56
Automobile	4,826	6,873	+ 42	2,665,887	5,718,222	+114
Drug	870	2,171	+150	655,946	721,042	+ 10

Source: Sales and Marketing Management/1983 and 1987 Survey of Buying Power.

to 1,085 (Rusk County Farmland Preservation Committee, 1982, p. 37). In 1940, farming was the dominant form of employment, accounting for about 58 percent of total employment, compared with only 26 percent for the entire state. However, by 1980 resident farm employment accounted for only 19 percent of total employment, still higher than the six percent figure representing farm employment statewide (Rusk County Farmland Preservation Committee, 1982, p. 37). The cash receipts generated from farming activities in Rusk County according to the Wisconsin Department of Agriculture in 1985 follow (Rusk County Farmland Preservation Committee, 1982, p. 38).

	Average Per Farm	Total Cash Receipts ($1,000)
Rusk County	$47,677	$ 39,095
Wisconsin	61,678	5,119,286

As shown, the average cash receipts per farm are lower in Rusk County than for state farms overall. Rusk County agricultural cash receipts account for less than one percent of the cash receipts in the state.

3.13.4.6 Forestry and Forest Products

Forestry has been the dominant land use in Rusk County and is an important part of the county's economy. The past history of Rusk County's forest land is much the same as that of the majority of forest land in northern Wisconsin. Most of the original virgin stands of white pine, as well as other species, had been removed by the early part of this century. The existing forests in Rusk County are the results of second growth and planting. The number of forested acres in Rusk County is 213,600 acres based on unpublished estimates by the U.S. Forest Service (Rusk County Farmland Preservation Committee, 1982, p. 22).

Hardwoods are dominant in Rusk County, accounting for over 90 percent of total forested acreage and volume. Maple-basswood and aspen are the most dominant species, together accounting for three-quarters of hardwoods acreage and two-thirds of hardwoods volume. Maple-basswood is the most prevalent forest type, with aspen second within the county. Aspen is the most prevalent forest type on farm woodlands.

There are benefits to Rusk County residents from forest resources in the county. In 1980, stumpage value from the county forest lands was $172,000 (Rusk County Farmland Preservation Committee, 1982, p. 22). The value added by local wood workers increases the value to the local economy several times. Two of Rusk County's largest employers, Norco Windows and Weather Shield, are a direct result of the forestry industry. Benefits to county residents from forest resources

include in-lieu-of-tax payments to local units of government from federal lands, private stumpage sales, and forest industry employment.

3.13.4.7 Mining

The proposed mining of copper in the Ladysmith area would be a new development as currently no metallic mining is carried out in Rusk County or in the state. According to an Economic Development Plan developed by Northwest Wisconsin Regional Planning Commission in 1987, the development of some environmentally acceptable mining and minerals processing in the area is encouraged (NWRPC, 1987, p. 22).

The only mining currently taking place in Rusk County is the extraction of sand and gravel. Sand and gravel mining is not a major part of the Rusk County economic base. Four businesses involved in the extraction of sand and gravel currently operate in the county.

3.13.4.8 Recreation and Tourism

Hospitality, recreation, and tourism play a role in the economy of Rusk County. This role is examined in terms of eating and drinking establishments, lodging, and amusement and recreation services.

3.13.4.8.1 Eating and Drinking Establishments

From 1977 to 1982, Rusk County showed decreased sales for eating and drinking establishments (Table No. 3.13-10). Rusk County's decrease, at 17.7 percent, was in contrast to Wisconsin's increase in retail sales of more than 40 percent over that same time period.

Some reasons for the decline in sales of recreation-related industries in the Rusk County area include the below-average income and above-average age of the local population. Other factors include the barrier of travel time from major population centers and the missed potential for more winter activities.

The number of eating and drinking establishments over the same time period decreased significantly at the state level as well as in Rusk County.

3.13.4.8.2 Lodging

The state as a whole experienced a substantial increase (40 percent) in hotel, motel, and other lodging sales between 1977 and 1982 similar to the increase in lodging sales in the Rusk County area (39 percent).

However, the number of hotel and motel establishments actually declined over that time period. The decline in the number of

TABLE NO. 3.13-10

Sales and Establishments for Hospitality, Recreation, and Tourism Industry

Rusk County and Wisconsin

	Sales		Establishments		
	Amount ($1,000)	% Change 1977-1982	Number	% Change 1977-1982	% of State Sales
Eating and Drinking Places					
State of Wisconsin	$2,166,673	+42.2	9,493	-26.3	100
Rusk County	2,165	-17.7	22	- 6.4	.1
Hotels, Motels, etc.					
State of Wisconsin	$ 386,481	+39.8	1,040	-59.3	100
Rusk County	849	+38.5	10	-28.6	.2
Amusement and Recreation Services, including Motion Pictures					
State of Wisconsin	370,060	+36.2	1,548	-60.2	100
Rusk County	188	-16.1	4	-66.7	.05

Sources:

U.S. Department of Commerce, Bureau of the Census. 1982 Census of Retail Trade - Wisconsin. Washington, D.C.: United States Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1982 Census of Service Industries - Wisconsin. Washington, D.C.: United States Government Printing Office.

establishments is, in part, the result of fewer, larger establishments replacing more numerous smaller ones. The number of hotel and motel establishments in the state decreased from 12,889 in 1977 to 9,493 in 1982. In Rusk County, the number of hotel and motel establishments declined from 14 in 1977 to 10 in 1982.

3.13.4.8.3 Amusement and Recreation Service

In amusement and recreation service sales, the state of Wisconsin experienced an increase in sales of over 35 percent while Rusk County sales in this category declined by about 16 percent. The number of establishments providing amusement and recreation services decreased statewide from 3,982 in 1977 to 1,548 in 1982. Similarly, the number of establishments in Rusk County decreased from 12 in 1977 to 4 in 1982.

3.13.5 Housing

3.13.5.1 Housing Stock

The number of housing units in the study area by tenure are shown in Table No. 3.13-11. As shown, the majority of the housing in Rusk County and the Town of Grant is owner-occupied. However, the City of Ladysmith has considerably more rental housing opportunities than Rusk County overall or the Town of Grant.

As the increasing size of the elderly population is a growing force in the study area, the age of household heads was analyzed.

The greatest concentration of elderly-headed housing units is located in the City of Ladysmith (38 percent). A significant number of elderly-headed housing units are located in Rusk County (35 percent). Only 28 percent of the housing units in the Town of Grant are headed by persons over age 60 (U.S. Bureau of the Census, 1980).

The Wisconsin Department of Development's *201 Housing Report* identifies 22 percent of the housing units in Rusk County as inadequate, with 15 percent inadequate in the Town of Grant, and 32 percent of the housing in the City of Ladysmith considered inadequate.

In terms of age of housing, over 50 percent of the housing in Rusk County, the Town of Grant, and the City of Ladysmith was constructed before 1940 (U.S. Bureau of the Census, 1980). This accounts for the relatively low median value of the housing in the study area.

TABLE 3.13-11

Housing Units by Tenure

Rusk County, Town of Grant, City of Ladysmith
1980

	Rusk County		Town of Grant		City of Ladysmith	
	Number of Housing Units	% of Total	Number of Housing Units	% of Total	Number of Housing Units	% of Total
Total Occupied	5,336		310		1,426	
Owner Occupied	4,253	80%	249	80%	967	59%
Renter Occupied	1,083	20%	61	20%	459	41%

Source: U.S. Bureau of the Census, 1980. Summary File Tape 3A.

3.13.5.2 Housing Market Characteristics

Several real estate agents in the Ladysmith area were interviewed to determine the characteristics of the housing market in the study area (Weisenberger, 1989). There appear to be ample homes on the market because home sales have been fairly stagnant over the past several years. Most of the homes for sale are in the $20-$50,000 range. Vacant land and home sales have started to increase.

In 1984, a survey of local real estate listings suggested that about 35 units are available for sale or rent within the City of Ladysmith at any given time (NWRPC, 1984, p. 68). Countywide, the number of available units is much higher.

3.13.6 Public Facilities and Service Profile

In order to analyze the public facilities and service requirements for the study area, data was gathered by consulting the City of Ladysmith Comprehensive Plan (NWRPC, 1984). Most public facilities and services in the study area are provided by the City of Ladysmith.

3.13.6.1 Education Facilities

In 1968, the Hawkins School District and the Ladysmith School District merged to form Joint School District 1. The physical arrangement of the district is peculiar because the Flambeau School District lies between the two segments of Joint School District 1.

According to a report by Northwest Regional Planning Commission, the school facilities are in excellent condition. Ladysmith Elementary School was built in 1957 and contains grades K-5. Hawkins Elementary (formerly the Hawkins High School) was built in about 1920 and contains grades 1-8. Ladysmith Junior High School was built in approximately 1905 and contains grades 6-8. The building served as the senior high school until 1969, when a campus-style high school was built at the eastern edge of the city. The high school has some of the finest facilities in the region, including a collegiate-size indoor pool and a 500-seat auditorium.

Elementary and middle school enrollments at joint school District No. 1 have declined over the last three years while high school enrollment has increased slightly. The enrollment at Hawkins School has increased by almost 20 percent over that same time period. Total enrollment at Joint School District 1 has been relatively stable over the last three years at about 1,250 students.

The Flambeau School District, also located in the study area, consists of three elementary schools and one high school. The current enrollment of the Flambeau School District is about 750.

School district representatives estimate that over the last five years, enrollment in the district has further declined by between 50-75 children, or about 10 percent.

The City of Ladysmith also has two parochial schools. One of these is Our Lady of Sorrows which serves children from pre-school through grade 8. This parochial school was constructed in 1958. The total enrollment at Our Lady of Sorrows is approximately 125 this year and has declined from an enrollment of about 150 five years ago. This represents a decrease of about 15 percent in five years.

One other parochial school at Assembly of God Church was established in 1982. Enrollment data for this school was not available.

Study area schools are not overcrowded and, given the declining enrollments at most elementary schools, are not likely to be so.

The Ladysmith area has one independent liberal arts college offering various four-year degree programs. Mount Senario College, founded in 1962, is accredited by the North Central Association of Colleges and Secondary Schools. Its teacher education program is approved by the Wisconsin Department of Public Instruction. The Mount Senario campus comprises 130 acres located along the Flambeau River at the southern end of the Ladysmith city limits.

Mount Senario's current enrollment, including both full-time and part-time students, is about 400 (Delong, 1988). The Ladysmith campus enrollment has been increasing slowly over the last five years.

The regional vocational school serving the Ladysmith area is the Wisconsin Indianhead Technical College (WITC). WITC has a campus in Rice Lake which is located about 40 miles northwest of the City of Ladysmith.

3.13.6.2 Health Facilities and Public Health and Welfare Services

Ladysmith is currently served by eleven doctors, two physicians' assistants, six dentists, and two optometrists. The city also has three pharmacies which adequately serve the medication/drug needs of persons in the city and surrounding area (Pluth, 1989).

3.13.6.2.1 Hospital

Rusk County Hospital is located on the Flambeau River at the southern edge of Ladysmith, adjacent to the west side of Highway 27. This facility was founded as a private hospital and was managed by the Servants of Mary from 1918 until 1973. In 1973, it was purchased by Rusk County. A new, modern hospital

building was completed and occupied in 1975. At that time, a portion of the old St. Mary's was razed, and the rest of the building was renovated to provide space for the Marshfield Clinic-Ladysmith Center with room for nine physicians. The Rusk County Memorial Hospital, Marshfield Clinic-Ladysmith Center, and the Rusk County Nursing Home make it possible to receive complete medical care under one roof. The hospital and nursing home are controlled by the Rusk County Board of Supervisors, which appoints a board of trustees for the hospital.

The hospital houses all facets of medical needs for a city the size of Ladysmith, including 30 medical/surgical beds, one pediatric bed, four special-care beds, six obstetric beds, emergency room, surgery suite, and recovery room. X-ray, laboratory, physical therapy, respiratory therapy, and pharmacy are included in addition to other departments required in the operation of a hospital facility. An ambulance, used for hospital transfers, is located on-site.

Of the hospital's 43 beds, the average daily occupancy in 1988 was 12, or 28 percent occupied. Over the last five years, occupancy has decreased; however, the Director of Nursing believes that the decline has bottomed out and that occupancy rates will begin to stabilize (Pluth, 1989).

3.13.6.2.2 Extended Care Facilities

Two long-term care facilities are located in the Ladysmith area. The Rusk County Nursing Home has a 117-bed capacity and an average daily census, in 1986, of 81 occupants. Ladysmith Nursing Home, licensed for 42 beds, is considered an intermediate-care facility. The average daily census at this facility in 1986 was 33. Therefore, there was an availability of 45 beds in the area during 1986 (WDHSS, 1986, pp. 318-319).

3.13.6.3 Emergency Medical Services

The emergency medical services for Rusk County are administered by the Rusk County Department of Social Services. Ambulance services have been provided by the county since 1969. The county has four ambulances, with one each servicing the City of Ladysmith and the villages of Bruce, Sheldon, and Hawkins. Residents of the Ladysmith and Bruce area use a 911 technique to request emergency medical services, while residents of Sheldon and Hawkins dial the Rusk County Sheriff's Department directly for ambulance dispatch.

All of the ambulance attendants are required to complete Emergency Medical Technician (EMT) training. The attendants provide their services on a part-time, on-call basis. The distance from the Rusk County Hospital to the proposed mine site is about one-half mile.

3.13.6.4 General Government

Rusk County is governed by a 21-member board of supervisors. The chairman of the board of supervisors is selected by the supervisors themselves. The county has no elected chief executive officer such as a county executive.

Rusk County does not have staggered elections for county supervisors and, therefore, the entire 21-member board of supervisors is up for election every two years.

Rusk County is divided into 21 districts with one supervisor representing each district. The district boundaries are based on population estimates, and county districts are reapportioned every ten years following state statutes. The City of Ladysmith, with the largest population base in the county, is represented by five county supervisors.

3.13.6.4.1 Grant Township

The Town of Grant is governed by a three-member town board. The board consists of a town chairman and two supervisors. Other elected officials include a town clerk and town treasurer.

The term for the entire town board and for the clerk and treasurer is two years. All positions are elected from at-large candidates whose names are selected at a pre-election caucus. The town board meets once a month on a regular basis and more frequently as required.

3.13.6.4.2 City of Ladysmith

The City of Ladysmith is governed by a mayor-council form of government assisted by a city administrator. The city is divided into seven wards with each ward represented by one council member.

The city administrator is responsible for all of the day-to-day operations of the city. The mayor, on the other hand, oversees the general activities of all city employees and is more involved in larger policy issues than in daily operations.

The mayor and seven council members are up for re-election every two years. However, the elections are staggered so that odd-numbered ward elections are held one year and even-numbered ward elections are held the following year.

The City Council meets regularly on a bimonthly basis or more frequently if necessary. The city's wards will be reapportioned after the 1990 census in accordance with state statutes.

3.13.6.5 Police Protection

Police protection for the project area is under the jurisdiction of the Rusk County Sheriffs Department. The department is located at 311 Miner Avenue East, Ladysmith, Wisconsin. This building, known as the Rusk County Law Enforcement Center, was constructed in 1985 and also accommodates the City of Ladysmith Police Department.

The Rusk County Sheriffs Department contains 18 full-time employees, including one chief deputy, 16 deputies (one of which is an investigator), and one administrative assistant.

Equipment includes six patrol cars. Patrol officers and the investigator are each assigned a patrol car. All vehicles are equipped with two-way radios, and are part of a computerized dispatch system, which also coordinates all fire and ambulance calls for the county and City of Ladysmith.

The Rusk County Sheriff's Department handles an average of 600 police calls per year.

The nearest municipal police force is the Ladysmith Police Department. The city has two squad cars equipped with two-way radios and a third car used for weekend duty and substitution. The city provides 24-hour coverage with two officers on duty from 9 p.m. to 3 a.m.

3.13.6.6 Fire Protection

Fire protection for the project area would be provided by the Ladysmith Fire Department volunteer department located at 316 West Miner Avenue.

The city has a class six fire insurance rating--which is very good for a small community.

Fire equipment includes six pumper trucks with water storage capacity, one pick-up truck, and one equipment van. In addition, a 1989 Pierce-Dash equipped with a 1,250 gpm pumper and 750-gallon water capacity is on order.

The supply and condition of existing equipment is very adequate and the current volunteer staff is well-trained and highly regarded.

3.13.6.7 Utilities

3.13.6.7.1 Electrical/Telephone/Natural Gas

Local electrical service is provided by the Lake Superior District Power Company. Service lines are distributed around the project area as shown in Figure No. 3.13-2.

Local phone service is provided by Wisconsin Bell. Service lines are distributed around the project site as shown in Figure No. 3.13-3.

There is currently no natural gas service to the project area. The Wisconsin Gas Company provides this service to the City of Ladysmith. The Wisconsin Gas Company is interested in providing natural gas services to areas south of Ladysmith and are planning to install a natural gas mainline along a corridor west of STH 27 south from Ladysmith.

In addition to these utilities, the Wisconsin Central Railroad operates a telegraph line within the track right-of-way.

3.13.6.7.2 Water/Sanitary

The project area is not served by a municipal water system. The nearest water system is the City of Ladysmith utility. The city has constructed one river crossing to serve its industrial park, which is located along Doughty Road east of STH 27 and the Wisconsin Central Railroad tracks.

Based on water usage and required fire flows, the city has water capacity in excess of its current needs. However, the existing system was upgraded with the intention of accommodating future industries in the city's industrial park. High iron and manganese concentrations have caused various system and maintenance and domestic usage problems.

Total water pumped by the city increased from 146,281,050 gallons in 1973 to 151,347,000 gallons in 1987. Daily consumption also increased. In 1987, 129,000,000 gallons were consumed.

Average consumption per capita, based on total water pumped, is 107.84 gallons/day. The proposed mine operation will supply its own water facilities; water usage there should not have any effect on the city system.

The nearest wastewater treatment facility to the project area is in the City of Ladysmith. Secondary wastewater treatment is provided using the trickling filter process. The treatment facility was designed to handle average daily clear water flows of 300,000 gpd in addition to normal daily flows.

The construction of a new wastewater treatment facility (aerated lagoon system) for the City of Ladysmith is scheduled for May 1989. Specific design criteria are as follows:

1. Design population - 4,280 (year 2006)
2. Average daily design flow - 778,000 gpd
3. Peak daily design flow - 1,400,000 gpd
4. Maximum pumping rate - 2,500 gpd

With the completion of a new wastewater treatment facility, the city will have excess capacity. The proposed mine operation will supply its own wastewater facilities, and should not have any direct effect on the city's wastewater treatment facility.

3.13.6.8 Transportation Network

3.13.6.8.1 Streets and Roads

Approximately 1,215 miles of roads and streets are present in the land use study area. STH 27 is the major north-south thoroughfare in the county, including 2.21 miles through the study area. U.S. Highway 8 (USH 8) is the major east-west thoroughfare. Both highways intersect within the city of Ladysmith. County Trunk highways account for 245.9 miles of roadway within Rusk County. Secondary roads, which include town roads, village streets, city streets, and state forest roads, account for 853.8 miles of roadway within the county.

A specific street and road breakdown for the entire Rusk County transportation system is as follows:

Road Classification	Miles	Bridges
State trunk highways	116	29
County trunk highways	246	46
Town roads	780	- 71
City streets	30	
Village streets	35	
State forest roads	8	
TOTAL	1,215	146

Source: Wisconsin Department of Transportation

STH 27 forms the west boundary of the project site and will be the major thoroughfare used by traffic associated with the project site. USH 8, located a little more than one mile north of the project site in the City of Ladysmith, will also be used. The nearest County Trunk Highways include CTH P located one mile south of the project site and CTH G located one and one-half miles east of the project site.

Secondary roads adjacent to the project site are maintained by the Town of Grant and include: Blackberry Lane, which forms the northern border of the project site; Jansen Road, at the southwest corner of the project site; and Doughty Road, a western extension of Blackberry Lane. Kennecott Drive, a 2,000-foot lane, serves the project site from the north off Blackberry lane.

3.13.6.8.2 Highways

Intercity connections to Ladysmith are provided principally by U.S. Highway 8 (USH 8), an east-west primary arterial, and by STH 27, a north-south minor arterial.

STH 27 provides access to the project site. The highway consists of two 15-foot paved lanes (including paved shoulders) with gravel shoulders, on a 100-foot right-of-way. The highway was resurfaced in 1988 in the form of a bituminous concrete mat overlaying the original portland cement concrete. As a result, both the driving surface and rebuilt shoulders are in excellent condition. Sight distances are generally excellent. Physical conditions and traffic volumes are summarized in Table No. 3.13-12. The volumes shown are estimates based on Wisconsin Department of Transportation (DOT) information and on field counts.

According to the standards of the Highway Capacity Manual, the capacity of STH 27 at Level of Service A, which is the highest level of service for state highways, is 330 vehicles per hour.

At the 30th highest hour volume estimate for the highway, 657 vehicles per hour, the highway would operate at Level of Service B. During the normal weekday evening peak hour, the volume reaches only 230 vph, and therefore the highway operates at Level of Service A.

Table No. 3.13-13 summarizes physical and operating conditions on the minor roadways adjacent to the site. All other roadways carry low traffic volumes and are of correspondingly similar design and maintenance standards.

3.13.6.8.3 Railroads

The City of Ladysmith is served by two lines of the Wisconsin Central Limited (formerly Soo Line Railroad). The north-south line passes about three-quarters of a mile east of the eastern boundary of the project site.

The rail line near the site is constructed with 115RE rail at a -0.21 percent gradient (to the north). Based on a field survey in 1988, rail, ties, and bed appear to be in very good condition. Right-of-way width in the project vicinity varies, but is generally 120 feet.

The Wisconsin Central railroad operates two through trains (of about 40 cars each) plus one switch train in each direction daily. Most movements fall into the 5 p.m. to 10 p.m. period. The average speed in the area is 20 miles per hour.

A study of noise associated with railroad operations was performed as part of the baseline study for this report. This study is described in Appendix 3.13-A.

TABLE NO. 3.13-12

Summary of Conditions
STH 27 at Site

Traffic Volumes	
Average Daily Traffic	3,420 vehicles per day
Average Weekday Traffic	3,260 vehicles per day
Weekday P.M. Peak Hour	238 vehicles per hour
30th Highest Hour (Annual)	657 vehicles per day
Truck Component	6.0 percent
Physical Conditions	
Speed Limit	55 miles per hour
Gradient	+0.1 percent (northward)
Sight Distance	3,600 feet to north of proposed main site entrance
	1,800 feet to south of proposed main site entrance

TABLE NO. 3.13-13

Surface Transportation Summary

Roadway	Classification	Average Daily Traffic (vpd)	Surface Width and Type	Surface Condition
STH 27	Minor Arterial	3470 at Bridge 3420 at Site	24′ Bit. Concrete with 3′ Bit. and 7′ gravel shoulders*	Excellent
C.T.H. P	Minor Collector	450	22′ Bit. Concrete without shoulders	Poor
Blackberry Lane	Local Road	<300	20′ Gravel	Poor
Doughty Road	Local Road	650	22′ Bit. Concrete	Fair
Gokey Road	Local Road	<300	22′ Bit. Concrete	Fair
Jensen Lane	Local Road	<300	24′ Gravel	Good
Meadowbrook Lane	Local Road	<300	24′ Gravel	Good
Tiews Road	Local Road	<300	22′ Gravel	Fair

*Six-foot shoulder on bridge

3.13.6.8.4 Airports

The City of Ladysmith is served by the Rusk County Airport, located four miles northeast of the city. The airport has two runways; one is asphalt-surfaced, and the other is of turf construction.

Ladysmith is not served by scheduled air service. Passenger and air cargo service is available at Eau Claire Municipal Airport (60 miles away).

3.13.6.8.5 Public Transportation

The City of Ladysmith has no general intracity public transit service. The closest service points are Cadott (39 miles) and Prentice (42 miles).

3.13.6.9 Library Services

The present staff of the City and County Library consists of a director, a children's librarian, two part-time assistants, and one substitute. The City and County Library serves all of Rusk County, including the Town of Grant and the City of Ladysmith. The library is funded by both the City of Ladysmith (57 percent) and Rusk County (43 percent) (C&CL, 1987).

3.13.6.10 Recreation

Land available for recreation purposes in Rusk County is extensive, due primarily to the 106,281 acres of county and state forest in the county, which are open to the public use. There are also designated park sites located throughout the county which are currently managed by the county.

Water resources contribute to the recreation opportunities provided in Rusk County. The water resources found in Rusk County are summarized as follows:

Trout Streams		121.6 miles
Lakes (named)	75 lakes	7,214 acres
Canoe streams (including the Flambeau River)		109 miles
Boating and water skiing (lakes 200 acres and over)	10 lakes	4,804 acres
Swimming	3 beaches	acres NA

At present the county offers 14 boat landings servicing most major rivers, flowages, and lakes throughout the county (NWRPC, 1975, p. 21).

The closest municipality to the project area offering recreation facilities is the City of Ladysmith, which has a total of 12 sites; these include city-owned parks, private school facilities, public school facilities, and the county fairgrounds. A total of 92.5 acres of land are classified as recreational in the city. Based on the Wisconsin Department of Administration's population estimate for the city of 3,845, a total of 23.9 acres per 1,000 population is provided. Comparison of the city's existing ratio with the National Recreation and Parks Association Standard of 12 acres of recreation land per 1,000 population indicates that there is no deficiency of recreation land in the city.

3.13.7 Fiscal Profile

The following profile of fiscal conditions covers the condition of the state of Wisconsin compared to the jurisdictions in the study area. Total revenues for each level of government have been analyzed and the net fiscal balance for each jurisdiction has been calculated. Sources of revenue for local jurisdictions are presented.

At the end of the fiscal year 1986, the state showed a surplus of $280 million, while revenues totaled 14.2 billion (WDOA, 1988 p. 792). The largest single revenue source for the state was income taxes on individuals and corporations.

The largest single source of revenues for local jurisdictions within the local study area was intergovernmental transfers from the state. Taxes were the second major source of revenue. Property taxes and state transfers were the major revenue sources for local school districts.

3.13.7.1 State Revenue and Net Fiscal Balance

During fiscal year 1985-1986, which began July 1, 1985, the Wisconsin state government received $14.2 billion in revenue from all sources and spent $10.5 billion for a $3.7 billion surplus (Table No. 3.13-14).

Approximately 55 percent of all revenues were to the General Fund and 74 percent of all expenditures were from the General Fund, which is the state's operating fund for nondedicated revenues. Segregated funds, or revenues dedicated by law for specific expenditure purposes, accounted for the remaining 45 percent of revenues and 26 percent of expenditures.

Between fiscal year 1978 and fiscal year 1986, total state revenues increased by 131.8 percent, and total expenditures increased by 93.6 percent. At the end of fiscal year 1986, the state showed a surplus of $279 million. The most recent deficit occurred in fiscal year 1983.

TABLE 3.13-14

State of Wisconsin Revenues and Expenditures, FY1978 and FY1986
($ millions)

	Revenues		
	FY1977-78	FY1985-86	Percent Change 1978-1986
General Fund	$ 4,240.3	$ 7,798.4	+ 83.9%
Segregated Funds	1,876.0	6,380.6	+240.1%
Total, All Funds	6,116.3	14,179.0	+131.8%

	Expenditures		
	FY1977-78	FY1985-86	Percent Change 1978-1986
General Fund	$ 3,994.2	$ 7,757.1	+ 94.2%
Segregated Funds	1,446.3	2,774.7	+ 91.8%
Total, All Funds	5,440.5	10,531.7	+ 93.6%

Source: WDOA, 1979-80 and 1987-88. State of Wisconsin Blue Book.

Own-source revenues including income, sales, excise, utility, inheritance, estate and gift taxes, are the major source of the state's revenues according to the Wisconsin Blue Book (WDOA, 1988). In fiscal year 1986, own-source revenues accounted for 85.4 percent of the state's total revenue. Federal aid comprised the remaining 14.6 percent of total revenues. Between 1978 and 1986, the source of revenues which showed the greatest increase was local sources, growing from 80.8 percent of revenues in 1978 to 85.4 percent of revenues in fiscal year 1986.

Federal aid received by the state increased only one half as much as own-source resources. This indicates Wisconsin's decreasing reliance on federal aids.

3.13.7.1.1 Income Taxes

Individual and corporate income taxes provided 55.4 percent of total state tax revenues in fiscal year 1986 (Table No. 3.13-15).

A schedule of income taxes for individuals and businesses for 1988 is shown in Table No. 3.13-16.

3.13.7.1.2 Sales and Excise Taxes

Revenues from sales and excise taxes accounted for 32.9 percent of the state tax revenues in fiscal year 1986 (WDOA, 1988, p. 781). The most important of these taxes is the general sales and use tax; this tax accounted for 90.2 percent of all sales and excise tax revenue and 30 percent of total state tax revenues in 1986. According to the State Department of Revenue, the state sales tax was increased to 5 percent in 1983. Excise taxes are imposed on cigarettes, other tobacco products and alcoholic beverages.

3.13.7.1.3 Public Utility Taxes

Public utility taxes accounted for 5.0 percent of state taxes in 1986 (WDOA, 1988, p. 781). Public utility taxes comprise the net utility tax collections from railroads and related companies, rural electric cooperation associations, and electric, gas, and pipeline companies allocated to each taxation district.

3.13.7.1.4 Mining Taxes

The State of Wisconsin imposes a tax on mineral extraction called a "net proceeds tax." The tax is based on revenue generated from the mine, less applicable deductions. Kennecott has made certain guarantees regarding payments to local communities that are addressed in Chapter 4.0.

TABLE 3.13-15

State of Wisconsin Tax Revenues, FY 1986
($ millions)

Type of Tax	Total Taxes Less Refunds	Percent of Total State Taxes
General fund		
Income	$ 2,646.7	50.9
Sales and excise	1,710.3	32.9
Public Utility	262.3	5.0
Other	162.4	3.1
TOTAL	$ 4,781.7	91.9
Other Funds		
Transportation Fund	$ 397.5	7.6
Conservation Fund and Patient's Compensation Panel	25.3	.5
TOTAL	422.8	8 1
TOTAL STATE TAXES	5,204.5	100.0

Source: WDOA, 1987-88. State of Wisconsin Blue Book, p. 781.

TABLE 3.13-16

State of Wisconsin
Income Tax Schedules
1988 Tax Rates

Taxable Income	Rate
Single Taxpayer	
0-$7,500	4.9%
$7,501-$15,000	$367.50+ 6.55% of the amount over $7,500
$15,001 +	$858.75 + 6.93% of the amount over $15,000
Married Filing Jointly	
0-$10,000	4.9%
$10,001-$20,000	$490.00 + 6.55% of the amount over $10,000
$20,001 +	$1,145.00 + 6.93% of the amount over $20,000
Married Filing Separately	
0-$5,000	4.9%
$5,001-$10,000	$245.00 + 6.55% of the amount over $10,000
$10,001 +	$572,50 + 6.93% of the amount over $10,000
Corporate	
Any taxable income	7.9%

Source: Wisconsin Department of Revenue, 1988. Personal communications.

3.13.7.1.5 Waste Management and Groundwater Repair Funds

The Wisconsin Department of Natural Resources (WDNR) collects fees from waste haulers to finance a fund that is set aside for the clean-up of environmental problems associated with groundwater.

3.13.7.1.6 Other Taxes

General Fund taxes from other sources accounted in 1986 for 3.1 percent of tax revenues, or about $81 million (WDOA, 1988, p. 781). These other taxes include inheritance, estate, and gift taxes, and other miscellaneous taxes on items such as insurance premiums, bingo games, and forest crops.

3.13.7.1.7 Other Revenues

There are two major types of dedicated revenues, the Transportation Fund and the Conservation Fund. The Transportation Fund is supported by the motor fuel tax, vehicle registrations, and other fees. The motor fuel tax provided $388.5 million in revenue in fiscal year 1986 (WDOA, 1988, p. 781). The state tax on gasoline was $.20 per gallon in 1988.

The other major dedicated revenue source is the Conservation Fund, which is dedicated to reforestation and conservation of the state's natural resources. Conservation Fund revenues come from taxes on forest crop withdrawals and a property tax on forest land.

3.13.7.2 Local Revenues and Net Fiscal Balance

3.13.7.2.1 Local Revenues

According to the Wisconsin Department of Revenue (1989), in 1987 the study area collected almost $10 million in revenues. The largest amount of revenues collected by the local governments are categorized as intergovernmental transfers.

Almost 75 percent of the town of Grant's revenues are from intergovernmental transfers, as are just over 60 percent of Rusk County's revenues. Only about one-half of the City of Ladysmith's revenues are from intergovernmental revenues.

The next largest revenue category in the study area is taxes. Local government taxes are primarily made up of property taxes and contribute to about 30 percent of local government revenues. Miscellaneous revenues make up the remainder of local government income. Over 20 percent of the City of Ladysmith's revenues are from miscellaneous services.

3.13.7.2.2 Local Taxes

According to the State Department of Revenue, local government jurisdictions receive revenue from three major sources: 1) taxes, 2) intergovernmental transfers from the state and federal governments and 3) miscellaneous fees and charges.

Rusk County collects almost $9 million in total property taxes while the Town of Grant collects about $500,000 (Wisconsin Department of Revenue, 1989 p. I-7).

In April 1987 Rusk County imposed a county sales tax of one-half of one percent. Rusk County generated about $234,000 in revenue over the first nine months during which the sales tax was in effect (Wisconsin Department of Revenue, 1989, p. 9). Almost 60 percent of the county sales tax was attributed to sales in the retail trade category. The next-largest contribution to the county sales tax was from sales of electrical, gas, and sanitary services.

The full valuation of property in the study area amounted to just under $300 million in 1988. The City of Ladysmith accounted for 21.6 percent of the full value in Rusk County. The full valuation of property and the full and effective value rates for 1987 are shown below.

Study Area	Aggregate Full Value	Per Capita Full Value
Rusk County	$284,304,720	$18,394
City of Ladysmith	61,319,390	15,989
Grant Township	15,340,400	16,513

Source: Wisconsin Department of Revenue, 1988, pp. 21, 22, 73-75.

The majority of the value in all of the jurisdictions was in the residential property category.

Intergovernmental Transfers

Intergovernmental transfers include federal revenue sharing, federal aids, state-shared taxes, highway aids, other state aids, and aids received from other local governments.

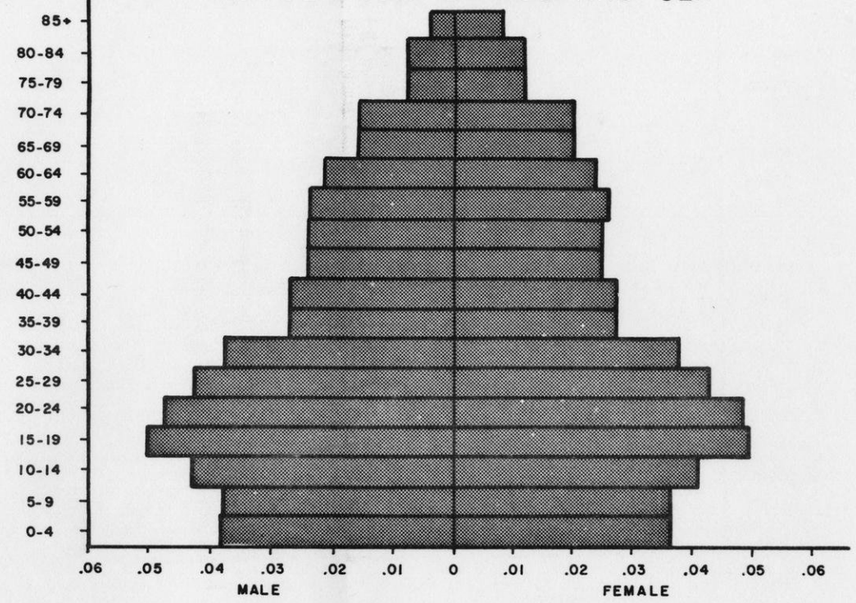
According to the Department of Revenue, Rusk County received over $3.5 million in intergovernmental revenues in 1987, the City of Ladysmith received about $800,000, and the Town of Grant received about $100,000 in intergovernmental revenues (Wisconsin Department of Revenue, 1989, pp. I-7, II-24, IV-124).

3.13.7.2.3 Local Fiscal Balance

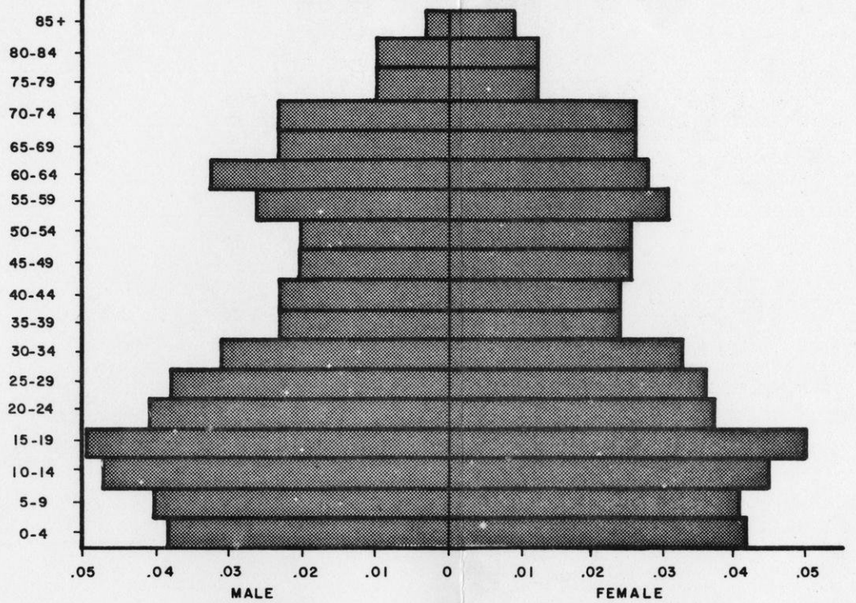
In 1987, study area governments collected just over $9.5 million in revenues for operations. Total expenditures for study area governments amounted to just under $8.7 million. Together, these local governments had a positive net balance of about $1 million, or almost 10 percent of total revenues. Only the Town of Grant had a negative fiscal balance in 1987 of about $500,000, according to the Department of Revenue (Wisconsin Department of Revenue, 1989, pp. I-7, II-24, IV-124).

Figures for Section 3.13

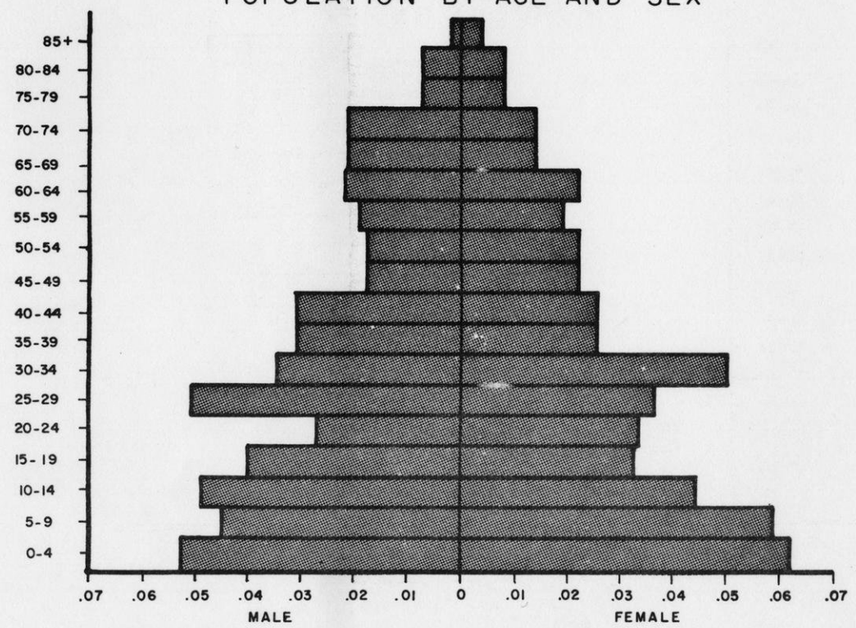
STATE OF WISCONSIN
POPULATION BY AGE AND SEX



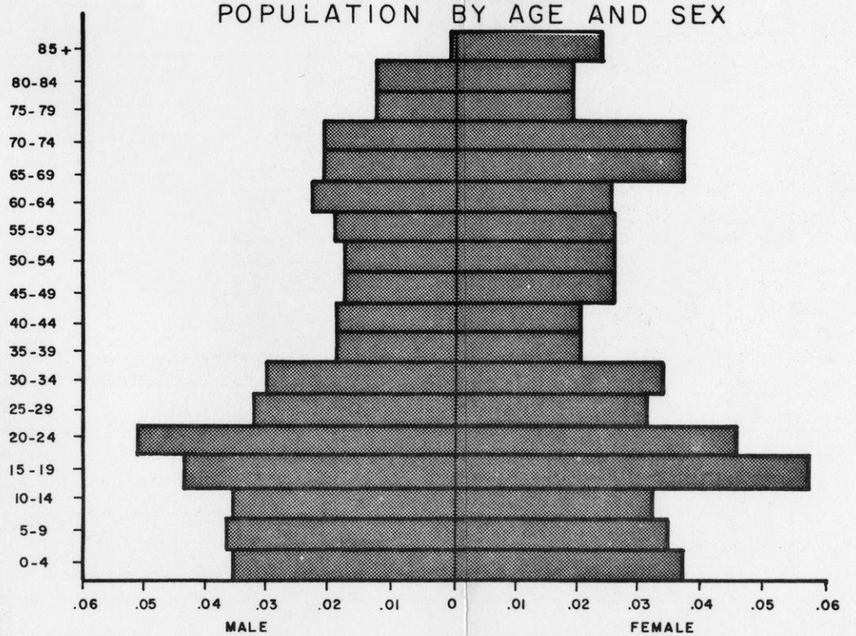
RUSK COUNTY
POPULATION BY AGE AND SEX



TOWN OF GRANT
POPULATION BY AGE AND SEX



CITY OF LADYSMITH
POPULATION BY AGE AND SEX



REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.

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

	BY	DATE
DESIGN		
DRAWN	SJL	FEB.89
CH'K'D	TJW	3/89
DES. ENG'R		
SECT ENG'R		

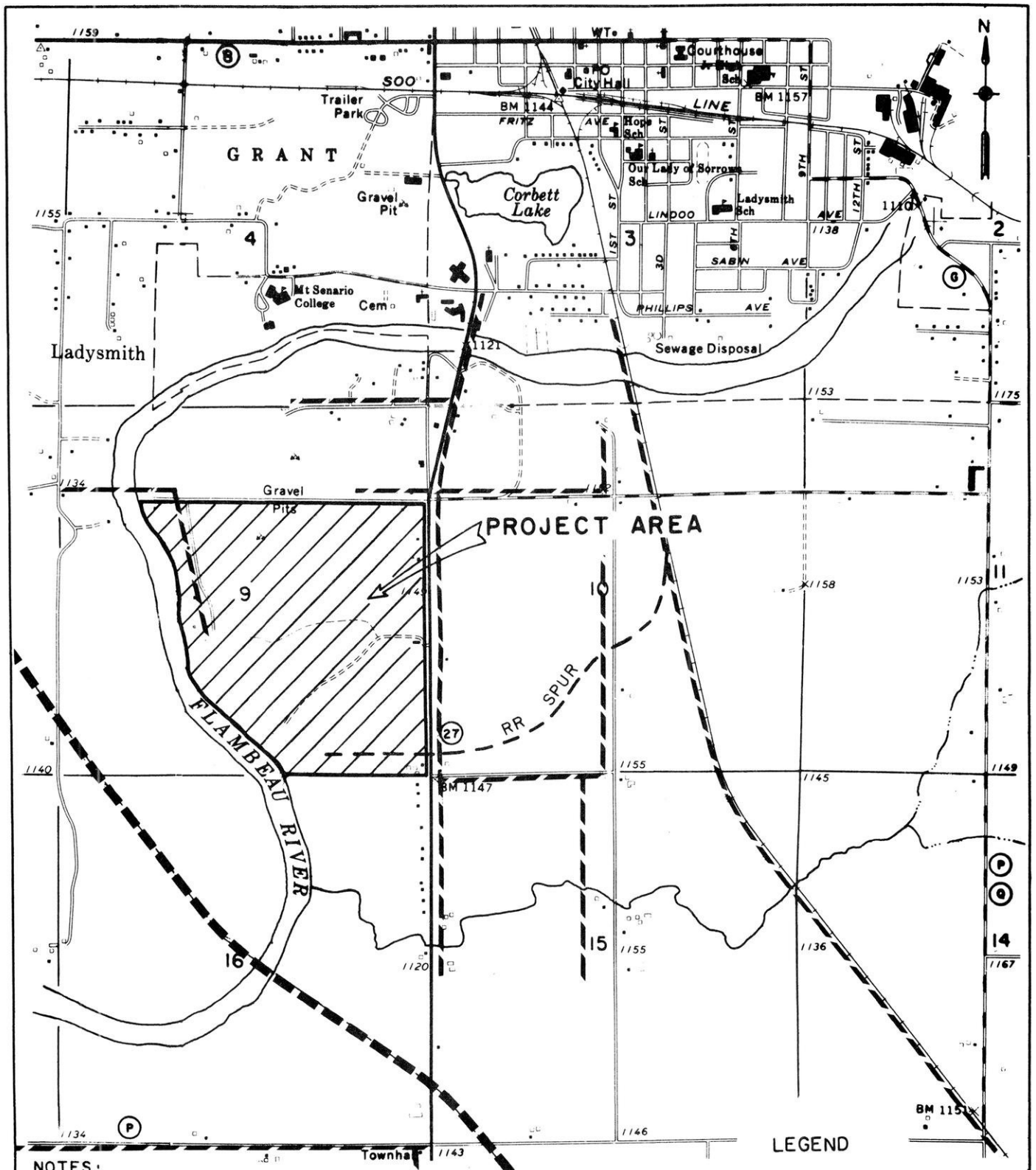
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 3.13-1
POPULATION
BY AGE AND SEX

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



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

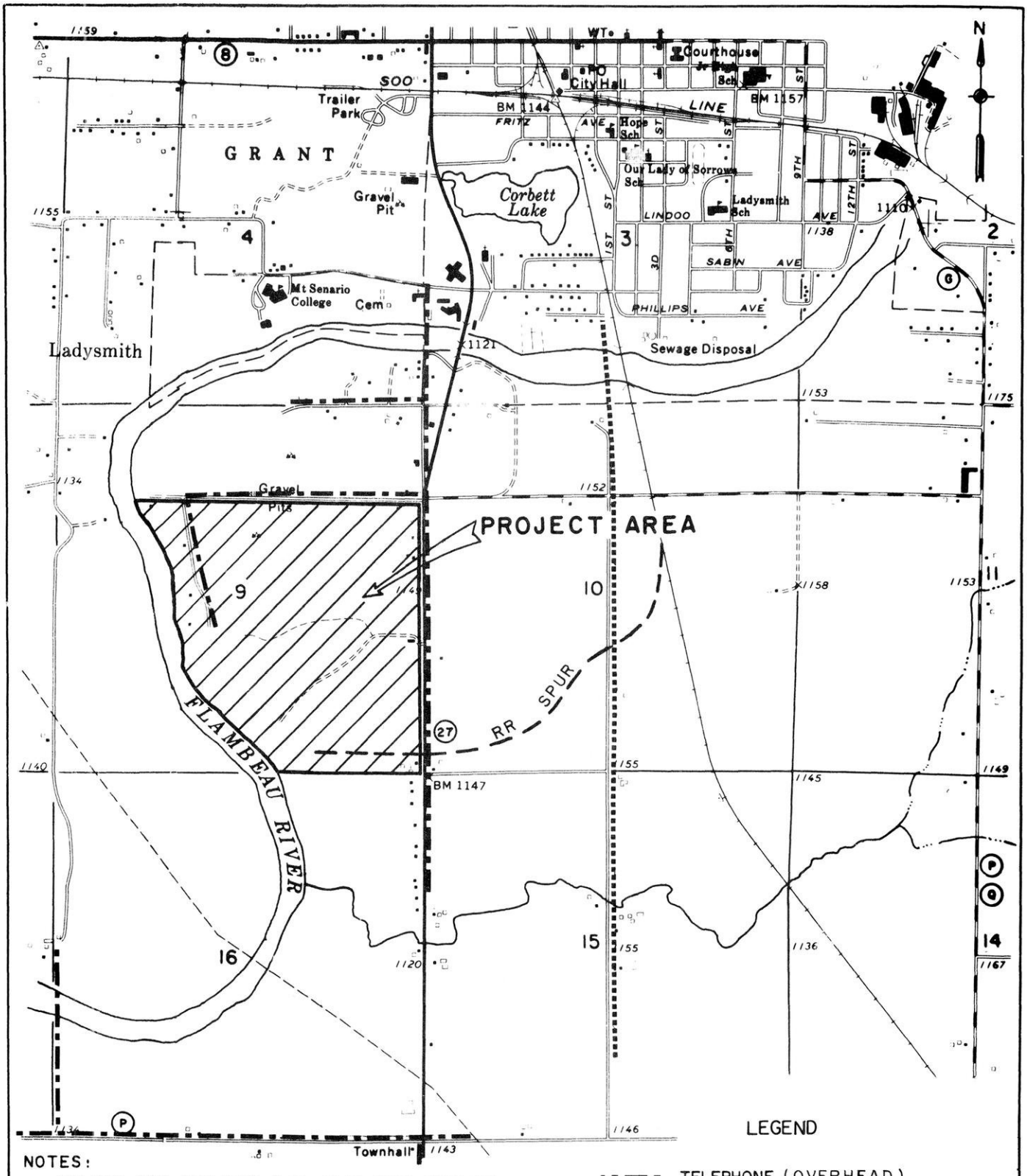
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GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	MWB	1/89
	CHECKED BY	TJW	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

FIGURE NO. 3.13-2
PETROLEUM PIPELINE / ELECTRICAL ROUTING

Job No	Dwg No	REV



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

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KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 3.13-3
TELEPHONE ROUTING

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	MWB	1/89
	CHECKED BY	TJW	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

Job No	Dwg No	REV

4.0 ENVIRONMENTAL IMPACTS

4.1 Introduction

The following section presents the environmental impacts of the preferred alternative and other alternatives identified for further study in Section 2.8 of this Environmental Impact Report. These alternatives are:

1. No Action alternative.

2. Preferred alternative as described in detail in the Mine Permit Application and referenced documents.

3. Alternatives to the Preferred Alternative.

    a. In-pit storage of the Type I material (excluding overburden) and all of the Type II material.

    b. Placement of the Type I material in Section 10, approximately 2,000 feet to the east of the proposed open pit.

    c. Two alternative locations for the topsoil stockpile, both within Section 9.

    d. Truck versus rail haulage to mainline track.

    e. Settling pond siting.

Section 4.0 is organized to address each alternative.

4.2 No Action Alternative

The alternative of not proceeding with the project will allow the current natural and cultural processes to continue assuming no other significant change occurs. The following current environmental resources and systems including trends are not expected to change in character or quality in the next decade. These include:

Historical and Archaeological Resources
Climatology, Meterology, and Air Quality
Geology
Groundwater
Surface Water and Bottom Sediments
Aquatic Biology
Terrestrial Biology
Ambient Noise
Aesthetics

Impacts of the no action alternative on land use can be evaluated under two scenarios: 1) Kennecott maintains ownership

of the project area and leases the property, and, 2) Kennecott sells the project area land with mineral rights.

1. Kennecott maintains ownership of the project area and leases the property.

   Under this scenario, existing land use within the project area will probably experience little if any change. The existing homes owned by Kennecott in the project area would continue to be leased as single-family residences. Lands being actively farmed will continue to be leased for agricultural purposes in the future.

2. Kennecott sells the project area land with mineral rights.

   Under this scenario, the significance of any major land use change within the project area largely depends upon who purchases the Kennecott property. For example, if the property is purchased by another mining company, the potential for another mine proposal is possible. Such a proposal could include an expanded project with processing facilities and a tailings storage facility. If the Kennecott property is purchased by private individuals, there is also a chance that portions of the land containing saw timber or pulp value could be cut. Although timber cutting is known to provide improved wildlife habitat, it presents a significant change to the appearance of the land.

The no action alternative would have a negative economic impact on Rusk County, the Town of Grant, and the City of Ladysmith in the form of lost potential revenues and the loss of employment opportunities.

In terms of employment, at least 41 residents in Rusk County will not have had an opportunity for direct employment by Kennecott over the nine-year life of the proposed project. Nor would approximately 19,000 manhours of construction work for outside contractors occur. Employment benefits of at least 38 secondary jobs would also be lost.

The fiscal impact on the study area and the state of Wisconsin without the proposed mine project would be the loss of the economic benefit of the project. Primary economic benefits that will not be realized under the no action alternative include potential revenue from property, income, sales and excise taxes. Of these potential losses, approximately $2,400,000 to $4,400,000 (based on fourth quarter 1988 dollars) could be lost to the local governments, assuming the project is completed in accordance with the terms of the local agreement.

With the above-mentioned exceptions, the socioeconomic conditions and trends will remain as described in Section 3.13.

4.3 Preferred Alternative

The following discussion addresses the impacts of the preferred alternative. Those environmental resources and systems which will not be affected will not be discussed.

4.3.1 Air Quality

4.3.1.1 Planned Emission Sources

Processes and operations that could be potential sources of air emissions include:

- Exhaust gases from natural gas-fired space heaters located in the mine buildings.
- Fugitive lime releases occurring as the silo at the wastewater treatment plant is filled.
- Fugitive diesel fuel vapor release at the storage tank.
- Exhaust from the diesel-powered vehicles operating in the mine site.
- Fugitive particulate generated as a result of mining activities.

4.3.2 Air Quality Impacts

Air quality impacts considered included: carbon monoxide, hydrocarbons, oxides of nitrogen (NO_x), aldehydes, and oxides of sulfur (SO_x) for the area surrounding the mine site.

Potential worst case emissions for the mine operations excluding the rail spur in tons per year are as follows:

	TSP	CO	HC	NO_x	ALDEHYDES	SO_x
Construction	45	37	6	105	3	11
Operations						
Year 1	31	12	2	36	1	4
2	31	12	2	36	1	4
3	31	13	3	38	1	4
4	30	13	3	38	1	4
5	24	12	2	36	1	4
6	28	10	2	30	1	3
Reclamations						
Year 1	53	42	7	117	3	13
Year 2	40	42	7	117	3	13

These figures assume the truck activity and mining operations as described in the Mine Permit Application. Emissions for hauling of ore to the railroad are discussed in Section 4.4.4. Maximum TSP generation for the entire project area will be 53 tons per year which is well under the 250-ton per year rate at which the Clean Air Act would require a Prevention of Significant Deterioration review and permit. The emission values projected for the project will not significantly add to the ambient concentrations nor will any ambient air standards be exceeded with the application of routine and proven emission control measures because the site is in an attainment area.

4.3.3 Geology

This section refers to geology which was discussed in Section 3.5. In general, the mass balance for topsoil and subsoil will not be significantly impacted. Landforms will be significantly altered during the operation but this will be a temporary feature as the project area will be returned to its approximate original contour.

The preferred alternative located within the project area, Section 9, will temporarily affect the soils and landforms in an area of about 40 acres in the area of the Type I stockpile, about 27 acres in the area of the Type II stockpile, and about 7 acres in the area of the topsoil stockpile. Support facilities will affect about 29.5 acres. Soils, landforms, and geologic strata to an approximate depth of 225 feet will be affected over an area of about 32 acres that will be disturbed to excavate the open pit. Sand and gravel for construction will be obtained from the existing inactive gravel pit and off-site sources. About 140,000 cubic yards of material suitable for roadbase and drainage blanket for the liner of the Type II stockpile will be brought from an unidentified off-site source.

4.3.3.1 Soils

Clearing and grubbing will result in some loss of soil. Salvageable topsoil will be placed in a stockpile for use during reclamation. Soil structure and humus material will receive some degradation during removal and storage in the stockpile but will still be suitable for final site reclamation. Fertilization and liming will improve the soil capability to support vegetation and to replace soil microorganisms. Although minimized by use of erosion control techniques such as revegetation of the topsoil stockpile, sediment traps, straw-bale filters and siltation basins, minor amounts of soil will be lost from the open pit, and from the waste rock and soil stockpile areas by erosional processes.

4.3.3.2 Landforms

Construction and operations activities will temporarily impact existing landforms in the Type I and Type II stockpile areas,

the open pit, and the area of the topsoil stockpile. The land surfaces in these areas consist of broad areas that are gently rolling to nearly flat, or nearly flat with moderate relief due to dissection. The project area contains no unique landforms.

After removal and stockpiling of topsoil, the Type I, and Type II stockpile areas will be graded and berms will be constructed. Excavated material will be moved to the Type I and Type II stockpiles. A berm will be constructed between the river and the southwest end of the pit. The pit will be excavated to approximately 225 feet. These landform alterations will be temporary, however, as long-term effects will be minimized by reclamation consisting of using the stockpiled material and berm material to backfill the pit. The backfilled material will be placed on the floor of the working bench, dozed, and compacted by repeated passes with the dozer, trucks, and grader to minimize subsidence. Swell and compaction factors indicate that sufficient material is available for backfilling the open pit to its approximate original contour. If additional material is required for backfilling, it would be obtained from the abandoned gravel pit. For further details on backfilling, the reader is referred to the Mining Permit Application. Any excess overburden material will be used to backfill the abandoned gravel pit. The abandoned gravel pit area will also be graded and contoured to more gentle slopes. Because the original landforms are generally broad, low-relief areas, backfilling and grading should provide effective restoration to approximate premining conditions.

Construction impacts to the landforms along the route of the railroad spur line will be minimal as this is originally an area of low relief. Therefore, extensive cutting and filling will not be necessary.

During reclamation, railroad ties and rails, ballast and base material will be removed. Any alteration will be temporary as this area will also be graded to original surface contours during reclamation of the spur line unless it is left in place at the request of local government officials in accordance with the Local Agreement.

4.3.3.3 Mineral Resources

Till, sandstone, and saprolite will be excavated from the open pit. Although some of the excavated material will be useful in berm and road construction on the site, the materials do not have sufficient quantity to have any significant economic value and are not considered as a mineral resource.

The structural and stratigraphic integrity of the Quaternary sediments and the Cambrian sandstone will be lost. The stratigraphic sequence is, however, typical of the region, does not have any unique scientific significance and, therefore, there are essentially no short- or long-term adverse impacts.

The major impact of the mining operation is that the known economic mineral reserve of the deposit that is obtainable by open pit mining will be removed. Extraction of the ore results in a local mineral reserve becoming a long-term useable resource to the nation. Copper is one of the more useful and long-term industrial metals as about 23 percent of the domestic copper is recycled. For example, copper can remain in use to society sometimes for more than a century through continued use as electric wiring or through recycling.

Although not included as part of this project, the proposed project plans do not preclude the recovery of the lower grade mineralization that occurs below the bottom of the pit as part of a future project.

4.3.4 Groundwater

4.3.4.1 Impacts on Groundwater Levels

Impacts on groundwater levels due to the presence of an open pit have been anticipated and predicted by Kennecott since the time the Flambeau project was first contemplated in the early 1970s. Predictions of groundwater level changes that would result in a cone of depression around the open pit are closely related to predictions of groundwater inflows to the pit. Three major studies to predict one or both of these items have been made since the 1970s.

4.3.4.1.1 Finite Element Modeling

For the 1976 EIS and Mining Permit Application, pit inflows were modeled using finite element methods. The pit was divided into three representative cross sections through the river pillar on the southwest side of the pit, through the glacial-fluvial deposits on the northwest side of the pit, and through the glacial till in the middle of the pit.

Maximum instantaneous pit inflow rates were then calculated by multiplying the estimated inflow through the cross section by a length of the pit perimeter. The maximum instantaneous short-term groundwater inflow to the pit calculated from the model was 1620 gallons/minute.

However, both the EIS and the Mining Permit Application went on to say, "experience with other mine pits has shown a rapid initial inflow into a pit during excavation followed by great reduction in flows of up to 80 percent to 90 percent of the initial inflow". Based on this, the long-term estimate of groundwater flow to the pit after flows stabilized was 320 gallons/minute, which is 20 percent of the 1976 calculated theoretical instantaneous figure.

4.3.4.1.2 King Hydrogeologic and Groundwater Modeling Study

King (1983) used hydrogeologic and hydrologic information from the initial investigations to prepare a Ph.D. dissertation which discussed the following project site conditions:

1. Project site surficial and bedrock geology.

2. Surface water hydrology.

3. Hydrologic budget.

4. Hydrogeology.

Based on his interpretations of these conditions, and using a publicly available, documented code from the U.S. Geological Survey, (Trescott, et. al. 1980) King prepared a two-dimensional, finite difference groundwater flow model. The model was calibrated to average water table elevations in the glacial overburden and sandstone units. A high and low range of expected recharge was applied to the model to obtain the range of calibrated permeabilities. The Precambrian unit was considered to be the underlying boundary condition due to its low permeability. Constant-head boundary conditions were assumed around the perimeter of the model, including the Flambeau River to the north and west of the project area. The model was used to estimate groundwater drawdown and open pit seepage rates during the project.

The modeling effort concluded the following:

1. Groundwater withdrawal during pit excavation would induce groundwater infiltration in the overburden eastward from the Flambeau River.

2. The eastward expansion of the cone of depression would be effectively halted by the till on the eastern half of the project site.

3. Steady state groundwater seepage rates into the final open pit would range from 31 to 45 gpm.

4.3.4.1.3 1989 Pit Inflow Prediction

The data collected in 1987 and 1988 during the current investigation showed that, contrary to the assumptions made by King in 1983 and Kennecott in 1976, the permeability of the Precambrian in the vicinity of the ore body and the river pillar is sufficient to significantly contribute to the overall estimate of pit inflow.

Calculations of pit inflow were made using a two-dimensional version of the PLASM digital model. The details of this

methodology, the computations and the results are contained in Appendix 4.3-A.

These calculations show the maximum steady-state inflow to the pit will be 294 gallons/minute when the pit is at its largest areal extent and depth. Of this, it was computed that 258.5 gallons/minute would be entering the pit through the Precambrian in the river pillar.

The remaining flow into the pit, 33.5 gallons/minute, would come from the sandstone (14.5 gallons/minute) and Precambrian rock not in the river pillar (21.0 gallons/minute). No flow was predicted to come from the till overlying the sandstone since it will either be dewatered or be drained by the underlying sandstone.

The computed 258.5 gallons/minute coming through the river pillar would ultimately be derived from the Flambeau River. However, average flows in the river as it passes the site are on the order of 800,000 gallons/minute. Therefore, since 258.5 gallons/minute is only 0.03% of 800,000 gallons/minute, and since the 258.5 gallons/minute of pit inflow will ultimately be returned to the river after passing through the water treatment plant, it is concluded that pit inflows will have no impact on the flow regime of the Flambeau River.

4.3.4.1.4 Drawdown Prediction

The current estimate of pit inflow exclusive of the river pillar, 35.5 gallons/minute, falls near the lower end of the range of 31 to 45 gallons/minute predicted by King. Thu,, predictions of drawdown based on King's 1983 model are considered to be overestimates of possible impacts of the current mine plan. This is consitent with the differences between the current plan and the 1975 plan that King modeled. The 1975 mine plan included an open pit 55 acres in size, 285 feet deep, and in operation for 12 years. At the end of mining, the pit was going to be allowed to fill with groundwater, leaving a lake behind as the reclamation method. In contrast, the present plan calls for a pit 40 percent smaller (32 acres), 20 percent shallower (225 feet) and in operation for less than half the time (five years). At the end of mining, the pit will be completely backfilled with waste rock and overburden. Therefore, the current mine plan places much less stress on the groundwater system than the mine plan modeled by King and should result in less impact to the water levels.

Impacts on Private Wells

The 1983 model drawdowns are shown on Figure No. 4.3-1. In areas near the pit containing private wells (these are the closest wells to the pit and potentially would be the most affected by pit dewatering), the only drawdowns would occur at the Kennecott-owned residences in the vicinity of STH 27,

between Blackberry Lane and Jansen Road. In this area, drawdowns from the 1975 mine plan could have ranged from three to six feet. Given the smaller current mine plan, its impact will be even less. In any case, such drawdowns are no more than the normal seasonal fluctuatios in water level.

In all other private well areas, the 1983 model predicted no drawdowns greater than one foot, a no-impact condition.

Impacts on Wetlands

The 1983 model predicted some drawdown beneath in wetland areas (Figure No. 4.3-1). The only significant drawdown predicted was beneath Wetland Area 1, northwest of the proposed open pit, and beneath Wetland Areas 3c, 5c, and 10a to the east of the proposed open pit. The maximum model-predicted drawdown beneath the southern portions of Wetland Area 1 is ten feet. Maximum model-predicted drawdown beneath the northern part of that portion of Wetland Area 5c which will not be filled during facility construction is predicted to be four feet. Maximum drawdown beneath Wetland Area 3c and the west side of Wetland Area 10a is predicted to be ten feet. In the center of Wetland Area 10a, approximately 1,500 feet to the east of STH 27, the 1983 model predicted drawdowns on the order of three feet.

The impacts of drawdowns predicted by the 1983 model on groundwater levels beneath the wetlands are predicted to be insignificant for two reasons. First, the fact that the current mine plan entails a smaller, shallower open pit in existence for a shorter time period, means that the drawdown cone for the current mine plan will be smaller than what King predicted.

Second, field data indicate that water in the wetlands is hydraulically isolated from the water table. In Wetland Area 1 this is demonstrated by the existence of downward hydraulic gradients greater than 0.5 feet per foot. This very high vertical gradient is evidence of the presence of low permeability materials immediately beneath the wetland which essentially separate the wetland water from the groundwater. Wetland Area 1 is supported chiefly by spring flow along its eastern edge. According to the 1983 model, the spring zone may be affected by the drawdown cone. However, if this situation occurs, the impact will be mitigated by providing an alternative source of clean water to the wetland to sustain its various functions.

The hydraulic isolation of Wetland Areas 3c, 5c, and 10a, to the southeast and east of the proposed open pit, was discussed in detail in Section 3.6.3.2.1. Existing water table elevations are deeper than four feet beneath the centers of these Wetlands and are deeper than ten feet around the peripheries of the wetlands. This shows that, although the wetlands do provide

limited recharge to the underlying groundwater flow system, they are not directly connected to it. Therefore, drawdowns of the water table beneath Wetland Areas 3c, 5c, and 10a (if such drawdowns occur) will not cause changes in the water regime of the wetlands.

Post Reclamation Impacts

The 1983 model did not simulate the post-reclamation conditions contemplated by the current mine plan, i.e., a backfilled reclaimed pit. However, the current reclamation plan involves placing waste rock and overburden back into the pit in the same order that it was removed, so that the land contours and vegetation will be restored in a manner similar to the existing grades. Although changes in topography can cause changes in underlying flow systems, no such topographic changes will occur under the current reclamation plan. A hydrogeologic change will be the new, possibly higher permeabilities that will be present in the form of backfilled pit material. However, the backfilled pit will be only a higher permeability lens contained largely within a low permeability matrix, the Precambrian rock. No major high permeability connection will exist between the pit and any sensitive receptor. Therefore, the post-reclamation impact on groundwater levels will be minimal and the groundwater flow system will return a configuration similar to the existing condition.

4.3.4.2 Impacts on Groundwater Quality

No significant groundwater quality impacts are predicted under the proposed mining and reclamation plans. Potential hypothetical impacts during mining are those associated with the Type I waste stockpile and the sedimentation basins. These sites will be unlined, and seepage emanating from them may reach the water table. The Type II waste stockpile and the ore crushing and loading areas will be underlain with an impermeable synthetic liner, preventing any seepage to the water table. No seepage from the open pit will occur since it will act as a sump, collecting groundwater during the mining operation. The water collected in the pit will be treated and then discharged to surface water.

The only potential hypothetical groundwater quality impact in the post-closure period is within and near the reclaimed pit, since the reclamation plan involves placing the overburden and waste rock back into the pit and regrading the site to a condition similar to its preconstruction state. Transferring the waste rock from the stockpile to the pit may expose fresh surfaces to weathering. Sulfide mineralization thus exposed may then cause some metals to be leached to the groundwater in low concentrations, but below Primary Drinking Water Standards (see Section 3.6.2.2.4).

4.3.4.2.1 Type I Stockpile

The waste characterization studies (see Section 3.5.6) show that leachate from the Type I stockpile will not exceed any of the Primary Drinking Water Standards. The waste may initially leach iron up to 80 mg/L, manganese up to 25 mg/L, and copper up to 14 mg/L. These concentrations, however, will drop by as much as two orders of magnitude during the six months following the pre-stripping of overburden and the placement of the overburden in the Type I stockpile. The waste characterization studies further show that, regardless of concentration, the leachate will be further reduced because the glacial till underlying the Type I stockpile has a significant sorption capacity for both iron and copper (Table No. 3.5-27 in Section 3.5.6).

Existing concentrations of iron and copper in the groundwater beneath the Type I stockpile location are characterized by the water quality measured in well nests 1002, 1003, and 1006, which are downgradient, side gradient and upgradient, respectively, of the Type I stockpile location. Iron was not detected in samples collected from shallow wells MW-1002 and MW-1006G during the course of the baseline study. Iron in samples from MW-1003, a water table well, ranged from nondetectable to 0.35 mg/L and averaged 0.25 mg/L during the course of the study. Copper was detected three times each at wells MW-1002 and MW-1003, averaging 0.013 mg/L at each well. Copper was detected twice at well MW-1006, averaging 0.012 mg/L.

Much of the iron and copper leached from the Type I stockpile will be sorbed by the till between the pile bottom and the water table. By the time the leached water percolates through the unsaturated zone and reaches the water table, it will have concentrations of these metals similar to that of the background groundwater. Although manganese was not modeled during the waste characterization study, it should behave in a manner similar to iron, since both metals participate in redox processes in weathering environments. The likely leached concentrations of manganese will be considerably below those of established drinking water standards. Therefore, the Type I waste stockpile should have no significant impact on the underlying groundwater quality.

4.3.4.2.2 Settling Ponds

There should be no impact to groundwater quality from the settling ponds because the material underlying the ponds will completely sorb any iron and copper that may percolate toward the water table. In a manner similar to the Type I storage pile, the till underlying the settling ponds will readily sorb iron and copper, thereby reducing the concentrations of these elements in the leachate reaching the water table to below background levels. Since the settling ponds will be used to capture surface runoff from the Type I storage pile, leachate from the pile during storm events will be significantly diluted.

4.3.4.2.3 Backfilling of the Open Pit

Potential impacts of the reclaimed pit on downgradient groundwater are influenced by on several factors. First is the leachability of the waste rock and the overburden materials in the pit after they have been exposed to weathering in the stockpiles for no more than five years. Second is the sequencing of the placement of waste materials back into the reclaimed open pit. And third is the interaction between the leachate from the reclaimed pit with the groundwater and geologic formations downgradient of the reclaimed pit.

The waste characterization studies (see Section 3.5.6) have shown that waste materials placed into the saturated environment of the reclaimed pit (including liming of the Type II waste - see Section 3.5.6.1) would not leach any metals in concentrations that exceed the Primary Drinking Water Standards. The study shows that the following Secondary Drinking Water Standards could be exceeded in the leachate:

	Parameter Concentrations (mg/L)		
Material	Iron	Manganese	Copper
Type II Waste Rock	0.9	0.4	5.0
Type I Waste Rock	0.08	0.03	0.02
Saprolite	0.3	0.05	0.04
Sandstone	1.9	0.12	0.03
Glacial Till	1.6	0.03	0.02
Secondary Standard	0.3	0.05	1.0

It should be noted that Secondary Drinking Water Standards are not based on health concerns. Rather, they represent concentrations that affect aesthetic qualities of the water, such as taste and odor.

A parameter not included on the above table is pH. The waste characterization study showed that the pH of the Type II leachate in the pit could be less than 4.0. However, the preferred alternative includes addition of lime to the waste rock as it is placed back in the pit so that a pH of approximately 6.5 is permanently maintained. Maintenance of a natural pH of 6.5 will significantly reduce the leaching of metals from the Type II waste rock.

A worst case assumption is that water containing these concentrations would move laterally out of the reclaimed pit. Eventually the water would occur within the entire groundwater flow system between the pit and the groundwater discharge

points: the Flambeau River, the spring seepage into Wetland Area 1, and the private wells at the Kennecott-owned residences along Kennecott Drive south of Blackberry Lane.

However, even in the unlikely event that the worst case assumption occurs, the groundwater quality impacts will not be significant. As stated above, iron, copper, and manganese are compounds that do not cause health problems. Rather, they cause taste and odor problems that can easily be removed by water softening in affected private wells (all such potential wells are Kennecott-owned). Nor would impacts be anticipated from these compounds at these concentrations on the biota in Wetland Area 1. The impacts on the Flambeau River of groundwater-transported iron, manganese, and copper would be insignificant due to the tremendously large dilution factor involved. In Section 3.6.3.2.3, it was shown that the discharge of groundwater flowing through the area to be occupied by the open pit is 170,000 times less than the average Flambeau River discharge passing by the site. Thus, for example, if the mine contributes a parameter to the groundwater at an average concentration of 1 mg/L, then the worst case resultant concentration in the river would be 0.000006 mg/L (six parts per trillion). Such concentrations applied to the metal compounds in question would not only cause no impact in the river, they would not even be quantifiable by today's laboratory techniques.

Potential groundwater quality impacts are likely to be considerably less than the worst case scenario for at least four reasons.

First, a more reasonable assumption than the worst case is that the leachate concentrations coming out of the reclaimed pit would be significantly reduced by the addition of lime to the Type II waste rock as it is placed in the reclaimed pit (see Section 3.5.6).

Second, concentrations as estimated above would not migrate from the backfilled pit. A sump system will be used during backfilling to keep the rising groundwater level just below the working surface. Thus, the groundwater which initially re-saturates the backfilled Type II waste rock (the worst case contamination) will not flow out of the pit in the groundwater, but rather will be pumped out the sumps and treated in the on-site wastewater treatment plant.

Third, a layer of clay-rich saprolite material from the Type I stockpile will be placed back into the pit in a single layer on top of the Type I material. The top of the saprolite layer will be no greater in elevation than the top of the Precambrian rock in the pit walls. Since the saprolite material contains abundant clays, upon its placement back in the pit it will form a less permeable layer over the Type I (which, in turn, is on top of the Type II material) reducing potential upflow of water from the pit bottom to the more permeable overburden.

Fourth, since the Precambrian rock also has lower permeability than the overlying glacial materials, the materials placed back into the pit will be surrounded on all sides by relatively low permeability material. While the pit walls and overlying saprolite will transmit minor quantities of water, the rate at which water of elevated metals concentration will migrate from the Type I and Type II materials into surrounding groundwater should be substantially less than flow through the glacial material overlying the reclaimed Type I and Type II materials. Therefore, any discharge from the reclaimed pit that flows upward through the saprolite will be substantially diluted by groundwater flowing through the glacial material.

4.3.5 Surface Water and Bottom Sediments of the Flambeau River

The proposed project is located adjacent to the Flambeau River. Measures will be taken to limit and/or eliminate the impact of the mining operation on the river and no significant impacts are expected.

In accordance with applicable regulations, Kennecott will treat water from specified areas disturbed by mining. Runoff from the topsoil, , and Type I material stockpiles will be treated in settling ponds. An extensive wastewater treatment system will be constructed to treat water which has contacted Type II material, the processing area or pit inflow after the Type II material has been exposed. The design of the wastewater treatment system is based on extensive waste characterization studies described in Section 3.5.6 and bench scale testing as described in the Preliminary Engineering Report for Wastewater Treatment Facilities. Both the settling ponds and the wastewater treatment system are designed to produce effluent which would meet applicable water quality standards for the Flambeau River.

The settling ponds will be constructed and operated during the construction phase of the operation and throughout the life of the project. The wastewater treatment plant will operate as long as required to treat Type II material runoff water including during the backfilling of the open pit.

The wastewater discharges from this project will be controlled by a Wisconsin Pollutant Discharge Elimination System Permit (WPDES). The WDNR is responsible for establishing limits on the discharge of pollutants to all waters of the state including the Flambeau River. The Wisconsin Administrative Code establishes wastewater effluent standards based on water quality criteria. These criteria, when applied to specific waters, such as the Flambeau River, are designed to maintain the quality of water in the receiving stream. Applicable standards will be established during the WPDES permitting process.

Kennecott has proposed the previously referenced wastewater treatment system, which will meet the applicable standards. The Flambeau River will be protected from any significant or adverse impacts due to the wastewater discharged from the mining operation.

Kennecott has taken numerous steps to protect the river because environmental concerns were one of the main criteria in selecting the preferred alternative. Surface water flows of the Flambeau River will not be affected in any measurable amounts by the proposed mining operation because there will be no diversion of water from the river and surface water, and groundwater flow to the river interrupted by the mine will be returned to the river after treatment. Likewise, intermittent Stream C flow will not be significantly affected, nor will intermittent Stream A due to introduction of supplemental water into Wetland No. 1. Intermittent Stream B will be temporarily removed for about nine years until site reclamation returns the pit area to approximate original topography and another intermittent stream is created. Stream B, however, is an intermittent and non-navigable stream.

The initial stages of construction for the project will involve the development of the settling ponds to control sediment from surface water runoff on the site. These ponds will control the stormwater runoff from the pit during the construction phase and this water will be piped to a discharge location at the Flambeau River.

Sediment traps, straw bales, rock riprap, revegetation, or other erosion control measures will be used as needed to aid in erosion control. Although some minor erosion is inevitable in any earthwork construction on a river bank, the duration of the erosion will be kept to a minimum. Erosion that may take place will result in an insignificant increase in sediments carried by the river and deposited in the river bed. This minor sedimentation is not expected to perceptibly affect the river water quality. The total amount of existing sediment carried by the Flambeau River will far exceed the amount of sediment produced from this project.

Intermittent Stream A will have its natural watershed reduced temporarily by the development of the open pit, the Type I stockpile, and the settling ponds. While this will temporarily lower the flow from intermittent Stream A to the river, this water will not be removed from the overall water budget of the river. This water will be handled through and treated in the settling ponds with the treated water being discharged to the river and/or the wetland adjacent to the river.

Almost all of intermittent Stream B and its watershed will be eliminated by the development of the mine pit during preproduction. Again, this will lower the flow from Stream B to the river, but will not reduce the overall water budget for the

river. This water will be handled through either the settling ponds or the wastewater treatment facilities. The treated water from these facilities will be discharged to the river and/or the wetland adjacent to the river.

Water from less than ten percent of the watershed for intermittent Stream C will be diverted through the wastewater treatment plant and discharged into the Flambeau River. No water quality impacts on the remaining flow are expected because there will be no discharge to the stream as a result of the operation.

Flows in the Flambeau River will not be affected by the preferred alternative. The area of the watershed impacted is approximately one-quarter of a square mile. This compares to the total watershed for the river which is 1,838 square miles. As stated above, flow from the watershed will continue to be discharged to the river after receiving treatment.

Reclamation of the land will approximate the original surface topography. This will return the watersheds and the channels for the intermittent streams to their approximate original status, and will return the water balance for the river to its pre-mining state.

4.3.6 Aquatic Biology

This section refers to aquatic biology identified and discussed in Section 3.8. In general, the Flambeau River is a body of free-flowing water, which fluctuates in elevation daily in accordance with actions taken at hydroelectric dams above and below the site. The species present are common to other rivers of comparable structure in the region. The project will not alter the flow regime in any discernible fashion, nor will it have any measurable impact upon the aquatic communities.

Intermittent Streams A, B, and C were found to harbor no significant aquatic life and will, therefore, not be discussed in this section.

The potential effects of the preferred alternative on the aquatic environment are from surface water runoff and point source discharges.

The construction phase requires construction of two outfall structures where water discharges will enter the river. During the construction of these structures, some minor amounts of sedimentation will likely enter the river. The effect on the aquatic ecosystem will be minimal and localized along the east bank. Due to the large size and flow of the Flambeau River, a very small portion of its cross section will be affected. What little sedimentation could enter the channel during construction will last for a few days. Riprap will be used to stabilize the disturbed river bank and protect the discharge line.

The effluent from the wastewater treatment plant and the settling ponds will be ambient temperature. Therefore, there is no risk of temperature elevation from the point source discharges. There is also minimal risk of increased siltation entering the river from these discharges due to riprap protection which will protect the bank from erosion and discharge line.

The effluent limitations to be established for the point source discharges will be based on existing water quality in the Flambeau River and calculated so as to protect, to the degree reasonably possible, its most sensitive forms of aquatic life. Therefore, there will be no expected adverse effects on water quality from the point source discharges and, therefore, no adverse impacts on the aquatic life downstream of the project area.

Reclamation of the site will require extensive movement of soils and rock. Runoff control measures, will be maintained for the maximum amount of time during reclamation, so that the potential for uncontrolled surface runoff is minimized. Measures to minimize soil erosion (e.g., slope stabilization and revegetation) will significantly reduce the potential for soil loss to the Flambeau River during surface water runoff. Effects on the river from sedimentation should be minor, localized on the east side of the river, and short-term.

Removal and reclamation of the outfall areas on the river bank will include removing the facilities and seeding the disturbed areas to its original vegetation. Runoff may occur during this process and minor siltation may result. No reclamation plans are required for aquatic communities of the Flambeau because none will be affected.

4.3.7 Terrestrial Biology

The preferred alternative discussed in Section 2.0 was strategically arranged to minimize environmental impacts on terrestrial systems. During construction and mining operations, existing plant communities would be eliminated within the designated project area. Due to their mobility, many faunal species would be displaced into surrounding habitats for the duration of the project. As stated in Section 3.9, no endangered or threatened species or natural communities were found on the site, so no impact on these resources will occur. While an active bald eagle nest is located 1.75 miles to the southwest of the site, the project is not expected to adversely affect this nest or limit the use of the river at the site by these birds.

During the construction phase of facilities associated with the mining operation, nine plant community types on the project area will be removed. The proposed site area and railroad spur encompasses approximately 173 total acres. Table No. 4.3-1

TABLE NO. 4.3-1

Impacts: Plant Communities on Site Area

	A	F	OF	R	W1	W3	W4	W5	W6	Total Acres
Type II stockpile	10.9	6.0	4.9				1.0	0.3	3.4	26.5
Plant area	8.3									8.3
Crusher	3.0									3.0
Topsoil stockpile observation		.1	6.9							7.0
Settling ponds		1.4	4.4							5.8
Type I stockpile	17.9	12.2	9.4							39.5
Visitor parking observation			.3							.3
Parking for plant area	1.1			.3					.1	1.5
Haul road	2.7	2.3	3.0				.3			8.3
Pit area		15.8	15.9		0.7			0.1	0.7	33.2
Railroad spur within fenced area	1.9	—	—	—	—	—	—	—	—	1.9
TOTAL	45.8	37.8	44.8	.3	.7		1.3	0.4	4.2	135.3
Area within fenced boundaries	65.0	45.2	51.1	1.5	.9		2.0	0.4	4.2	170.7
Railroad spur east of fence	.9	1.5	.1			.1	.4		.2	3.1

Key: A = Agriculture
F = Upland mixed fores
OF = Old field/early successional
R = Residential/disturbed areas
W1 = Northern wet mesic forest
W3 = Alder thicket/bog
W4 = Disturbed/alder thicket/sedge meadow
W5 = Dug ponds
W6 = Northern sedge meadow

shows the nine plant communities affected within the site area. Three plant communities inside the fenced area: upland mixed forest (45 acres), old field (51 acres), and agriculture (65 acres) account for 94 percent of the total acreage affected. Residential/disturbed areas accounted for 1.5 acres. The remaining area (about 7 acres) is divided between five wetland types: northern wet mesic forest, alder thicket/bog, northern sedge meadow/alder thicket, dug pond, northern sedge meadow. None of these communities are unique to the region. (Refer to Appendix 3.8-C for further discussion of wetlands).

Arranging the preferred alternative so that all facilities, with the exception of the railroad spur, will be located within Section 9 minimizes the area impacted. The displacement of faunal species is also decreased due to the smaller total area affected.

Direct impacts on the terrestrial communities will all occur during the construction phase. Indirect impacts of the project, including disruption of communities peripheral to the immediate area of impact resulting from noise, will also occur at this time.

There are six major features within the site boundaries that will be constructed. The preferred alternative will remove the plant communities on acreage affected by each facility.

The Type I stockpile directly affects 40 acres. The existing communities affected by this facility will be agriculture (18 acres), upland mixed forest (12 acres), and old field/early successional (9 acres).

Clearing the 33-acre pit area will remove three different plant communities. The old field/early successional (16 acres) and upland mixed forest (16 acres) communities will be impacted the greatest by this facility. Three wetland areas: northern wet mesic forest, dug pond, and northern sedge meadow will be directly affected with a combined area of 1.5 acres removed. An additional one acre of northern wet-mesic forest (Wetland Area 2 in Appendix 3.8-C) will be unavoidably dewatered as a result of mining.

The Type II stockpile area impacts 27 acres consisting of agricultural areas (11 acres), upland mixed forest (6 acres) and old field communities (5 acres). Three wetland communities covering about 5 acres contain smaller acreages and will also be affected by this facility: northern sedge meadow, northern sedge meadow/alder thicket, and dug pond.

The proposed administrative and plant facilities, including the crusher, will impact 11 acres of which all are agricultural.

The topsoil storage and observation platform facility will impact 7 acres of the old field/early successional community on the eastern portion of the site.

The remaining facility, including the settling ponds, will have marginal impact on the plant communities due to their small size. In total, this area will impact 5.8 acres including agriculture, upland mixed forest, old field/early successional, and northern wet-mesic forest. The two plant communities most affected will be upland mixed forest and old field/early successional. Other mine site facilities and their affected acreage are presented in Table No. 4.3-1.

The indirect effects of ore removal, blasting and transportation on the surrounding flora and fauna are judged to be minimal once the surface is disturbed. Dust suppression will minimize impact to vegetation due to dust accumulation on foliage.

The impacts of this alternative on terrestrial communities during the operations phase are primarily from noise and dust due to transportation. The noise impacts on the flora and fauna are minimal but may be responsible for temporarily dispersing fauna.

Because the wetlands peripheral to the open pit are hydraulically isolated from the groundwater beneath them, groundwater drawdown effects are not expected to affect the biological functions of these areas. The groundwater seep into Wetland Area 1 may be temporarily interrupted as a result of the drawdown. Clean water from an alternative source will be supplied to Wetland Area 1 (and other peripheral wetland areas if necessary) to maintain water levels until the groundwater conditions return to approximate premining conditions after reclamation. Therefore, the biological functions of Wetland Area 1 and other peripheral wetlands should not be affected by the groundwater drawdown.

The length of time of this project's direct impact on the environment is short-term in ecological terms. The temporary loss of habitat will eventually be restored once the reclamation plan is implemented and vegetation has sufficiently matured. In addition to revegetation by Kennecott, natural revegetation processes will occur. Seeds from the surrounding plant communities will be windblown or deposited by birds and animals. Eventually, through years of natural succession, the plant communities will reach a forest community of northern hardwoods common to the region. Faunal species found on the area as described in Section 3.9 will also return to utilize the new habitat after reclamation. Since no endangered or threatened terrestrial species were encountered on the site, it is unlikely that any would appear on-site after reclamation.

The background tissue chemistry presented in Section 3.9 indicates there are no anomalous levels of metals in the flora or fauna of the project area when compared to the control area or other background sites. The project is designed to manage contact water and leachate that will be generated during mining. No exposure to available metals other than what is currently occurring under natural conditions is expected as a result of the project during operations. Replacement of site materials during reclamation, subsequent revegetation and re-establishment of terrestrial communities will allow natural geochemical and physiochemical processes to take place.

4.3.8 Mine-Related Noise and Vibration

The noise impacts arising from the construction phase are those associated with the operation of motorized construction equipment, used for excavation, hauling and building of stockpiles. The equipment used for this phase includes:

5 haul trucks
1 front end loader
1 grader
2 bulldozers
1 small haul truck
2 water trucks
1 shovel

The trucks would be operated throughout the project area while the other heavy equipment would be largely concentrated in the open pit. Peak truck operations could be as high as 136 movements in each direction while building the waste rock stockpiles. The noise arising from this movement would be:

L at source: 108 decibels
at 100 feet: 78 decibels
at 200 feet: 72 decibels
at 300 feet: 68 decibels
at 400 feet: 66 decibels
at 500 feet: 64 decibels
at 600 feet: 62 decibels and so on.

The proposed Type I stockpile location is a minimum of 300 feet from the project area boundary and a maximum of 2,900 feet. Ambient noise levels in the area range from 55 to 61 decibels in winter and from 56 to 62 decibels in summer. Noise increases due to the project at the Type I stockpile would be about 7 decibels in winter and about 6 decibels in summer. Four existing Kennecott-owned residences shown on Figure No. 4.3-1 could be subjected, on an occasional basis, to noise levels in excess of 65 decibels; but such levels would be only one to five decibels in excess of ambient levels. Using the DOT noise impact criteria, (6 dBA as some impact and a 15-dBA increase as a significant impact) this would not be significant.

The proposed Type II stockpile location is a minimum of 200 feet from the project area boundary and a maximum of 1,300 feet. Ambient noise levels in the area range from 56 to 61 decibels in winter and 61 to 67 decibels in summer. Neither the highway nor any residences would be exposed to an increase greater than 15 dBA.

To put noise levels of the 60-decibel range into perspective, conversational speech is about 60 decibels, a dishwasher in the home 70 decibels, and a food blender about 90 decibels.

The third noise source in the construction phase is the open pit where the heavy equipment would be operated. The noise distribution characteristics for this condition would be:

L at source: 100 decibels
at 100 feet: 70 decibels
at 200 feet: 64 decibels
at 300 feet: 60 decibels and so on

The open pit is located a minimum of 600 feet from the east project area boundary and a maximum of 2,600 feet. Ambient noise levels in the area range from 48 to 58 decibels in winter and 56 to 63 decibels in summer. Noise increases due to vehicular traffic in the project area would range from 0 to 10 decibels in winter and from 0 to 15 decibels in summer. No significant net increase would be observed at the east project area boundary and no residences would be affected. The west end of the pit is near the Flambeau River. Noise levels on the water surface could be as high as 56 decibels (allowing for elevation differences), slightly higher than current levels for winter and summer, but well within the 6 dBA guideline. No significant impact would result.

In summary, four Kennecott-owned residences would be subject to some higher noise levels (between 6 dBA and 15 dBA) during the pre-operational phase of the project. Several of the same residences are among those subjected to such higher levels of highway noise under the no action scenario. Therefore, these residences should expect no increase in noise levels over and above those experienced from STH 27.

The noise impacts described for the construction phase of the project from heavy earth moving equipment will also apply during the operational phase. A source of noise during the operational phase will be the crusher, which will be located approximately 700 feet from the south project area boundary and 1,300 feet west of STH 27. Noise levels are indicative of similar-sized crushers located at the gravel pit north of Blackberry Lane. The proposed crusher will be operated an average of four hours per workday or eight hours every other work day.

Noise propagation from the crusher will depend on a variety of factors, including distance, weather, topography, and vegetation. Noise levels shown on Figure Nos. 4.3-2 and 4.3-3 have the crusher location as the center. They assume a largely flat ground surface surrounding the crusher site; changes in topography could increase or decrease noise levels at selected locations. For example, the surface of the Flambeau River is approximately 60 feet below the elevation of the crusher. This means that noise levels produced by the crusher would be eight decibels lower at the water surface. Likewise, vegetation will reduce noise levels, but the amount depends upon height and density and is difficult to quantify. The maps show a small reduction in noise levels in summer; the actual reductions may be greater in some locations. Day-to-day variations due to temperature and wind speed and direction are also important.

Figure No. 4.3-2 shows the area of higher noise levels as a result of the preferred alternative under winter conditions. The area of greatest increase in noise (greater than 15 dBA according to USDOT standards) is limited to the project area. Using the criteria for existing land uses and increases from ambient levels (Table No. 3.10-4), only the area within 450 feet of the crusher will be significantly affected. This is entirely within lands controlled by Kennecott and does not affect any private residences. The larger area will be affected by some minor impact (+6 to 15 decibels). These levels can be heard but are not considered intrusive. The actual noise levels, 42 to 50 decibels at this location, are well within accepted guidelines.

Figure No. 4.3-3 shows the areas affected by crusher noise for the preferred project under summer conditions. Despite reduced noise propagation with denser vegetation, impacts are about the same as in winter, due to varying ambient noise levels. Again, the area adjacent to Flambeau River would be subject to some elevated noise which is within acceptable guidelines (less than 65 dBA or an increase over ambient conditions of 15 dBA) for residential areas. However, only the area in the immediate vicinity of the crusher would be subject to significant impact (above 15 dBA). Noise levels would not exceed levels acceptable for residential areas outside of the lands owned by Kennecott.

A secondary noise source during the operational phase would be the pit-to-crusher truck operation, peaking at about 46 vehicle round trips per hour. Associated noise levels at 100 feet distance would range from 54 to 57 decibels, depending on gradient and other conditions. When the crusher is not operating, the truck noise at the project boundary would not exceed acceptable levels.

During the post-operational phase, the affected areas and levels of operation would be approximately the same as the areas and levels for the construction phase. Noise production would be

reduced by four decibels to 74 decibels at 100 feet because of reduced truck traffic during this phase. Existing residences would not be impacted by these reduced noise levels.

The proposed mine plan has been designed to minimize the affects of air blast noise on surrounding areas. At lower benches of the open pit where waste rock and ore are encountered, carefully designed charges will be used to fragment these materials. Worse case noise levels, or air blasts, resulting from the explosions will be well below those levels that could cause physical damage and well below the maximum levels allowed by the U.S. Bureau of Mines and the Wisconsin Department of Industry, Labor and Human Relations (WAC ILHR 7) for all dwellings, institutions, and other inhabited structures. Refer to Appendix 3.10-A for further information.

The necessary blasting will occur during normal work hours so the minor noise that may be heard in the vicinity will be restricted to daylight hours. Kennecott will monitor noise and vibration levels during blasting events so adjustments can be made if necessary.

Maximum noise levels from blasting are estimated to be 124 dB within 500 feet of the blasting area. This value is below the maximum allowable level of 129 dB. Other than the mine facilities themselves, there are no occupied structures within this area.

At 2,000 feet, the estimated noise level will be 120 dB which is close to background maximum noise levels recorded during site investigations (118 dB). Therefore, the Rusk County Memorial Hospital and Mt. Senario College may experience minor increases in maximum noise levels over and above current conditions. Noise from air blasts will occur for very short durations and will not be continuous.

U.S. Bureau of Mines funded studies and work done in hard rock Scandinavian mines under similar conditions both indicate that ground vibrations from the Flambeau Project will result in insignificant impact to structures in the open pit vicinity. (See Appendix 3.10-A).

Eventually, after shutdown, noise levels are expected to go back to above current ambient because of STH 27 traffic increases, which are expected to be higher than at present.

4.3.9 Land Use

Construction of the project, which includes preparation of the open pit site, surface, and other support facilities will occur over an eleven-month period.

The first significant land use change begins during site preparation work. Existing large-diameter vegetation within the confines of the pit perimeter will be logged off for pulp and/or saw timber.

The preferred actions will potentially affect approximately 45 acres of upland forest within the project fenced area and along the spur line area, 38 of which will be removed from production. Other site preparation work will involve excavation work to bring the stockpile and plant sites to proper grade and to accommodate the construction of facilities.

Approximately 135 acres inside the 170 acres that will be fenced will be disturbed to accommodate all the mine facilities during construction and into full operation.

Land use classification totals within the fenced mine complex which will be disturbed or undisturbed during the construction and operation phase of the preferred alternative are shown below. Five land use classifications, agricultural (A), upland forest (F), old field (OF), residential (R), and wetlands (W) were used to compile this table.

Land Use Classification					
A	F	OF	R	W	Total Acres
65.0	45.2	51.1	1.5	7.9	170.7

A railroad spur line will be constructed to run east of the project area fenceline through Section 10. The spur line right-of-way will be 36 feet wide for approximately the first 1,450 feet, going east from the project area fence and 24 feet wide for the remainder of its 2,700-foot length. Land uses which will be disturbed in order to accommodate the spur line are as follows.

Land Use Classification					
A	F	OF	R	W	Total Acres
0.9	1.5	0.1	0.0	0.6	3.1

An area of wetland (i.e., Wetland Area 2 in Appendix 3.8-C) adjacent to and northwest of the open pit site, but outside of the fenceline, will be affected by dewatering, making the total wetland disturbed area 8.3 acres. Also, a parking area for the observation platform and the plant access road and parking lot will add 1.5 acres to the disturbed old field land use classification. Total land use changes as a result of preferred action is as follows:

Land Use Classification					
A	F	OF	R	W	Total Acres
65.9	46.7	51.2	1.5	8.3	173.6

The largest land use types to be disturbed include upland forest, old field, and agriculture. The 66 acres in agricultural use is not identified in the county's farmland preservation plan and hence, there will be no loss of prime agricultural land. The 51 acres of old field would be temporarily delayed in succeeding to upland forest due to the mining operation. Project area reclamation could recommence this succession process.

Residential land use totals only 1.5 acres. This total includes a vacant home located in the far southeast corner of the project area which will be removed to accommodate the railroad spur line. This home is currently owned by Kennecott.

Project effects on wetlands are addressed in Appendix 3.8-C.

There are nine homes in the project area which are owned and rented by Kennecott. The homes are presently rented by Kennecott and will continue to be used as residences through the project life, since they are are located outside of the mine site area and will not be significantly affected by the operation. An average of 53 employees is estimated by Kennecott over the project life. An analysis of available housing suggests that the Rusk County area will provide adequate housing opportunities for employees. This statement is based primarily on the fact that 75 percent of those hired for the project will be from Rusk County or within ten miles of the Rusk County line. Up to 13 employees may be from outside Rusk County so that ample, adequate housing is available. The only housing shortage which exists is for homes in excess of $90,000. However, transition of undeveloped land to accommodate new residential development is not anticipated since ample residential lots are available for construction in the study area. Indirect or secondary effects on land use associated with development or additional services to support the mine and its personnel will be negligible.

Once the mine facilities are constructed and pre-production activities are complete, additional land use will not be altered. As in the construction phase, no housing shortages should occur during the operations phase, and only minimal production of surplus housing is anticipated within existing residentially zoned areas.

The reclamation phase of the project includes removal of all project features and return of the disturbed area to approximate original contours and preproject land uses.

4.3.10 Aesthetics

The construction phase will include construction of the dike along the west end of the pit, clearing and grubbing of the site and construction of the surface facilities. This activity will create the visual impact from Viewpoint 1 in the first months of the project and early in the Construction Phase. The impacts on Viewpoint 1 will occur at this time and remain in effect until the dike is removed during reclamation. The dike will occupy about 100 feet of the forest fringe above the east bank and the pit will create about a 600-foot open space behind it. The sense of an open space behind the dike will occur during all phases of the project until mature trees are established during reclamation.

Viewpoints 4 and 8 will not be impacted by the construction activity because of adequate natural screening. Surface construction activities will be visible from Viewpoints 1, 2, 3, 5, 6, 7, and 9. Additional traffic due to commuter activity will be apparent on the highway during the entire project. See Section 4.13-11 for further discussion of transportation impacts.

The operations phase will begin after about 11 months of construction activity. The largest project features, Type 1 and Type II stockpiles, will be built up over the six-year operational phase. The full height of Type I stockpile (60 feet) will be achieved after about five years of activity. The Type II pile will not reach full height (70 feet) until year six of the operation. The Type I and II piles will remain at full height for only a short time before they are gradually removed over a one- to two-year period and used as backfill for the open pit.

Since the land will be returned to its approximate original contours, all impacts on aesthetics are considered to be only temporary in nature. These impacts occur primarily during operations. The paragraphs below list these impacts in detail.

Viewpoint 1 (west bank of Flambeau River)

> Figure No. 4.3-4 depicts the simulated view of the project from the river during the short time when Type I and Type II stockpiles reach maximum height. The primary visible feature will be the earthen dike separating the open pit from the Flambeau River and the open area behind it. The Type II stockpile will be partially visible from this viewpoint, but only in the later stages of the operations phase.

Viewpoint 2 (Mount Senario College)

Figure No. 4.3-5 depicts the simulated view of the project from subviewpoint 2b (top of slope south of McLaughlin Hall), and is typical of the other two subpoints (2a and 2c). The main visible feature will be of the north side of the Type I stockpile. The top of this stockpile and truck activity on it will be slightly visible from the higher elevations at the college dormitory. The stockpile will be obscured from the lower elevations at the college forest between the project area and the campus and will not be visible even from the college dorm until the third or fourth year of operation.

Viewpoint 3 (St. Mary's Complex)

Figure No. 4.3-6 depicts the simulated view of the project from subviewpoint 3c (4th floor lounge of St. Mary's Hospital). The only visible portion of the operation will be of the north side of the Type I stockpile during later years of operation. The top of this stockpile will be slightly visible from only the highest elevation of the St. Mary's complex viewpoint (3c). It will not be visible from the lower elevations of the St. Mary's Hospital Complex because of forest between the complex and the project. It will not be visible from the ground elevation at the hospital.

Viewpoint 4 (STH 27 Bridge Across Flambeau River)

The proposed project will not be seen from this viewpoint along STH 27. Viewpoint 4 is significantly lower than the project area, and is separated from it by forest.

Viewpoint 5 (Intersection of Highway 27 and Blackberry Lane)

During the simulation, which occurred well before full foliage conditions, the balloons situated nearest this viewpoint at the maximum height of the Type I stockpile were not visible. The project will only be slightly visible from this viewpoint (Figure No. 4.3-7).

Viewpoint 6 (East side of Highway 27,

Subviewpoint 6a (STH 27 due east of Type II stockpile)

Figure No. 4.3-8 depicts the simulated view of the project from the subviewpoint 6a. The Type II stockpile and the crusher ramp and ore stockpile will be visible from STH 27 at subviewpoint 6b. Also, the topsoil stockpile and observation platform will be visible to traffic on STH 27 at this location. However, preservation of the mature pine trees between subviewpoint 6a and the proposed observation platform will significantly screen the project.

Subviewpoint 6b (STH 27 at Service Building)

Figure No. 4.3-9 depicts the simulated view of the project from subviewpoint 6b. The topsoil stockpile and observation platform will be clearly visible from STH 27 and will obscure the on-site truck operations from this perspective. The Type II stockpile will be visible from this location during the latter stages of construction.

Viewpoint 7 (Centerline of Jansen Road, 80 feet east of STH 27)

Figure No. 4.3-10 depicts the simulated view of the project from Jansen Road looking west. The crusher ramp and ore stockpile and the south end of the Type II stockpile will be clearly visible from Jansen Road by westbound traffic. The site access road and railroad spur will cross the highway at Jansen Road and just north of this location, respectively, but will not present any significant change in the viewscape.

Viewpoint 8 (STH 27 south of Project Area looking north)

The only mine-related feature visible from this viewpoint will be rail transportation of ore across STH 27, which will occur three to four times per week. None of the proposed project facilities are visible from this point except the railroad crossing and possibly the power transmission line. This viewpoint is the same elevation as the project area east of the highway, but is separated from it by forest.

Viewpoint 9 (Blackberry Lane west of STH 27 looking south)

Figure No. 4.3-11 depicts the simulated view from Viewpoint 9. The Type I stockpile will be clearly visible from Blackberry Lane. The overall impact from this location is of minor significance because traffic on Blackberry Lane is very minor. It is a deadend lane with five residences owned by Kennecott and the active and abandoned gravel pits along its length.

The temporary visual intrusions presented by the stockpiles, crusher and related facilities visible from Viewpoints 1, 2, 3, 5, 6, 7, 8, and 9 during the operation phase of the mine, will be entirely removed during reclamation. As vegetation is re-established, the open spaces left after the site facilities are generally closed to become similar in nature to preconstruction conditions. The reader is referred to the Reclamation Plan in the Mine Permit Application for details.

4.3.11 Socioeconomics

4.3.11.1 Employment and Population Trends

The population trends in the study area will be minimally impacted given the preferred alternative scenario. During the construction phase, which comprises a facility construction (seven months) and mine preproduction phase (four months), the project will employ about 70 people and 160 people respectively. In the facility construction phase, an average of five will be mine employees and 65 will be construction contractor employees. The construction force is estimated to be staffed by 50 percent from the local community, which is defined as an area in and within 10 miles of Rusk County. At a maximum, about 33 employees will be brought into the area from outside for a very short period of time so relocation is not expected.

During preproduction, construction staff will average about 100 persons. It is expected that 50 percent of these workers will commute from outside the local community and 50 percent will be local. No appreciable increase in local population is expected from construction work. Mine staff during preproduction will average 56 with 25 percent (14 persons) coming from outside the area. Including their families, an increase of 41 in Rusk County's population. is expected. This is 0.2 percent of the Rusk County population. It is estimated that throughout the entire project that 75 percent of the nonlocal employment will reside in the City of Ladysmith with the remaining 25 percent scattered throughout the County. Therefore, it is estimated that about 31 of the 41 person increase in the population will reside in the City of Ladysmith. An increase of 31 persons to the City of Ladysmith's population represents an increase of 0.8 percent.

The population trends in the study area will be minimally impacted during the operations phase. During the six year operations phase, Kennecott will employ an annual average of 53 persons. Again, an average of 40 of the persons employed must be local residents. Therefore, at a maximum, 13 persons will be brought into the area from outside of ten miles of Rusk County's border. Given 1980 family size estimates, the influx of 13 employees and their families would increase the study area's population by 38. An increase of 38 in Rusk County's population represents an increase of 0.2 percent.

It is estimated that 29 of the 38-person increase in the population will reside in the City of Ladysmith. An increase of 29 persons in the City of Ladysmith's population represents an increase of 0.8 percent. The remaining nine persons will probably reside in surrounding rural areas, presenting only a very minor increase in populations to those outlying areas.

During the reclamation phase, which is estimated to last two years, Kennecott will employ an average of 61 persons. A

maximum, 15 persons may be brought in to the area from outside. Given 1980 family size estimates, the influx of 15 employees and their families would increase the study area's population by 44 persons. An increase of 44 in Rusk County's population represents on increase of 0.3 percent. It is estimated that about 33 of the 44-person increase in the population will reside in the City of Ladysmith. An increase of 33 persons in the City of Ladysmith's population represents an increase of .9 percent.

During the entire project, a range of 38 to 44 persons will migrate to the study area and will have a slight impact on the age/sex distribution of the population. It is estimated that the majority of the 13 to 15 persons who will be brought in from outside of the county will be men or women between the ages of 18 and 50.

In other words, the majority of persons added will be to the working age population and also, to a lesser degree, to the school age population. School age population impacts will be exposed more fully in the Section 4.3.11.5.1.

The influx of 38 to 44 persons to the Rusk County area during the project will have either an insignificant or no impact on the ethnic composition of the study area. The urban and rural character of the population will not be affected.

Proposed mine economic activity results in new customers and demands for other goods and services. The employment multiplier for Rusk County is 1.72, based on Rusk County employment data. Therefore, every 100 positions in basic (export) activities can be expected to support 72 employment opportunities in nonbasic support activities. This suggests that the creation of an average of 53 jobs in Rusk County during the operating phase will support an additional 38 jobs in other activities within the County.

According to Job Service, in 1988, an estimated 540 persons in Rusk County were unemployed. Therefore, during the project the addition of 40 to 46 jobs and approximately 38 spin-off jobs could easily be absorbed by currently unemployed local residents as the local agreement dictates. The pool of unemployed is actually larger because Kennecott can recruit from an area ten miles outside of Rusk County's border.

4.3.11.2 Sociocultural Profile

During the project it is estimated that there will be no impact on marriage, divorce, family size, mortality, leisure, or form of transportation. Due to the estimated increase in working age families, the number of births in the County could increase slightly.

4.3.11.3 Economic Profile

4.3.11.3.1 Income

During the 11-month construction phase, the project will employ an average of 70 persons for the first seven-month facility construction period and an average of 150 for the next four months. During the seven-month facility construction phase, the project's total payroll (Kennecott and contractors) is estimated at between $700,000 and $800,000 including fringe benefits. The four month preproduction phase will provide between $1.5 million and $2.0 million in income to the area for all persons working on the project.

Income in the study area would be impacted during the operations phase of the proposed project as an annual average of 53 persons would be on Kennecott's payroll. During the six years of the operations phase, Kennecott's total payroll is estimated at approximately $8,000,000 including fringe benefits.

Income in the study area would be impacted during the reclamation phase as an average of 61 persons would be on Kennecott's payroll. During the two-year reclamation phase, Kennecott's total payroll will be approximately $2 million to $3 million including fringe benefits.

4.3.11.3.2 Business and Financial Summary

During the construction phase, the deposit and loan amounts in local banks will increase due to the increased payroll provided by employment from the proposed mine project. Given historical savings patterns, local banks could see an increase in savings deposit during the construction phase of about $20,000. This estimate is based on the national personal savings rate of 4.1 percent in 1988 reported by Business Conditions Digest (1988). During operations and reclamation, the savings deposits could be as much as $340,000 and $87,000 respectively.

The construction phase payroll will also impact restaurant sales. Based on the latest consumer survey of Midwest households, about five percent of a household's income is spent on food away from home. Therefore, it is expected that about $24,000 will be spent in local restaurants during the construction phase. Approximately $415,000 and $106,000 could be spent during the operation and reclamation phases, respectively.

4.3.11.3.3 Retail Trade

Retail sales in dollars in the study area would increase during the construction phase of the proposed mine project. The U.S. Department of Commerce conducts consumer survey to determine the pattern of spending by geographic area of households. According to the latest survey conducted in 1984, Midwest families spend

about 23 percent of their income on retail items including food at home, alcoholic beverages, household furnishings, apparel, reading material, and tobacco. Given Kennecott's projected payroll, about $114,000 will go toward retail sales. As 75 percent of the employees must be local, not all of the retail sales generated during the project are expected to be an increase over existing sales.

Given Kennecott's projected payroll during operation, about $1.9 million will go toward retail sales over the six-year operations phase of the project. This represents annual sales in retail trade of about $300,000. During the reclamation phase, approximately $500,000 could be spent on retail sales.

4.3.11.3.4 Agriculture

Approximately 32 acres that are currently cultivated on the proposed mine site would be temporarily lost if the mine project proceeds. Currently, Kennecott leases about 32 acres to local area farmers for $13.00 per acre. In 1988, the acreage was cultivated in oats and corn. The total value of the acreage to the local farmers in 1988 was approximately $8,000. The estimated profit on this acreage is about $3,200 (Weisenberger, 1989). This land could revert to a farming use after the mine project is complete.

No additional agriculture acreage will be impacted during the operational phase of the proposed project other than that reported above in construction.

The goal of the reclamation phase is to return the land disturbed during the mining process back to its approximate topography. Formerly cultivated land could revert to farming after the mine project is complete.

4.3.11.3.5 Forestry and Forest Products

Current forest land in the proposed mine site would be harvested if the project proceeds or not. The total value of the forested acreage in the project site according to a report by David A. Lee in 1988 was $20,861, including the railroad spur right-of-way (Lee, 1988).

No additional forested property will be impacted during the operational phase of the proposed project.

The reclamation phase of the project will have no economic impact on forestry or forest related projects in the area. Portions of the mine site could revert to a commercial or recreational forest use after the reclamation phase is complete.

4.3.11.3.6 Recreation and Tourism

When the proposed mining project proceeds, a new tourist attraction would be developed, that being the mine observation area. Mine observation areas are very popular attractions in the western United States, where mining is more prevalent. During the summer months, over 2,000 overnight visitors per day are in the Rusk County area (NWRPC, 1975). We estimate that the mine observation area will be visited by over 10,000 persons per year.

4.3.11.4 Housing

One vacant Kennecott housing unit that is in poor condition adjacent to the mine site will be eliminated during the construction phase. Nine other Kennecott homes which are located on or close to the project area will not be affected by the project.

During the project, the Rusk County area can provide adequate housing opportunities for the employees and their families, especially considering that 75 percent of those hired will be from within the local community. It is estimated that the majority of the 40 to 46 local employees and their families who do not currently live in the City of Ladysmith will not relocate to the area due to the temporary nature of the employment (nine years overall). For the 13 to 15 employees who could come from outside the County, ample housing opportunities are available. If there is a demand for $90,000-plus housing, that demand could be met through new construction. Lots for new construction are available.

4.3.11.5 Public Facilities and Services

4.3.11.5.1 Education Facilities

The educational facilities in the Rusk County area have adequate capacity to serve the estimated population increase due to the influx of 13 to 15 families from outside of Rusk County during the project. Given an average family size of 2.9, 13 to 15 new job opportunities could translate to an increase in the population of 38 to 44 persons. Assuming traditional two-parent families, an estimated 12 to 14 children could enter the local school district. This assumes that all of the new children coming into the community are of school age. This is unlikely and therefore, the actual number of children entering the local school districts is likely to be less. Twelve to 14 new students would not impact the school district in terms of requiring additional classroom space. Limited additional instructional staff may be required to meet state pupil-to-teacher ratios.

4.3.11.5.2 Health Facilities

Rusk County health facilities have adequate capacity to serve the influx of 38 to 44 new residents during the project. Rusk County emergency medical services are conveniently located about one-half mile from the mine site. As the hospital is currently under-utilized, new area residents could positively impact the hospital as new hospital users would reduce hospital operating costs.

4.3.11.5.3 General Government

The government structure in the study area would not be impacted during the construction phase of the proposed mine project.

After reclamation is complete the minor demands placed on these services and systems, if any, will no longer be required.

4.3.11.5.4 Police Protection

Police protection required to provide adequate service may require increased staffing at the county level regardless of whether the project commences in the near future or not.

4.3.11.5.5 Fire Protection

Adequate fire protection will be provided by the City of Ladysmith Fire Department. Water would be provided by a system constructed by Kennecott located at the mine site. The Ladysmith Fire Department's service and equipment is adequate to absorb the estimated additional households related to the proposed project.

4.3.11.5.6 Electrical/Telephone/Natural Gas

An electrical feeder line would be installed in existing right-of-way on STH 27 Road to serve the project site, as shown in Figure No. 4.3-12. The Lake Superior Power District has stated that supplying the project demands will present no problems.

Wisconsin Gas Company is interested in providing natural gas services to areas south of Ladysmith. They will install a natural gas mainline to the project area along a corridor west of STH 27 from the City of Ladysmith (refer to Figure No. 4.3-12). This installation will provide an economical heating fuel alternative to homes near the project area in addition to servicing the mine.

Construction of the railroad spur will require raising electrical lines at the Meadowbrook Road crossing to ensure adequate clearance over the railroad track in accordance with A.R.E.A. standards. One overhead telephone line would be similarly affected at the STH 27 crossing. In both instances, the total distance involved would be 150 to 300 feet. The spur

track would also pass over an existing underground telephone line at Meadowbrook Road, which would have to be protected during construction. In each case, proper coordination with the utility companies will guarantee safe construction without disruption of customer service. Affected locations are shown on Figure No. 4.3-12.

Administrative, ore-crushing, and maintenance activities will require the consumption of a limited amount of electricity throughout the life of the project. Regular phone service would be provided by Wisconsin Bell. Local petroleum distributors foresee no difficulty in supplying the project with the relatively small amounts of fuel, oil and lubricants.

4.3.11.5.7 Water/Sanitary

Water and sanitary facilities for the project site will be provided by Kennecott and, therefore, will not tax the existing Ladysmith system. The existing Ladysmith system will be able to accommodate the estimated increase in potential users which would result from the project without any difficulty.

4.3.11.5.8 Streets and Roads

All heavy vehicular traffic associated with the project will occur within the confines of the project area. Some vehicular traffic will be necessary to bring in heavy equipment for construction. This traffic will be restricted to major paved routes.

Streets and roads within the City of Ladysmith will also receive increased use but are currently in adequate condition to accommodate these slight increases. Streets and roads adjacent the project area which are also likely to experience increased commuter traffic include Blackberry Lane, Doughty Road and Jansen Road.

4.3.11.5.9 Highways

The impacts on highways will vary according to project phase and alternative. Table No. 4.3-2 and Figure No. 4.3-13 summarize the traffic volume changes arising from the project. Volumes will vary according to project phase.

The forecast is for a maximum employment level of 160 persons in four-month preproduction period of the construction phase. This will increase traffic on STH 27 north of the site by about 255 vpd and 115 vph in the p.m. peak hour. The latter would increase peak hour traffic to about 345 vph. According to the standards of the Highway Capacity Manual, the capacity of STH 27 is 790 vph for Level of Service B. The American Association of State Highway and Transportation Officials and Wisconsin DOT both have minimum design standards of Level of Service B for rural highways. Thus, the highway is expected to continue to

TABLE NO. 4.3-2

Highway Traffic Summary
Operations Phase

Average Daily Traffic (vpd)

Roadway	1988	W/O Project	With Preferred Alternate	With Selective Alternate	With Truck Hauling Alternate
STH 27					
At bridge	3,470	3,920	4,020	4,030	4,025
At site	3,420	3,950	4,055	4,065	4,050
At CTH P	3,420	3,950	3,990	3,990	3,990
CTH P	450	550	555	555	555
Blackberry Lane	<300	<300	<300	<300	<300
Doughty Road	650	740	745	745	745
Gokey Road	<300	<300	<300	<300	<300
Jansen Road	<300	<300	<300	<300	1,000
Meadowbrook Lane	<300	<300	<300	<300	1,000
Tiews Road	<300	<300	<300	<300	<300

operate at Level of Service B with no significant impact. The 30th highest hour volume will be unaffected by the project because the annual peak hours occur on Saturday and Sunday when the mine will not be operating.

Design and construction of the principal entrance and the secondary entrance for sightseers will be in accordance with state permits and design standards. The traffic at the principal entrance is about 33 percent of the peak hour traffic on STH 27 for a short period during the preproduction period, but no significant impact on capacity or operational safety is expected. A stop sign control on the entrance will be adequate traffic control. Sight distance is excellent, a minimum of 1,800 feet at the principal entrance and 1,000 feet at the secondary entrance (required stopping sight distance at 55 mph is 450 feet). The gradient is nearly level, so no adverse safety impact is expected. Some traffic disruption will occur during the entrance construction period.

The forecast is for a maximum employment level of 57 persons during the operational phase (the numbers would range from 53 to 57). This would increase traffic on STH 27 north of the site by 85 vph and 41 vph in the p.m. peak hour. The latter would increase peak hour traffic to 307 vph. Operation of the site entrances should continue to be safe with the expected traffic volumes. No special measures will be required.

The forecast is for a maximum employment level of 63 persons during the reclamation. This will increase traffic on STH 27 north of the site by 106 vpd and 48 vph in the p.m. peak hour. The latter would increase peak hour traffic to 314 vph. No safety or capacity problems should arise from this additional traffic.

The increased traffic volumes during the project will cause an increase of about 0.5 decibel in excess of the levels previously forecast. This will have an insignificant effect on adjacent land uses.

4.3.11.5.10 Railroads

A railroad spur is proposed to be constructed from the site to the adjacent Wisconsin Central tracks. The total length involved is 4,150 feet east of the site fence. Some minor construction impacts can be anticipated, including some disruption of traffic on STH 27 and Meadowbrook Road for a few days where surface crossings would be constructed. All construction would be in accordance with state permits and standards, as well as standards of the Wisconsin Central Limited, and efforts would be made to reduce effects. The STH 27 crossing will be provided with automatic flashing signals, and the Meadowbrook Road crossing with signs and crossbucks, both in accordance with Wisconsin DOT standards.

The current forecast of rail operations calls for one train of approximately 26 cars operating in each direction (one full, one empty) about four times per week. Thus, traffic on STH 27 and Meadowbrook Lane will be interrupted an average of twice every other day. At 15 mph, the train will take about 60 seconds to clear the intersection, so no significant impact would result.

Table No. 4.3-3 shows the day-night average sound exposure levels associated with the operation of the train. The gradient of the track is generally at 0.0 percent, and the speed of operation would range from 0 to 25 mph. The forecasted noise levels at 50 feet, 37 dB at 15 mph, and 43 dB at 25 mph, are lower than ambient levels so no impact would result. The noise levels cited are L_{eq}, average daily levels, not peak values. Train operation would produce maximum sound levels in the range of 80 to 90 decibels. Forecasted operations on the spur track would have no impact on the adjoining land uses.

Main line operations on the Wisconsin Central would be influenced by the extra trains but can easily handle the extra capacity. Table No. 4.3-4 shows an increase of one decibel above ambient levels arising from railroad operations, but the result, 51.5 dB, is well below acceptable levels. No impact would result.

No railroad operations will be required during reclamation, when the spur line will either be removed or left in place.

4.3.11.5.11 Airports

The Rusk County airport will not be significantly affected by the preferred alternative. In addition, the closest commercial airport in Eau Claire will not be affected.

4.3.11.5.12 Library Services

The library services in the study area are adequate to absorb the new use generated by the project for an estimated 38 to 44 potential new users of the services.

4.3.11.5.13 Recreation

Recreation facilities are determined by the population base they serve. Thus, the recreational impacts of the construction of the project is based on the estimated population increase. Given the 1980 family size estimates, the influx of 14 employees from outside and their families from outside the county would increase the study area population by 41 persons. It is expected that 75 percent (31 persons) will be from the City of Ladysmith area. Currently there are 12 recreation sites in the City of Ladysmith and 23.9 acres of recreation land per 1,000 population. Based on the suggested standard of 12 acres of land per 1,000, no recreational land deficiencies exist. Furthermore, the addition of 41 persons to the population base

TABLE NO. 4.3-3

Railroad Noise Under Operating Conditions

Spur Track

Operating Conditions	1	2
Number of cars	26	26
Speed, mph	15	25
SEL, dBA	86.5	92.5
Gradient adjustment, dBA	0	0
Daytime operations	1	1
Nighttime operations	0	0
L_{dn}, dBA	37	43

Mainline

Operating Conditions	1	2	3	4	5	6
Number of cars	40	40	10	10	26	26
Speed, mph	20	20	20	20	20	20
SEL, dBA	92	92	83.5	83.5	89.5	89.5
Gradient adjustment, dBA	-4	+4	-4	+4	-4	+4
Daytime operations	2	2	1	1	1	1
Nighttime operations	0	0	0	0	0	0
L_{dn}, dBA	41.5	49.5	30.0	38.0	36.0	44.0
Composite L_{dn} - ambient			50.5 dBA			
Composite L_{dn} - forecast			51.5 dBA			

TABLE NO. 4.3-4

Railroad Noise Exposure (L_{dn})

Track	Distance From Centerline (ft)	
Spur Track		
50	37	43
100	31	37
150	27.5	33.5
Mainline		
50	50.5	51.5
100	44.5	45.5
150	41.0	42.0

Net change +1.0 dB

will not justify the demand for more recreational acres or facilities. Likewise, county recreational facilities will be able to accommodate this marginal increase.

4.3.11.6 Fiscal Profile

4.3.11.6.1 State Revenue

The proposed project will have a positive impact on state revenues in several ways. The wages generated by this project will impact the total income tax collected by the state. Also, the increased purchasing power of the recipients of these new jobs will also contribute to an increase in sales and excise taxes received by the state. Kennecott will also pay a net proceeds tax and corporate income tax based on mine revenues. Finally, Kennecott will pay a tax on the gasoline it will purchase.

Income Taxes

Wisconsin taxes income on an escalating basis with rates between 4.9 and 6.93 percent. However, certain deductions to income for tax calculation purposes are allowed. Therefore, for estimating purposes, we will assume that the total payroll will be taxed at the lowest rate, or 4.9 percent.

The estimated construction period payroll (both phases) to be generated by the proposed project during the facilities construction period is about $2.5 million. Assuming 25 percent of the total labor cost is for fringe benefits, an estimated $93,750 in income tax revenue will be generated during the construction phase.

Payrolls generated during operation and reclamation are approximately $8 million and $2 million to $3 million respectively. Income taxes will be $400,000 and $100,000 for operation and reclamation activities, respectively.

Sales and Excise Tax

According to consumer surveys conducted by the U.S. Department of Commerce, approximately 18 percent of income in the Midwest is spent on items for which sales tax is charged. Therefore, about $4,500 in sales tax will be generated through the proposed project projected payroll during the construction phase. Likewise, estimated sales tax during operation and reclamation will be $75,000 on $608,000 of purchases and about $19,000 on $105,000 of purchases respectively.

Mine operation purchases will result in an additional sales tax revenue of about $38,000 during the construction phase of the project.

Additional excise taxes will also be generated during the project as a result of the proposed mine operation's projected payroll.

Mining Taxes

There will be a total of $300,000 tax payment to local municipalities within thirty days after the start of construction according to new Wisconsin tax laws. No net proceeds tax revenue will be generated during the construction or reclamation phases of the proposed mine project.

Net proceeds tax revenue will begin to be generated during the operations phase of the proposed project. The local agreement guarantees that the Local Government, Rusk County, the Town of Grant, and the City of Ladysmith will receive each year of operation $300,000, multiplied by the tonnage of ore shipped, divided by 300,000 tons, multiplied by an inflation factor. It is estimated that this will amount to approximately $2,400,000 during the operating period. In addition the local agreement guarantees that Rusk County can receive each year of operation from the net proceed taxes or Kennecott, $250,000, multiplied by the tonnage of ore shipped, divided by 300,000 tons, multiplied by an inflation factor, all adjusted according to copper price. If the copper price remains higher than 85 cent per pound the County would receive approximately $2,000,000 during the operating period. Kennecott has estimated its contribution in terms of net proceeds and corporate income tax to the state at about $7,500,000.

Waste Management Fund

The project will contribute approximately $40,000 to the Waste Management Fund under NR 182. These funds will not be impacted by the proposed mine project during any phase of the project.

Local Revenues

The majority of local revenues are the result of intergovernmental transfers. The proposed mine project will have no impact on intergovernmental transfers. The other largest local revenue category is local property tax. A significant property tax revenue will be generated as a result of the proposed mine project.

4.3.11.6.2 Local Taxes

The total value of the proposed mine site with improvements is approximately $20 million. Based on 1988 property tax rates, once the mine improvements are made Kennecott's total property tax bill at the end of the construction phase would be approximately $80,000. Based on current distribution, this local revenue would be divided among the study area's local jurisdictions as follows:

Local Revenue Estimate

Rusk County	$ 1,000
Townships	21,000
School Districts	53,000
VTAE	5,000
Total	$80,000

Kennecott's total property tax bill during the six years of the operations phase will be approximately $480,000. Based on current apportionment, this local revenue would be divided among the study area's local jurisdictions as follows:

State of Wisconsin	Revenue Estimate
Rusk County	$ 5,000
Townships	129,000
School District	315,900
VTAE	31,000
Total	$480,000

During the reclamation phase, the assessed value of the property and improvements will decrease as structures are dismantled and the deposit has been removed. Based on the 1988 Town of Grant tax rate, estimated property tax payments over the two year reclamation phase will total $160,000. The greatest beneficiary of the property tax revenues generated by the proposed mine project are the local school districts.

Other Local Revenues

Rusk County, Grant Township, and the City of Ladysmith will receive a combined $300,000 multiplied by an inflation factor within 30 days after construction starts.

4.3.11.7 Other Secondary Local Impacts

During the nine-year project, an estimated $8.5 million will be spent by Kennecott on project supplies. Many necessary supplies will be purchased locally. A summary of the estimated supplies and their associated costs are shown in Table No. 4.3-5.

As shown in Table No. 4.3-5, almost $450,000 will be spent by Kennecott during the construction phase on local goods and services.

Almost $1 million will be spent annually by Kennecott during the operations phase of the project on goods and services. Many of the products will be purchased locally. In total, over the six-

TABLE NO. 4.3-5

Mine Project Supply Estimates

Supplies	Construction Phase	Operations Phase 1	2	3	4	5	6	Reclamation Phase 1	2	Total
Parts & Consumables	$309,300	$687,000	$731,000	$780,200	$730,800	$542,900	$851,000	$625,900	$0	$5,258,100
Diesel	124,200	202,200	202,200	210,200	198,300	155,500	210,400	353,900	74,100	1,722,000
Gasoline	6,000	17,900	17,900	17,900	17,900	17,900	17,900	15,500	4	128,904
Natural Gas	0	52,200	69,600	69,600	71,600	69,600	69,600	25,700	0	427,900
Electric Power	0	107,900	143,800	143,800	143,800	143,800	143,800	122,400	0	949,300
TOTAL	$439,500	$1,067,200	$1,164,500	$1,212,700	$,162,400	$929,700	$1,292,700	$1,143,400	$74,100	$8,486,204

Source: Kennecott estimates, February 1989.

year operations phase of the project, more than $5.8 million will be spent, according to Table No. 4.3-5.

Over $1.2 million will be spent by Kennecott during the reclamation phase of the project, much of it on local goods and services. This total consumption will benefit the local suppliers of goods and services throughout the life of the project.

4.3.12 Summary and Conclusions

4.3.12.1 Historical and Archaeological Resources

No archaeological or historical resources were identified in the background studies and field investigations within the project area, so the preferred alternative will have no impact on these resources.

4.3.12.2 Air Quality

The projected effects of the project on the ambient air quality of the region demonstrate there will be no exceedances of ambient air standards as a result of the project. Careful selection of dust suppression measures and other pollution control strategies will result in a maximum of about 54 tons per year of total suspended particulate emissions from all operations. This total is only one fifth of the amount that would require a Prevention of Significant Deterioration review and permit under current air quality regulations. The project is in an area that attains ambient air standards and the project will not affect this status.

4.3.12.3 Geology

The impacts of the preferred alternative on the geological resources are temporary because the site will be returned to its approximate original contour. In general, the mass balance for topsoil and subsoil will not be significantly impacted. Extraction of the deposit results in a local mineral reserve becoming a long-term resource to the nation.

4.3.12.4 Groundwater

Based on the results of extensive testing and modeling, there are no short-term and no long-term changes anticipated in groundwater levels that will significantly affect any private wells or any other current uses of groundwater. The predicted, localized drawdown will be short-term and original water table conditions will return after reclamation under the proposed plan.

The minor effects on groundwater quality in the backfilled pit will be localized and will not exceed Primary Drinking Water

Standards under the proposed reclamation plan. The groundwater quality at private wells or surface water recharge areas will not be adversely affected under the proposed plan.

4.3.12.5 Surface Water/Aquatic Biology

The effluent limitations selected for the project will preserve and protect the aquatic ecosystem of the Flambeau River. The localized sedimentation that may occur due to the bank construction will result in the creation of two point source discharges which are considered to be very minor, short-term adverse effects.

4.3.12.6 Terrestrial Biology

From an ecological standpoint, it is preferable to keep environmental disturbances within a confined space as in the preferred alternative. In doing this, less total area is impacted. Plant communities are not separated by construction activities which in turn will displace fewer faunal species. Therefore, the preferred alternative minimizes impacts to terrestrial communities.

4.3.12.7 Mine-related Noise and Vibration

During the project life, four residences owned by Kennecott would hear some noise from truck and heavy equipment operation. However, no other residences will be significantly affected. During the construction period, projected noise levels will be below those normally acceptable for the existing land uses.

In the operations phase, blasting noise will not exceed existing standards. Crusher noise would be audible over a larger area, but only a small area within 400 to 500 feet of the crusher and entirely within the project area would be subject to high noise levels caused by the crusher, which will operate about four daylight hours per day. This crusher noise at off-site areas will not be at levels above those normally acceptable.

No significant vibration impacts at off-site structures will result due to the proposed plan.

No significant noise impacts would result from reclamation activities.

4.3.12.8 Land Use

The changes in land use caused by the preferred alternative will be temporary in nature and original uses will be returned after the project.

Secondary impacts on land use related to additional housing development or commercial expansion resulting from the proposed

mine are virtually negligible because of the very minor impacts on population.

4.3.12.9 Aesthetics

The preferred alternative will be visible for a temporary period from certain viewpoints in the surrounding areas. These visual impacts can be effectively mitigated in most cases as provided for in Section 5.0.

4.3.12.10 Socioeconomics

The socioeconomic impact of the proposed mine project is very positive. The infrastructure of the community can readily accept a project of this size. The proposed project will create between 50-60 jobs in an area in which unemployment has been running above the state average. The fiscal impact locally and statewide will be significant, with an estimated total labor cost to Kennecott over the nine-year life of the project at over $14 million including fringe benefits, given the preferred alternative. The approximately $11 million payroll, not including fringe benefits, will help stimulate the local economy through increased retail sales, restaurant sales, and through increased savings deposits.

State revenues will be impacted through increased income, sales, excise, and net proceeds taxes. Local units of government (Rusk County, City of Ladysmith, Town of Grant) will receive approximately $2.4 million to $4.4 million over the nine years of mine operation, as well as $720,000 in property taxes on Kennecott property and improvements.

Kennecott will spend over $8 million on goods and services, a portion of which will be purchased locally. This will positively impact the local suppliers of goods and services.

Kennecott estimates the potential economic benefit to the local governments and the state over the life of the project at about $36 million.

4.4 Alternatives to the Preferred Alternative

4.4.1 In-Pit Storage of Type I and Type II Waste Rock

This alternative is presented in Section 2.3.3.1. Impacts from this alternative are the same as identified under the preferred alternative except as noted below.

4.4.1.1 Air Quality

In-pit storage of the Type I and Type II waste rock will slightly reduce the TSP emissions because of the shorter haul

distances for this option. Other emission rates for this alternative are estimated to be the same.

Site Activity	TSP Emissions TSP
Construction	45
Operations	
Year 1	30
Year 2	30
Year 3	29
Year 4	26
Year 5	22
Year 6	20
Reclamations	
Year 1	46
Year 2	40

Over the project life, the TSP emissions are expected to be about eight percent lower than for the preferred alternative. Due to the already low levels projected for the preferred alternative, these reductions are not considered to be significant because emissions under the preferred alternatives with appropriate controls will not cause ambient air standards to be exceeded at any time.

4.4.1.2 Geology - (Soils and Landforms)

Use of this alternative method of waste rock storage would impact soils and landforms over approximately 27 fewer acres because the Type II material would remain in the pit and the Type II stockpile would not be required. The Type I stockpile and the topsoil stockpile would affect approximately the same amount of area as the preferred alternative. However, the volume of the piles will be 25 percent and 15 percent smaller, respectively. The effect on the mineral resource and the long-term effects on soil and landforms are largely the same as those produced by the preferred alternative.

4.4.1.3 Surface Water

The need for Type II stockpile area will be eliminated. This will reduce the amount of exposed area subject to runoff during construction by about 27 acres. Since there will be no significant adverse impact under the preferred alternatives, this reduction is inconsequential.

4.4.1.4 Aquatic Biology

Approximately five acres of low quality disturbed wetlands would not be affected under the in-pit option, compared to the preferred alternative.

4.4.1.5 Terrestrial Biology

Under this alternative, 27 acres would remain undisturbed and would not require reclamation. This area includes six different terrestrial communities: agricultural, upland mixed forest, old field/early successional, northern sedge meadow/alder thicket, dug pond, and northern sedge meadow; none of which are unique communities.

4.4.1.6 Land Use

In-pit storage of waste rock will reduce surface land disturbances by about 27 acres. This will allow the 1,000 foot setback requirement to be met for Type II materials. However, variances would be required for the Type I and topsoil stockpiles and east end of open pit.

4.4.1.7 Aesthetics

During construction the aesthetic impacts of the in-pit storage of waste rock will differ slightly from the preferred alternative. The Type II stockpile will be located in the pit and will be visible from slightly different viewpoints. In addition, the height of the Type I stockpile will be 25 percent lower because the Type I waste rock will also be stored in the pit.

Under this option, the Type II stockpile, which will reach a height of 50 feet, will be visible from the river (Viewpoint 1) during much of the second half (a two- to three-year period) of the operational period when it is piled over the backfilled western half of the pit.

During Phase I of mining, the Type II material will be piled over the pre-stripped eastern half of the bedrock pit creating a 60-foot-high pile behind the proposed topsoil stockpile and observation platform for about two years, both of which will be partially within the 1,000-foot setback from STH 27. Portions of the Type II stockpile will be partially hidden from the highway by the topsoil pile and the vegetation screen depending on the viewer's relative position. The visual impact on the highway of the Type II stockpile under the in-pit storage alternative will be of shorter duration (two to three years) than the preferred alternative.

All other visible features of the project described in the preferred alternative will be similar under the in-pit storage alternative.

4.4.1.8 Summary and Conclusions

The differences in impacts in this option compared to the preferred alternative will be that 27 acres less land, including five acres of low quality and disturbed wetlands, will be used and there will be lower TSP emissions from the operation. Other impacts for this alternative would be essentially the same as for the preferred alternative. Additionally, there are some potential cost advantages to Kennecott associated with this alternative.

However, as described in Section 2.0 there are significant operational problems associated with this alternative. These include safety, cash flow considerations, difficulty in controlling and handling contact water, and reduced efficiency and flexibility. When all these factors are considered, this alternative is less desirable than the preferred alternative.

4.4.2 Section 10 Alternative

This alternative is presented in Section 2.4.2.1. Impacts from this alternative are the same as identified under the preferred alternative except as noted below.

4.4.2.1 Air Quality

Storage of the Type I material in Section 10 adds about 4,000 feet of additional haul road to the overall haul distance for the project. Projected TSP emission rates in tons per year for this alternative are as follows:

Site Activity	TSP Emissions
Construction	59
Operations	
Year 1	44
Year 2	44
Year 3	41
Year 4	36
Year 5	26
Year 6	28
Reclamations	
Year 1	85
Year 2	62

This alternative increases TSP emissions by about 40 percent and because of the site layout, significantly increases the potential area affected.

4.4.2.2 Geology

Locating the Type I stockpile in Section 10 would have the same impacts on topsoil and landforms as the location proposed in the preferred alternative. The only significant difference would be the additional area disturbed when constructing the haul road to the stockpile.

4.4.2.3 Groundwater

Rearrangment of the waste stockpiles and other mine facilities so that the Type I waste stockpile is placed to the east of STH 27 would probably produce an overall effect somewhat different from that produced by the preferred alternative, but the resultant environmental impact would be similar. The proposed alternative location of the Type I stockpile would be in an area underlain by a minor groundwater divide. Some of the resultant flow would be to the north and some to the south. Therefore the private wells at the Kennecott-owned residences along the river to the south of Blackberry Lane would no longer be downgradient of the stockpile.

However, the private wells at the non-Kennecott-owned residences to the north of Blackberry Lane east of STH 27 and along the south side of Jansen Road east of STH 27 would be downgradient. Thus, the wells would potentially produce water slightly degraded by the alternative location of the Type I stockpile placement if this theoretical alternative were implemented. The glacial till that would underlie the stockpile has a significant capacity to sorb the metals that could be produced by the Type I pile. Therefore, it is likely that the metal constituents of the leachate would be reduced to background levels before reaching any of the private wells and primary drinking water standards would not be exceeded.

4.4.2.4 Surface Water

The wastewater generated by the use of Section 10 for Type I material storage will have impacts on the surface waters similar to the preferred alternative. Water from the Type I pile would have to be pumped under STH 27 to settling ponds in Section 9. The wastewater from this alternative would increase slightly because of the increase in total acreage for the project. This increase would, not however, be significant.

Reclamation of a larger area will increase the potential for sediment transport and erosion during this phase.

4.4.2.5 Terrestrial Biology

The configuration of the pit would remain unchanged under the general site arrangement for this alternative (Figure No. 2.4-1). The flora and fauna within 1,000 feet of STH 27 would remain mostly undisturbed except for the early successional

forest over the east end of the pit, which would be removed. This alternative directly affects an additional 1.3 acres because of the extended haul road. There would be additional indirect impact to terrestrial ecosystems under this layout because of the impact to flora and fauna of Section 10, which would displace faunal species within two sections instead of one. No different natural plant community types would be affected under this proposed alternative. However, 5.0 acres of low-quality northern sedge meadow, the dug pond, and alder thicket will remain relatively unaffected under this alternative.

4.4.2.6 Mine-Related Noise and Vibration

The impacts on noise levels and vibrations discussed under the preferred alternative largely apply to the Section 10 layout. The number of trucks would increase by about 68 round trips per day. Noise generation would be decreased by seven decibels at the new boundary compared to the preferred alternative because the noise generating equipment will be dispersed. Thus, although an additional area in Section 10 would be subjected to noise, the Kennecott-owned residences along STH 27 northeast of the pit would not be exposed to as much noise under this alternative because the truck traffic is further from the residences. However, noise from truck traffic over STH 27 would increase at that location.

4.4.2.7 Land Use

The land use impact of this alternative is related to the realignment of components adjacent to the open pit. The potential for repositioning these components was considered in order to meet the 1,000-foot setback requirement from STH 27.

The amount of land area impacted by the Section 10 alternative, compared to the preferred alternative design, will be relatively similar except for the additional haul road required for this option. The Section 10 alternative would also disturb about five fewer wetland acres near STH 27 than the preferred alternative. These are disturbed, low quality wetlands.

On the other hand, the Section 10 alternative disperses the facilities, in this case the Type I stockpile, to the east side of STH 27, thus affecting a larger area. Visually, Section 10 changes in land use will be perceived as more dramatic. In other words, it will appear in the public's perception that the mine operation affects more land area because waste material stockpile areas will be located on both sides of STH 27. The haul road bridge over the highway and the haul road will remove an additional 0.8 acre of old field and 0.5 acre of Section 10.

4.4.2.8 Aesthetics

A haul road and bridge to pass over STH 27 to transport Type I material to Section 10 cannot be effectively screened from the highway.

On the other hand, because all surface facilities are set back within the required distance from the highway under this option, they would be somewhat less noticeable than the preferred alternative. Placement of screens along the highway as described in Section 5.0 could reduce the visual intrusions of project features.

During operations, the truck traffic and bridge over STH 27 under the Section 10 alternative could present a continual visual intrusion to both north and southbound traffic on the highway as well as increased noise and dust from the traffic crossing the highway. Site reclamation would occur over a one- to two-year period. Truck traffic hauling the backfill into the pit from the Type I stockpile in Section 10 would be continual during operating hours. Under the preferred alternative, haul distance of backfill material will be shorter, and less traffic will result.

4.4.2.9 Socioeconomics

The estimated number of additional truck drivers that would be required over the life of the project, given the Section 10 alternative are summarized below:

	Construction	Operations						Reclamation	
Year	0	1	2	3	4	5	6	7	8
Additional Truck Drivers	5	4	5	3	1	4	5	5	6

The additional five truck drivers required for the Section 10 alternative would have only minor additional benefits on the local area.

4.4.2.10 Summary and Conclusions

Several impact differences exist between Section 10 storage of Type I material when compared to the preferred alternative. Section 10 was selected as an alternative in an attempt to locate the project facilities out of the highway setbacks. These setbacks were designed to minimize adverse visual impacts to the traveling public. However, in order to comply with these setbacks, the construction of a bridge over STH 27 would be necessary. The aesthetics of STH 27 would be dramatically impacted by the bridge and haul road approaches.

The section 10 alternative disperses the project facilities from a compact area of 175 acres in Section 9 to both sides of the highway. It would therefore appear in the public's perception that the mine operation affects considerably more land since waste stockpiles would now parallel both sides of the road.

Operational procedures pose several environmental concerns not raised by the preferred alternative. These are: significantly increased truck haulage distances; an increase in aesthetic impacts due to the bridge; consumption of more diesel fuel; more trucks required to haul the waste material; increased noise impact area; and potential for release of more fugitive dust.

The Section 10 alternative was rejected because it would not achieve the intended objective of minimizing the impacts on aesthetics along STH 27.

4.4.3 Topsoil Location Alternatives

This alternative is presented in Section 2.4.3.3. Impacts from this alternative are the same as those identified under the preferred alternative except as noted below.

4.4.3.1 Air Quality

The vehicular traffic variations between the three alternative stockpile locations are very minor due to the small volume of topsoil to be stockpiled and the similar distances of the alternative locations from the center of the active area to be stripped. TSP emissions during construction and reclamation under the two options for the topsoil stockpiles are within five to ten percent of the preferred location.

4.4.3.2 Groundwater

An alternative location to the preferred alternative for topsoil storage is the gravel pit to the northwest of the open pit. The waste characterization study showed that the topsoil is capable of leaching iron and manganese. Gravel usually does not have the capability to sorb significant quantities of metals. Therefore, the gravel pit location would result in more leached metals reaching the groundwater. This likelihood, combined with the fact that the gravel pit location is closer to the private wells at the Kennecott-owned residences along the river south of Blackberry Lane, means that the impact on groundwater quality could be greater under this alternative than under the preferred alternative.

4.4.3.3 Terrestrial Biology

Two alternative topsoil storage sites under consideration and the preferred alternative are located within Section 9. The preferred layout of the stockpile affects 7 acres of old field/early successional plant communities. Location of the

stockpile between the abandoned gravel pit and the open pit area would affect old field/early successional and upland mixed forest communities of about the same area. These areas will be reclaimed after nine years so the impacts would be temporary.

Placement of the stockpile in the abandoned gravel pit would not affect any natural communities. It will also not allow access to a portion of the gravel resource during the construction, operation, and reclamation phases.

4.4.3.4 Land Use

Neither topsoil alternative will have significant land use disturbances. For example, there will be no wetlands or residential homes impacted under any of the topsoil siting alternatives.

4.4.3.5 Aesthetics

The topsoil stockpile location alternatives placed the topsoil, which is removed from the site during construction, away from STH 27. Visual intrusion of the pile will be removed from the highway corridor if either alternate site west of Type I stockpile or in the abandoned gravel pit is selected. However, the alternative locations would not provide the screening effect achieved with the preferred topsoil stockpile with respect to pit noise, truck egress from the pit, and related operations. Other screening measures would have to be provided. Since the alternative stockpile locations are not in the observation area, another structure would be required.

4.4.3.6 Summary and Conclusions

Locating the soil stockpile at the preferred alternative site has several distinct advantages. Siting topsoil at the east end of the open pit provides a visual barrier between the mine and STH 27. This berm will quickly support vegetation, thus providing the public with a pleasing vantage point from which to view the operation.

Two alternatives were considered in an attempt to remove the project facilities out of the highway setback. These sites were rejected since the haul distance was increased, neither site was as centrally located as the STH 27 site, and an increase in potential environmental impacts such as noise was possible. The gravel pit site was not further considered since additional gravel could be required during various phases of the mining operation and access to this material could be blocked by the topsoil. Environmental benefits of using the already disturbed area were considered negligible.

4.4.4 Truck Versus Rail Haul Alternatives

This alternative is presented in Section 2.5.2. Impacts from this alternative are the same as identified under the preferred alternative except as noted below.

4.4.4.1 Air Quality

Appreciably higher vehicular emissions are associated with truck haul of ore to the railroad mainline over the preferred rail spur options. The following table presents the emissions for the truck haul alternative (in tons per year) during construction and operations, which represent an increase in total emissions of approximately 25 percent greater than the preferred alternative.

	Emissions					
	TSP	CO	HC	NO_x	Aldehydes	SO_x
Construction Operations	47	50	7	135	3	15
Year 1	52	16	3	44	1	5
Year 2	52	17	3	46	1	5
Year 3	50	15	3	42	1	5
Year 4	50	14	3	39	1	4
Year 5	45	13	3	38	1	4
Year 6	42	13	3	38	1	4

4.4.4.2 Surface Water

The ore loadout facilities for the truck haul alternative would require the collection of runoff from this site and the transportation of this contaminated water back to the wastewater treatment facilities. The transportation of wastewater in a tank truck over the roadways presents a low risk for spilling the untreated wastewater, which could cause uncontrolled discharges to occur.

4.4.4.3 Aesthetics

Truck haulage will require a bridge over the highway with frequent truck traffic. This presents a visual intrusion that cannot be effectively screened.

4.4.4.4 Socioeconomics

Given the truck versus rail scenario, two additional truck drivers would be required for the first two years of the operations phase with one additional driver required each of the remaining four years of the operations phase. This impact is offset by the additional employment by others under the rail haul alternative.

4.4.4.5 Summary and Conclusions

Truck haulage of ore versus rail haulage to the mainline track was considered. The truck route would be the same as chosen for the rail spur. A costly bridge and approaches would be necessary to convey the loaded trucks over the highway. This would visually intrude the aesthetics of STH 27.

The longer truck haulage increases fuel consumption. At the mainline track a special holding facility for contact water would be required and this water would be conveyed in a tank truck to the wastewater plant for treatment.

While this alternative does remove the inconvenience of rail cars crossing STH 27, it was nevertheless rejected because of aesthetic impacts, adverse economics, and additional contact water handling. It was decided that the few crossings per week by rail cars (about 8 round trips per week) and short time of highway closure (about 3 minutes per trip) did not warrant truck haulage.

4.4.5 Settling Pond Location Alternatives

This alternative is presented in Section 2.5.4. Impacts from this alternative are the same as identified under the preferred alternative except as noted below.

4.4.5.1 Geology

The settling pond location in the gravel pit will not disturb topsoil and subsoils, as would be the case in the preferred location. However, a portion of the pit will not be available for gravel if required for the project.

4.4.5.2 Terrestrial Biology

The alternative settling pond site is within the abandoned gravel pit. This location would have no affect on any natural community. The preferred site temporarily removes 1.4 acres of forest and 4.4 acres of old field community.

4.4.5.3 Land Use

The preferred alternative will temporarily change about 5.8 acres of forest and old field, while the gravel pit will affect 5.8 acres of previously mined land.

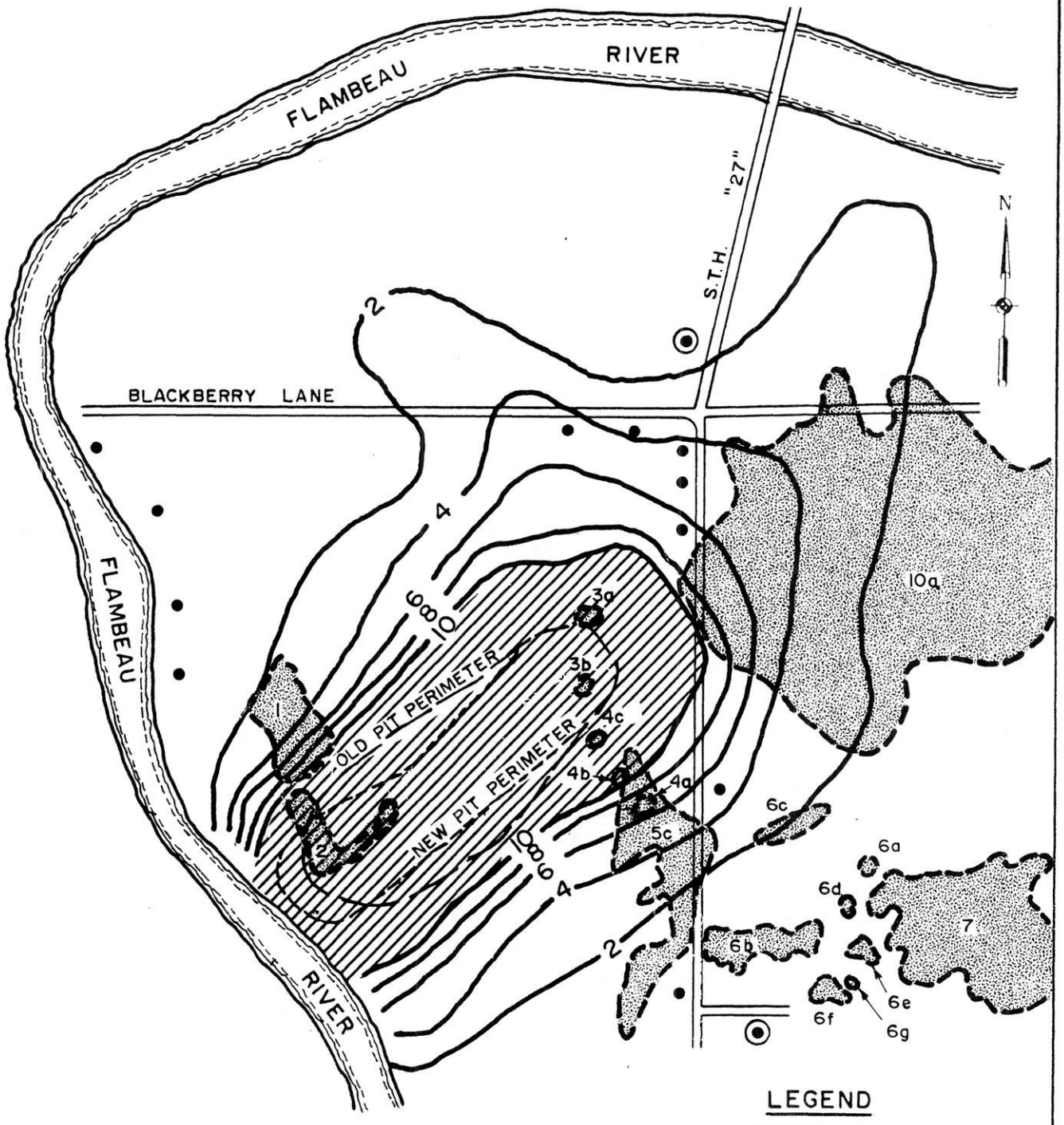
4.4.5.4 Settling Ponds - Summary and Conclusions

Impact differences between the preferred alternative site west of Type I stockpile and the gravel pit location are that a gravity feed system can be used for the preferred alternative. A pump system would be required to lift and transport the

clarified water out of the gravel pit to the river for disposal. In addition, placing the settling ponds in the gravel pit could impede access to gravel throughout the life of the project.

The gravel pit location was not further considered for the above reasons.

Figures for Section 4.0



LEGEND

- WETLAND OUTLINE AND I.D. NUMBER (6f)
- PRIVATE WELL OWNED BY KENNECOTT
- PRIVATE WELL NOT OWNED BY KENNECOTT
- 2 — DRAWDOWN CONTOURS
- ZONE OF DRAWDOWNS >10'

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

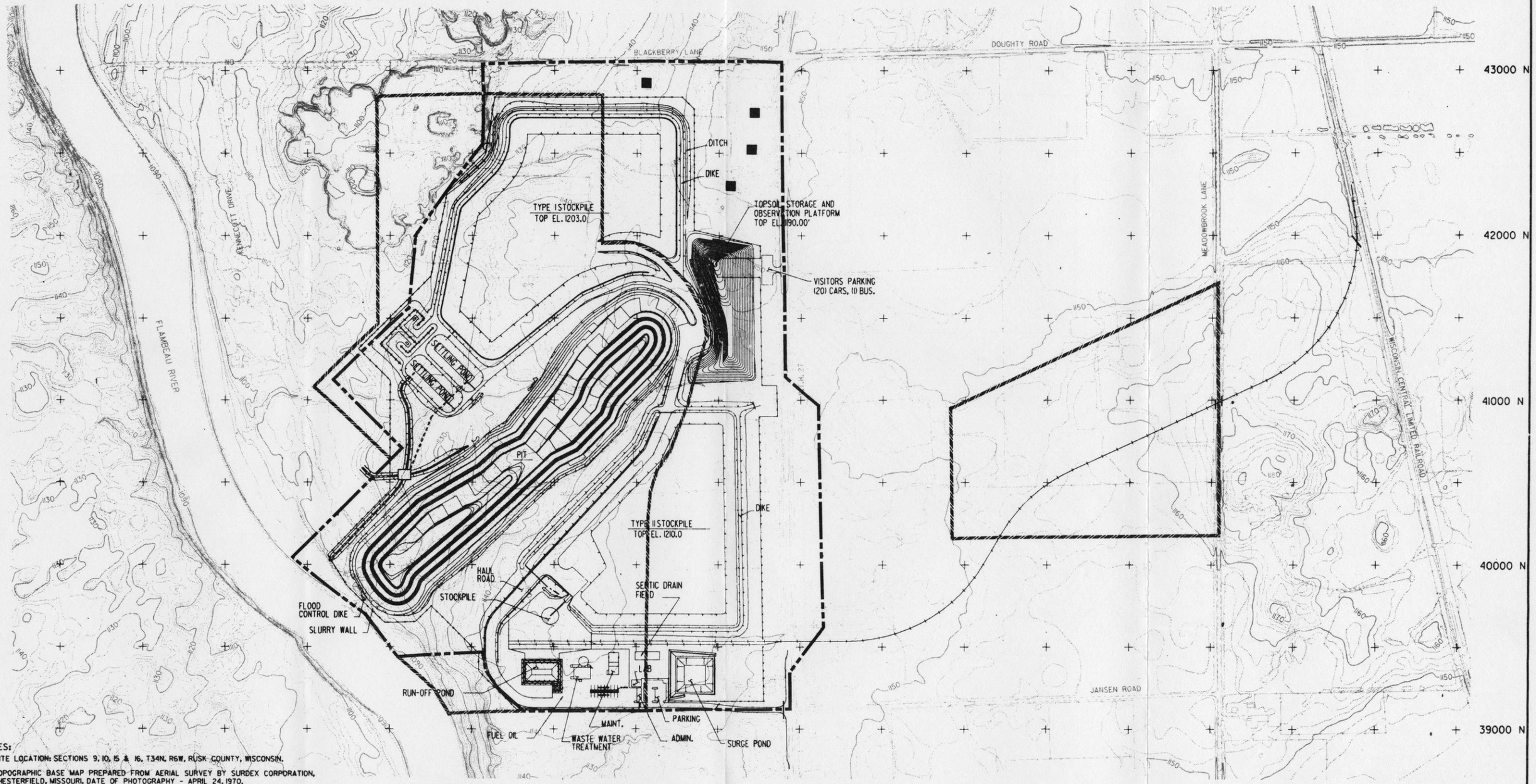
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4.3-1
INTERPRETATION OF MAXIMUM WATER TABLE DRAWDOWN BASED ON 1983 MODEL SIMULATIONS

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	R.M.H.	3/89
	CHECKED BY	B.N.P.	3/89
	APPROVED BY		
	CAD No.	SCALE 1"=1000'	

Job No	Dwg No	REV



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 CORPORATON, 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. 8087 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. MINE FACILITIES DESIGN BY FORD, BACON & DAVIS, INCORPORATED, SALT LAKE CITY, UTAH AND PINCOCK, ALLEN & HOLT, INCORPORATED, LAKEWOOD, COLORADO.

LEGEND

- EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- EXISTING FENCE
- NOISE IMPACT AREA PREFERRED ALTERNATIVE
- NOISE IMPACT AREA ALTERNATIVE
- KENNECOTT OWNED RESIDENCE SUBJECT TO SOME NOISE IMPACT, PREFERRED ALTERNATIVE ONLY

REFERENCES

DWG. NO.	DESCRIPTION

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DWG. NO.	DESCRIPTION

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

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

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GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

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MGR. PROCESS ENG'G.		
ENG'R MGR.		

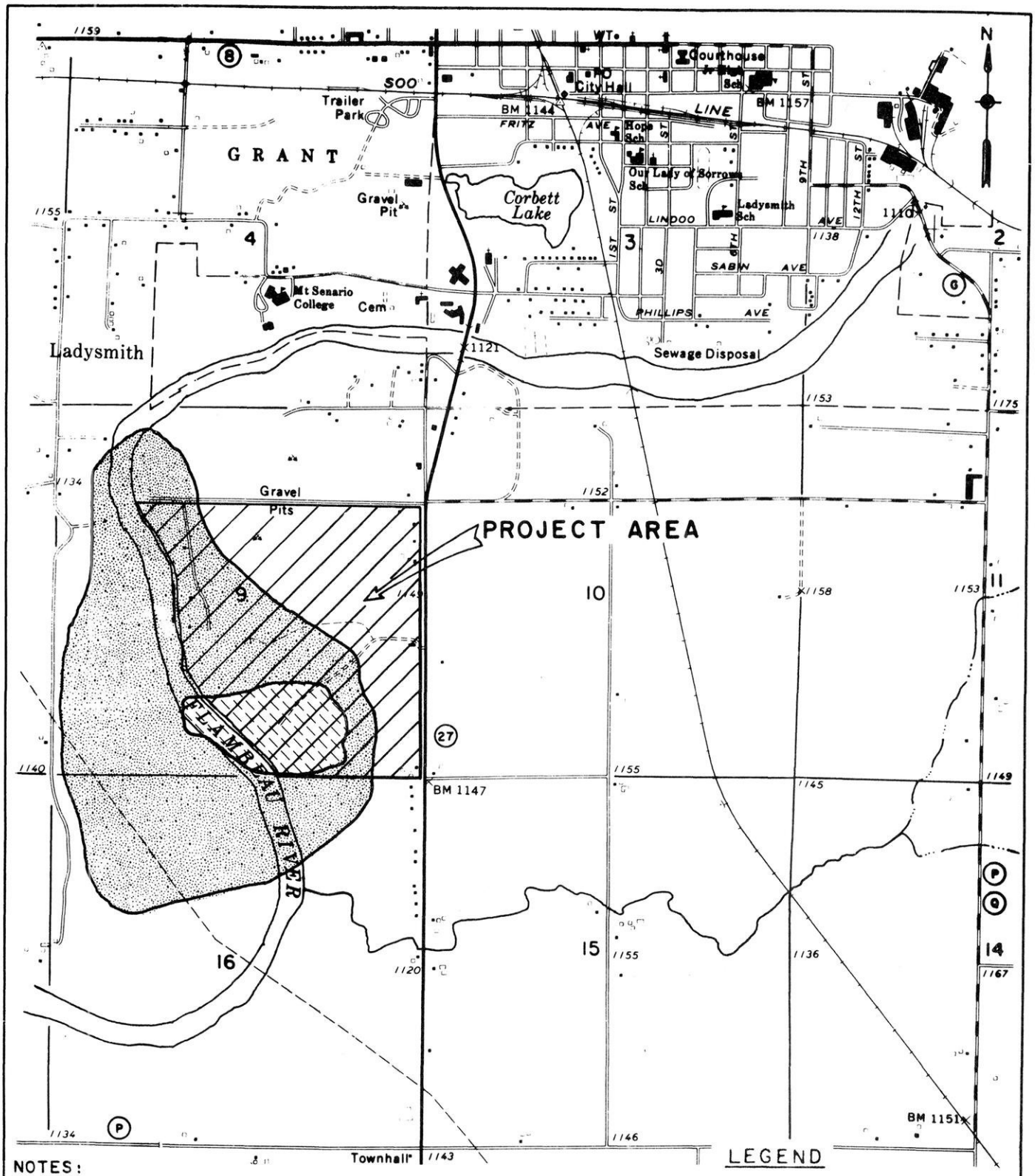
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DRAWN	S.J.L.	MAR. 89
CHK'D	T.J.W.	3/89
DES. ENG'R		
SECT ENG'R		

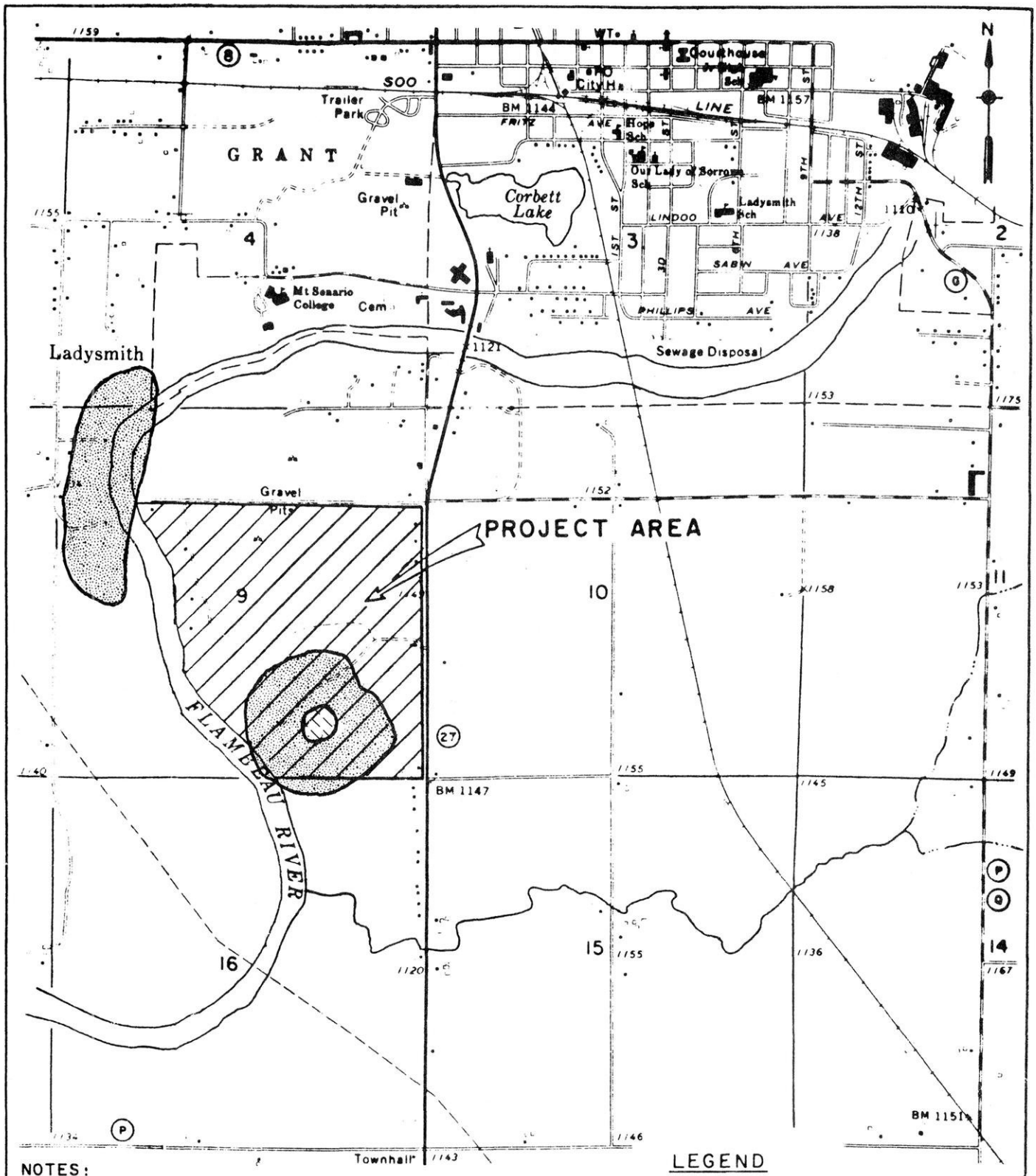
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

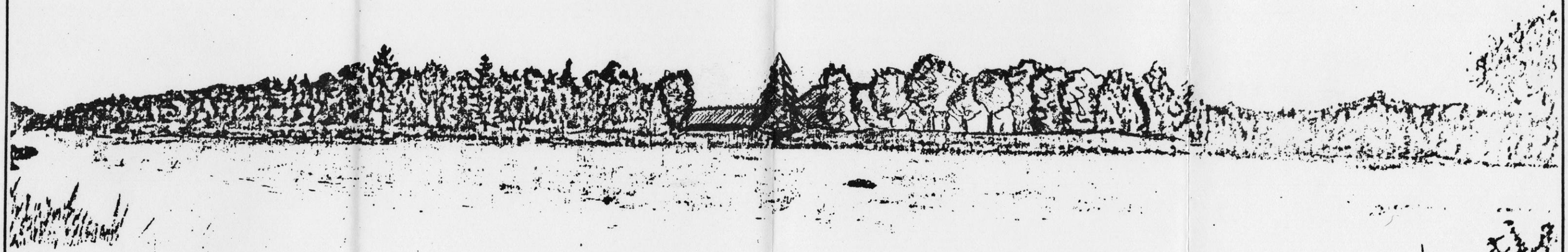
KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

FIGURE NO. 4.3-2
VEHICULAR NOISE IMPACT AREAS

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


N
GRANT
Trailer Park
Gravel Pit
Corbett Lake
Mt Senario College
Cem
Ladysmith
Courthouse
City Hall
Hope Sch
Our Lady of Sorrows Sch
Ladysmith Sch
Sewage Disposal
Gravel Pits
PROJECT AREA
FLAMBEAU RIVER
BM 1144
BM 1157
BM 1147
BM 1151
Townhall
SOO LINE
FRITZ AVE
LINDOO AVE
SABIN AVE
PHILLIPS AVE
1ST ST
3D ST
6TH ST
9TH ST
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Gravel Pit
Corbett Lake
Mt Senario College
Cem
Ladysmith
Sewage Disposal
Gravel Pit
PROJECT AREA
FLAMBEAU RIVER
Courthouse
City Hall
Hope Sch
Our Lady of Sorrows Sch
Ladysmith Sch
LINDOO AVE
SABIN AVE
PHILLIPS AVE
BM 1144
BM 1157
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REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

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

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

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MGR. PROCESS ENG'R		
ENG'R MGR.		

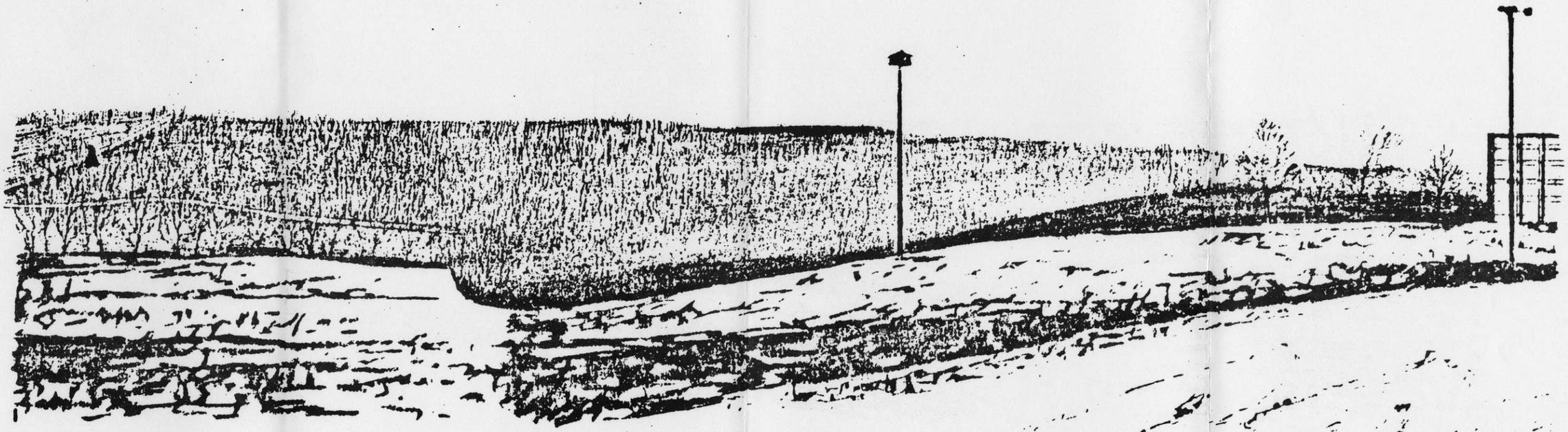
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DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

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84112

FIGURE NO. 4.3-5
AESTHETICS
VIEWPOINT I
PREFERRED ALTERNATIVE

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



P. Plewa

REFERENCES

DWG. NO.	DESCRIPTION

SUPERSEDES

DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHIEF ENG'R

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHIEF ENG'R

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

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DESIGN		
DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

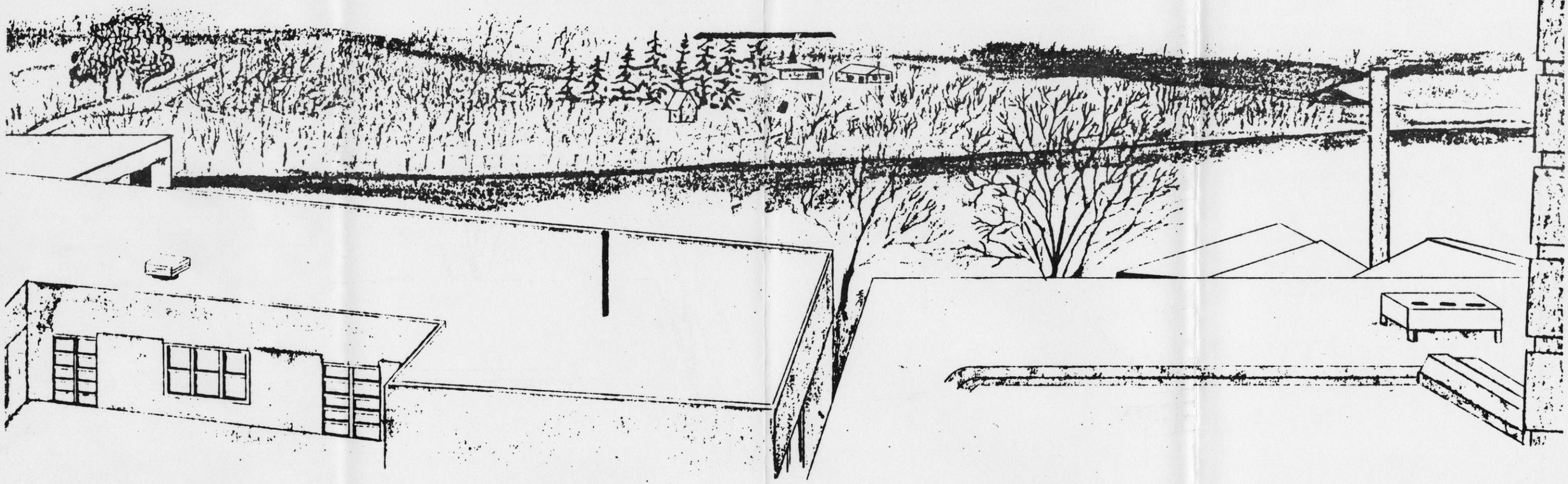
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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FIGURE NO. 4.3-6
AESTHETICS
VIEWPOINT 2B
PREFERRED ALTERNATIVE

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



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FIGURE NO. 4.3-7
AESTHETICS
VIEWPOINT 3C
PREFERRED ALTERNATIVE

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
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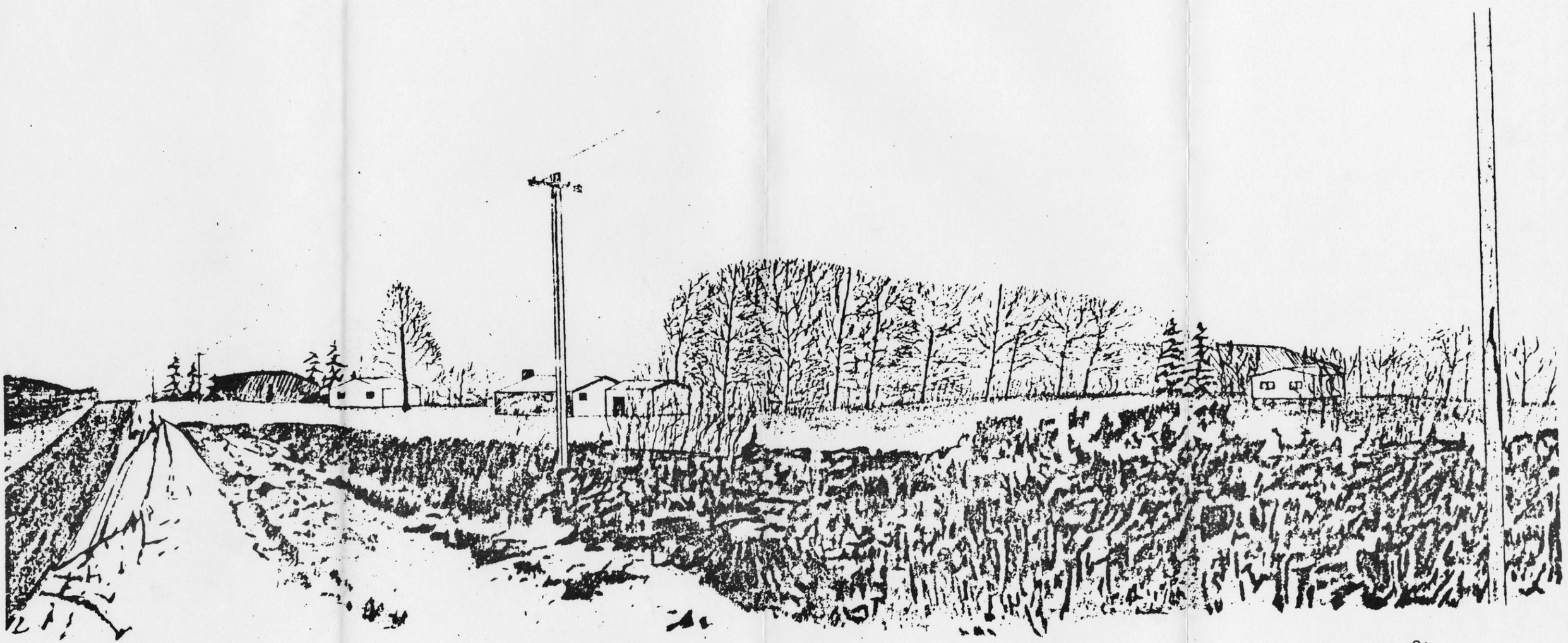
MICROFILM
DRAWING NO.
REV.
DIVISION DRAWING NO.
SCALE NTS

REFERENCES

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

PROJ. ENG'R
MGR. PROCESS ENGR
ENG'R MGR.



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FIGURE NO. 4.3-8
AESTHETICS
VIEWPOINT 5
PREFERRED ALTERNATIVE

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

REFERENCES	DWG. NO.	DESCRIPTION

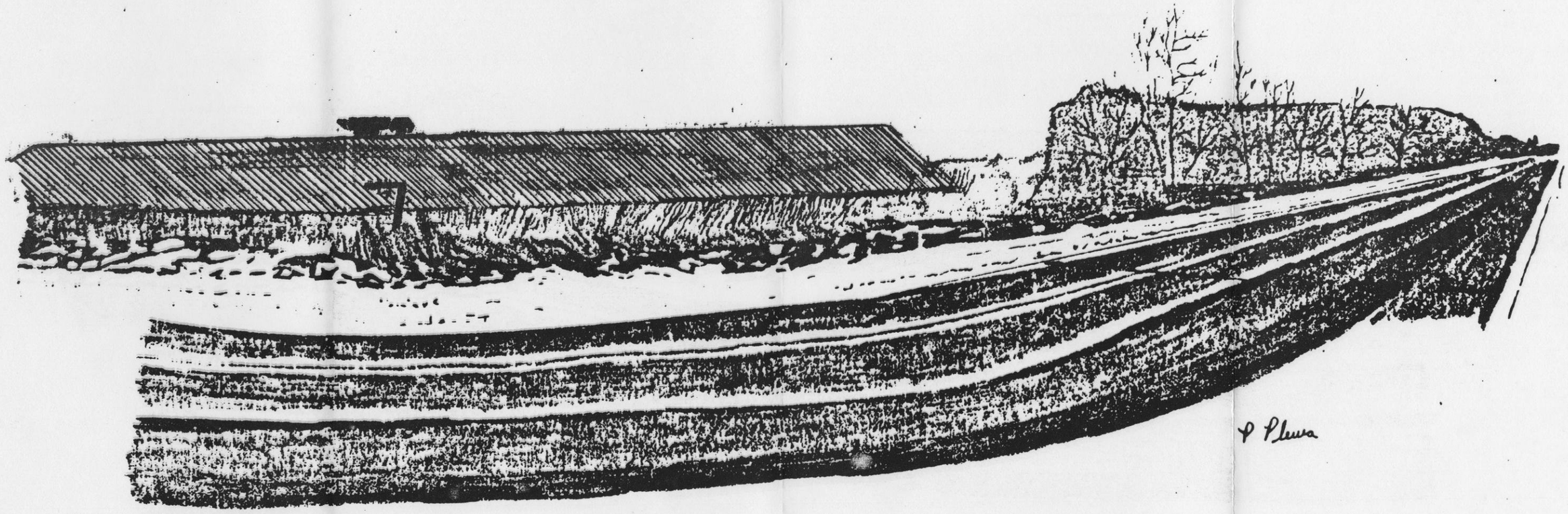
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NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHIEF ENG'R

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MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
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DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SECT ENG'R		



P Plewa

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GREEN BAY, WISCONSIN

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SALT LAKE CITY, UTAH 84112

FIGURE NO. 4.3-9
AESTHETICS
VIEWPOINT 6A
PREFERRED ALTERNATIVE

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		
DESIGN		
DRAWN	PDP	2/89
CH'K'D	PES	3/89
DES. ENG'R		
SECT ENG'R		

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

SUPERSEDES

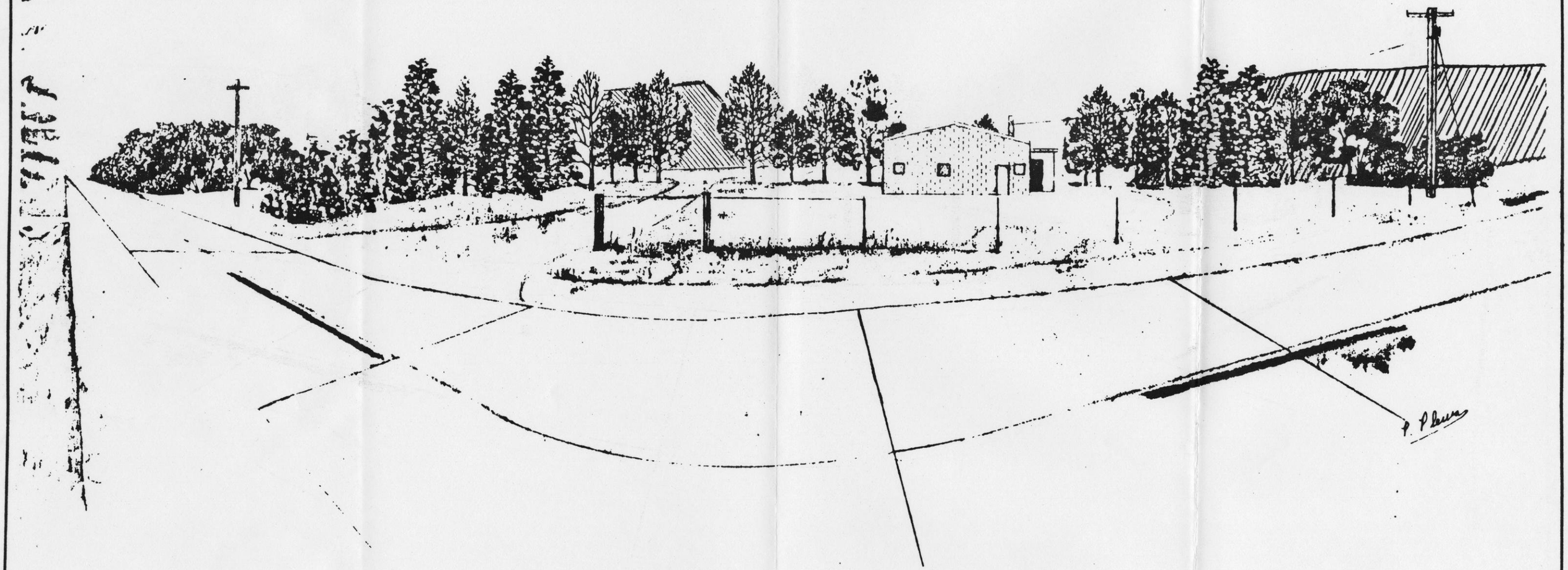
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SUPERSEDED BY

DWG. NO.	DESCRIPTION

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

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



REFERENCES

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DWG. NO.	DESCRIPTION

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

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHIEF ENG'R

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MGR. PROCESS ENG'R		
ENG'R MGR.		

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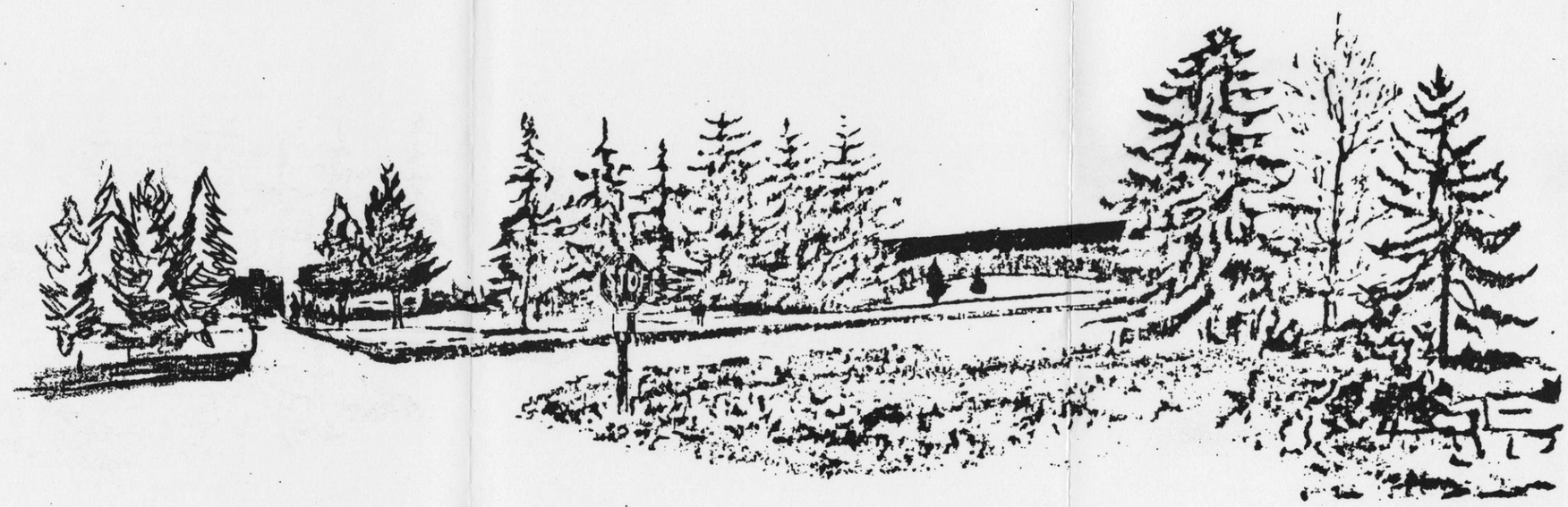
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1515 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

FLAMBEAU PROJECT
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FIGURE NO. 4.3 – 10
AESTHETICS
VIEWPOINT 6B
PREFERRED ALTERNATIVE

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



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FIGURE NO. 4.3 – 11
AESTHETICS
VIEWPOINT 7
PREFERRED ALTERNATIVE

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

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

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DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
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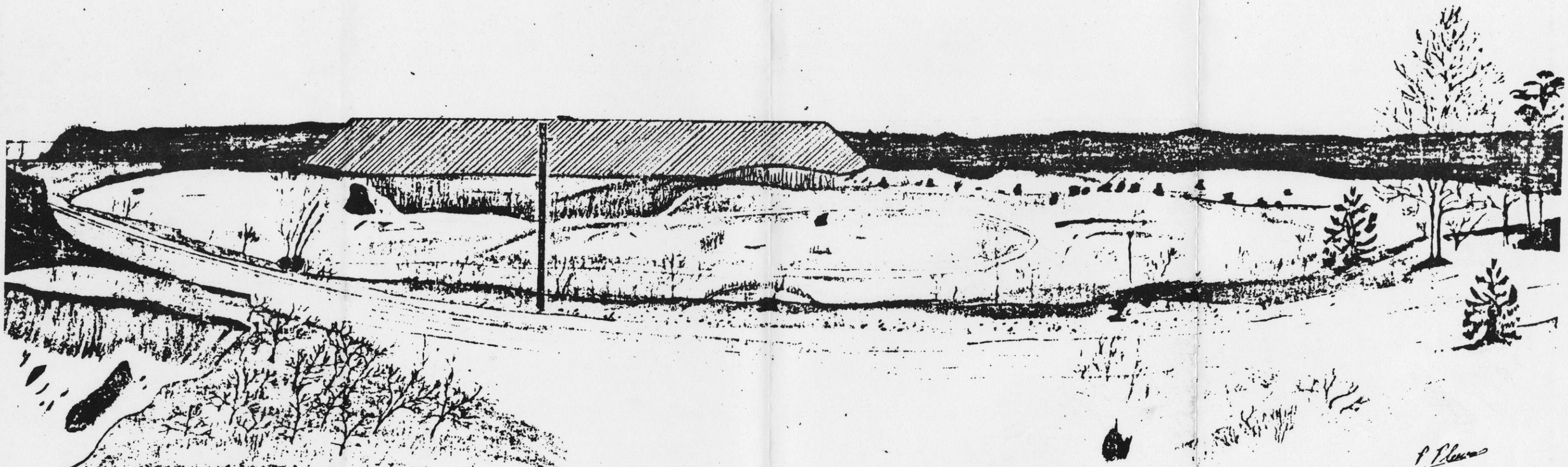
DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

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

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



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SALT LAKE CITY, UTAH
84112

FIGURE NO. 4.3-12
AESTHETICS
VIEWPOINT 9
PREFERRED ALTERNATIVE

	BY	DATE
DESIGN		
DRAWN	PDP	2/89
CHK'D	PES	3/89
DES. ENG'R		
SPCT ENG'R		

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

REFERENCES

DWG. NO.	DESCRIPTION

SUPERSEDES

DWG. NO.	DESCRIPTION

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

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

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

37000 E | 38000 E | 39000 E | 40000 E | 41000 E | 42000 E | 43000 E | 44000 E | 45000 E

43000 N | 42000 N | 41000 N | 40000 N | 39000 N

BLACKBERRY LANE
DOUGHTY ROAD
MEADOWBROOK LANE
ARNNECOTT DRIVE
FLAMBEAU RIVER
WISCONSIN CENTRAL LIMITED RAILROAD
RAILROAD SPUR (1)
JANSEN ROAD

DITCH
DIKE
TYPE I STOCKPILE
TOP EL. 1203.0
TOPSOIL STORAGE AND OBSERVATION PLATFORM
TOP EL. 1190.00'
VISITORS PARKING
(20) CARS, (1) BUS.
ELECTRIC FEEDER LINE
SETTLING POND
SETTLING POND
PIT
DIKE
TYPE II STOCKPILE
TOP EL. 1210.0
HAUL ROAD
STOCKPILE
SEPTIC DRAIN FIELD
FLOOD CONTROL DIKE
SLURRY WALL
T-1
LAB
RUN-OFF POND
MAINT.
PARKING
FUEL OIL
WASTE WATER TREATMENT
ADMIN.
SURGE POND
E-2
E-1
UT-1
UT-2

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 CORPORATON, 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 =	587,357.8087 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. MINE FACILITIES DESIGN BY FORD, BACON & DAVIS, INCORPORATED, SALT LAKE CITY, UTAH AND PINCOCK, ALLEN & HOLT, INCORPORATED, LAKEWOOD, COLORADO.

LEGEND

- 1100 — EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- (T-3) AFFECTED UTILITY
- T - OVERHEAD TELEPHONE LINE
- UT - UNDERGROUND TELEPHONE LINE
- E - OVERHEAD ELECTRIC LINE
- G - NATURAL GAS PIPELINE

N

0 300' 600'
SCALE

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84112

FIGURE NO. 4.3-13
PROJECT UTILITIES
AND IMPACTS
PREFERRED ALTERNATIVE

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

REFERENCES	DWG. NO.	DESCRIPTION

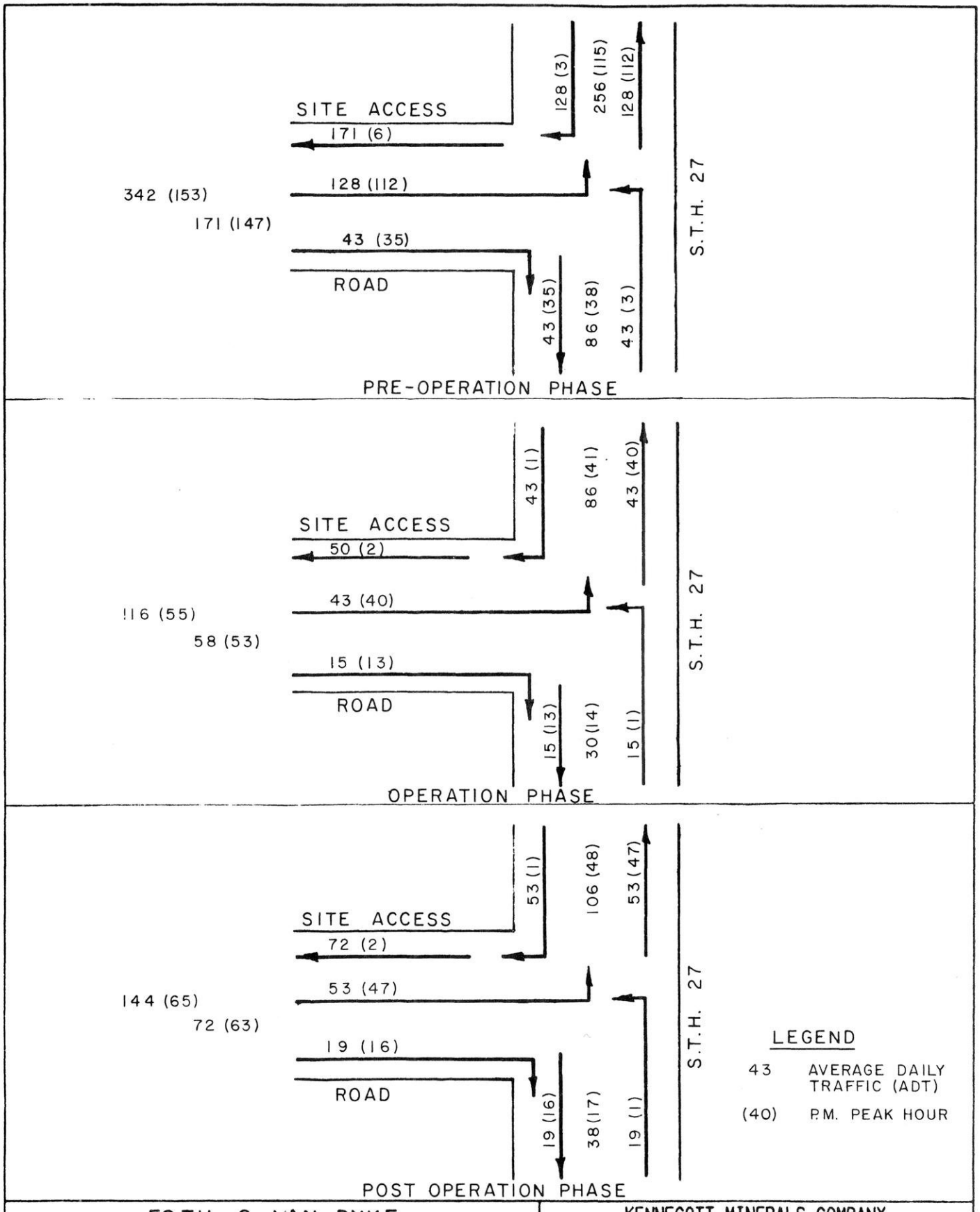
REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'D	ENG'R	ENG'R MGR.

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

	BY	DATE
DESIGN		
DRAWN	S.J.L.	MAR. 89
CH'D	T.J.W	3/89
DES. ENG'R		
SECT ENG'R		



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KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4.3 - 14
SITE GENERATED TRAFFIC
PREFERRED ALTERNATIVE

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	R.D.M.	3/89
	CHECKED BY	T.J.W.	3/89
	APPROVED BY		
	CAD No.	SCALE NONE	

Job No	Dwg No	REV

5.0 Mitigation of Impacts

Many of the unavoidable impacts of the project described in Section 4.0 can be mitigated by certain measures that are installed or otherwise used to reduce the impacts on the local environment. Mitigation measures will be discussed by subsections presented in Section 4.0.

5.1 Historical and Archaeological Resources

No mitigation is required because there are no known historical or archaeological resources in the project area.

5.2 Air

The dust suppression measures described in the Mine Permit Application and the Air Permit Application will be sufficient to control fugitive emissions from the project area. The project will be designed to meet applicable ambient air standards. No further mitigation is necessary.

5.3 Geology

The Reclamation Plan for the project details the backfilling of the mine pit and the replacement of soil so as to return the site to approximately its pre-project topography. Soil management practices will preserve the topsoil for use in reclamation. Backfilling plans will not prevent future use of the remaining mineralization should economic conditions change.

5.4 Groundwater

The backfilling plan for the open pit includes the addition of lime to maintain acceptable pH levels in the groundwater. This addition of neutralizing material will keep the groundwater quality within acceptable levels.

Wetland Area 1 to the northwest of the open pit will be preserved by replenishing groundwater which may be temporarily interrupted due to groundwater drawdown. The functions of this wetland will not be altered as result of providing an alternate clean water source to replace the existing inflow to this area, if it is interrupted.

5.5 Surface Water and Sediments

The careful management and treatment of runoff water from the site will prevent the off-site release of pollutants. The minor releases of suspended sediment during construction activities for the two outfall structures on the banks of the river will be temporary and short-term. Therefore, there will be no adverse effects of the project on surface water or sediment resources that will require mitigation.

Reclamation plans will return the temporarily disturbed surface drainage patterns to approximately their original configuration. The watershed size and character of the three post-reclamation intermittent streams in the project area will not be significantly changed or altered from the pre-project conditions.

Reclamation of the stream bank at the outfall locations after removal will consist of bank stabilization measures effective for long-term protection.

5.6 Aquatic Biology

The aquatic community of the Flambeau River will not be significantly affected by the project. The minor releases of sediment that may occur during construction of the banks of the Flambeau River will be short-term and minor and are not expected to be significant, nor will they require mitigation.

Wetland communities that will be unavoidably lost as a result of the project will be replaced during reclamation with reconstructed wetland areas. The reclamation plan in the Mine Permit Application describes the area and type of wetlands to be provided as mitigation for the loss of communities.

5.7 Terrestrial Biology

The impacts on the terrestrial communities will be mitigated during the reclamation period. Habitats that are lost will be replaced with similar communities that are characteristic of pre-project conditions and those found in the region.

A primary objective of the surface reclamation plan will to provide wildlife habitat.

Wetlands peripheral to the affected area will retain their biololgical functions due to their hydraulic isolation from groundwater or through mitigation addressed in Section 5.4.

5.8 Noise

The crusher will be the primary source of mine-related noise that will affect the areas as outlined in Section 4.0. In order to mitigate noise that will be heard from the Flambeau River (the only area outside of Kennecott-ownedproperty that will be affected), there will be a tree screen created using transplanted trees from areas over the Type II stockpile and the pit. This screen will reduce the noise impact from the crusher, which is expected to operate about four hours per day, on the river just west of the crusher location.

5.9 Land Use

The short-term changes of the proposed project on land use will be mitigated during reclamation. Land uses after the project will be similar to pre-project uses such as agriculture and open space.

5.10 Aesthetics

The viewpoints selected for analysis in Sections 3.0 and 4.0 are presented in Figure Nos. 5.10-1 through 5.10-5 with mitigative screening simulated. These figures demonstrate that strategically placed trees and shrubs will effectively screen the visual impacts described in Section 4.

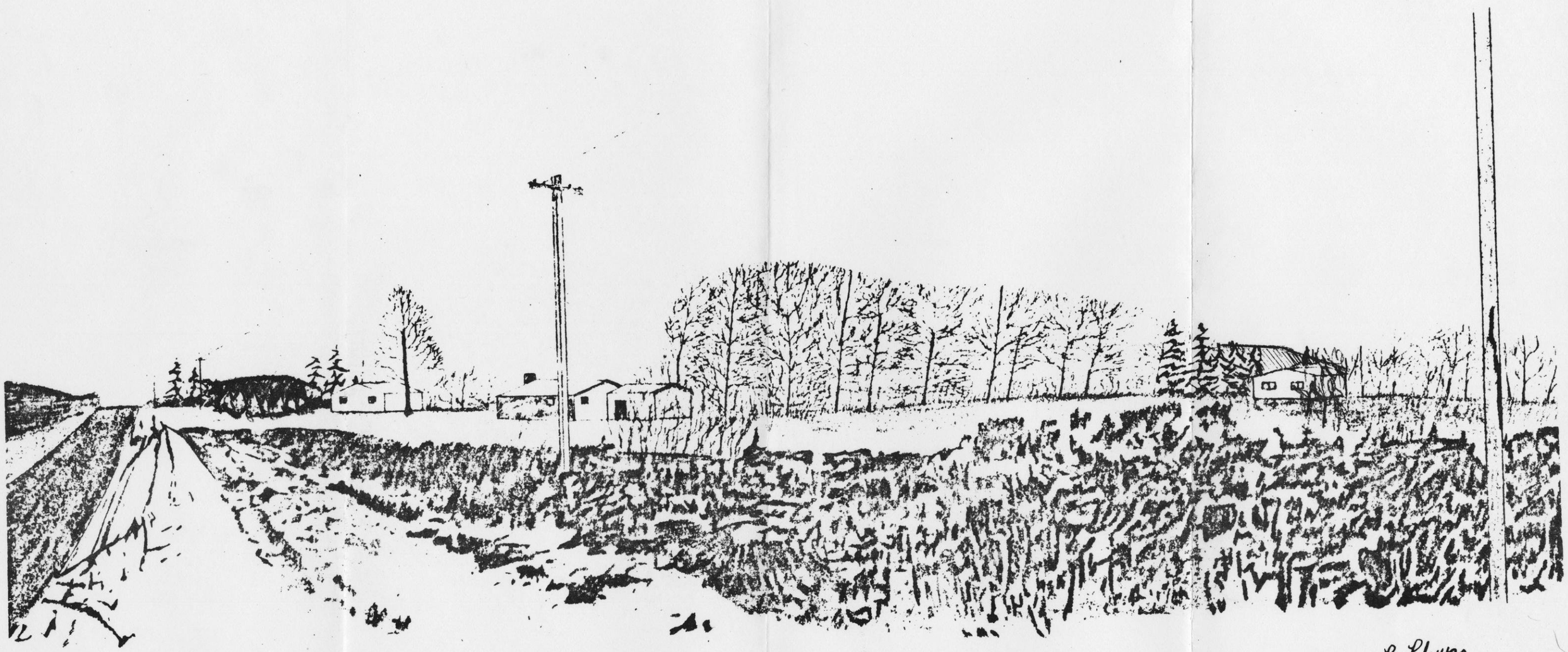
The temporary aesthetic intrusions the project will cause on the surrounding areas will be mitigated by tree and shrub plantings and berms placed at locations that will screen and/or break up the views of the major project features. Figure No. 5.10-6 shows these proposed plantings in relation to the proposed project facilities and strategic viewpoints.

5.11 Socioeconomics

Socioeconomic impacts of the project are primarily associated with economic benefits to be realized by the community in the form of jobs and related additional income and increased tax revenues. Because there will be no significant adverse impacts, mitigation is unnecessary.

Impacts on the transportation system and utilities are also very minor and need not be mitigated.

Figures for Section 5.0



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FIGURE NO. 5.10-1
AESTHETICS
VIEWPOINT 5
VISUAL MITIGATION

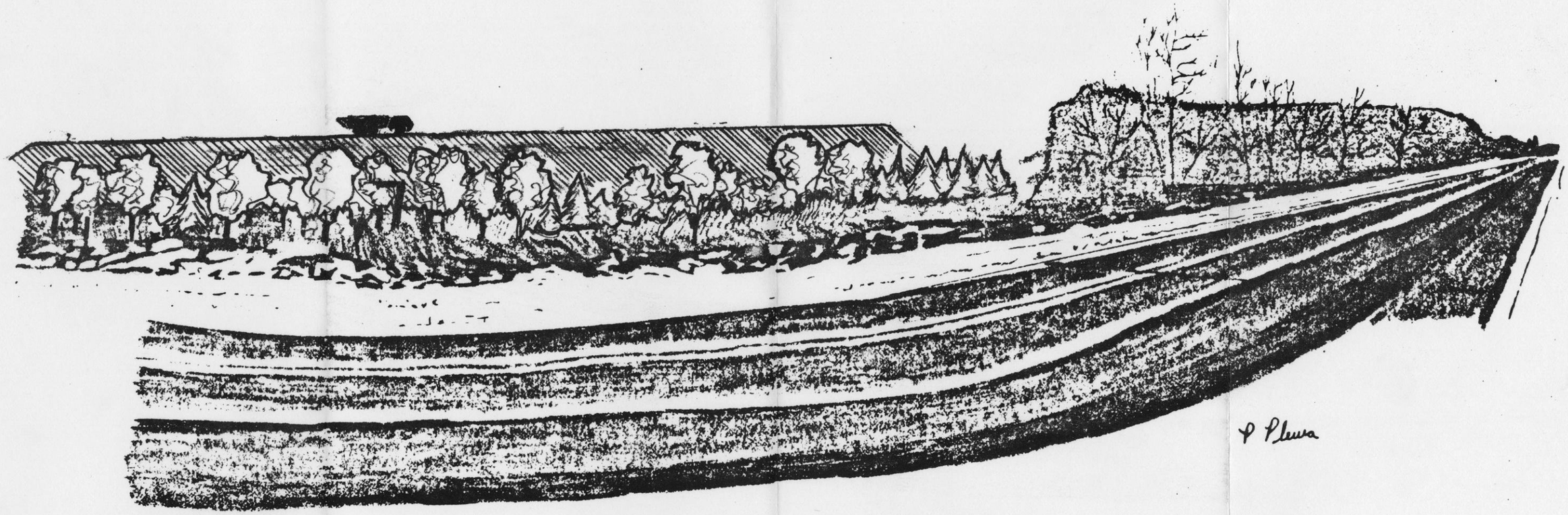
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FIGURE NO. 5.10-2
AESTHETICS
VIEWPOINT 6A
VISUAL MITIGATION

	BY	DATE
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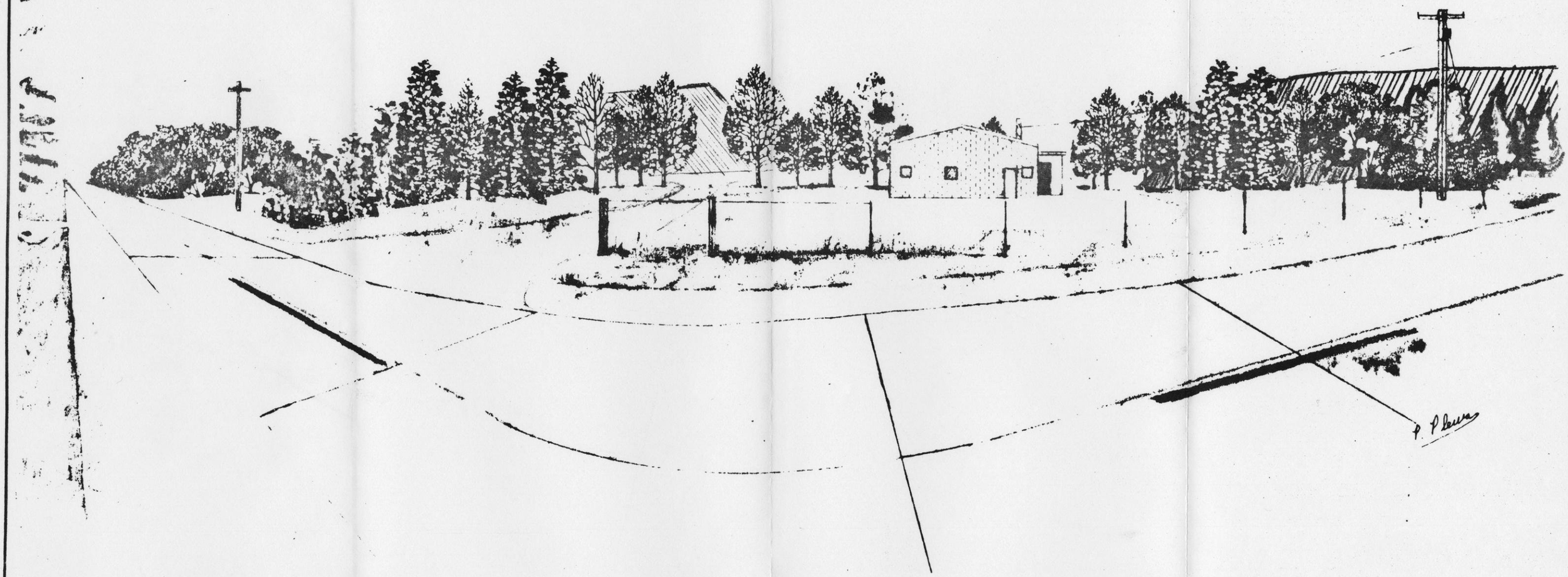
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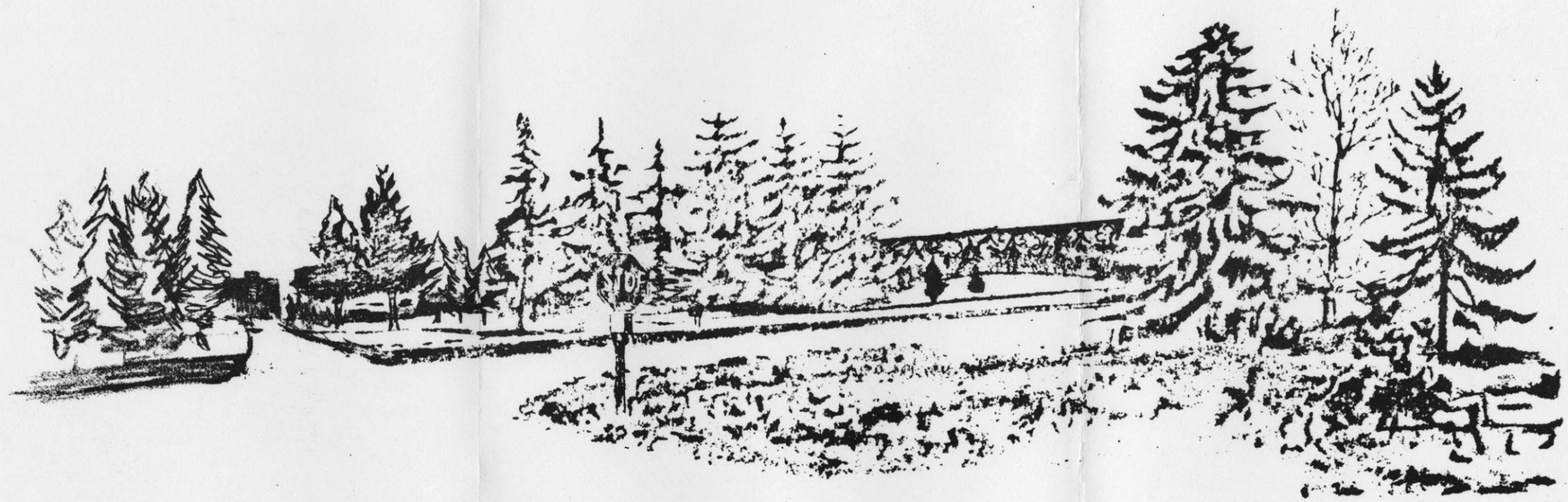
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FIGURE NO. 5.10-3
AESTHETICS
VIEWPOINT 6B
VISUAL MITIGATION

MICROFILM	JOB
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FIGURE NO. 5.10 - 4
AESTHETICS
VIEWPOINT 7
VISUAL MITIGATION

MICROFILM | JOB
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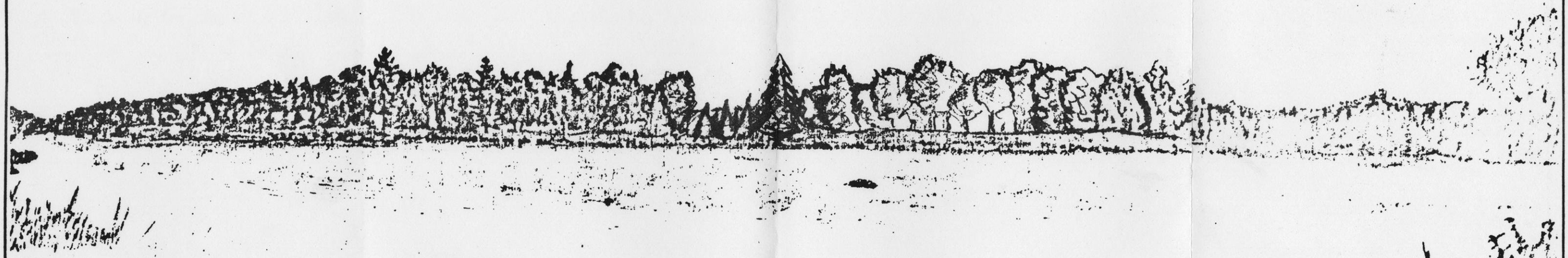
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FIGURE NO. 5.10-5
AESTHETICS
VIEWPOINT 1
VISUAL MITIGATION

REFERENCES	DWG. NO.	DESCRIPTION

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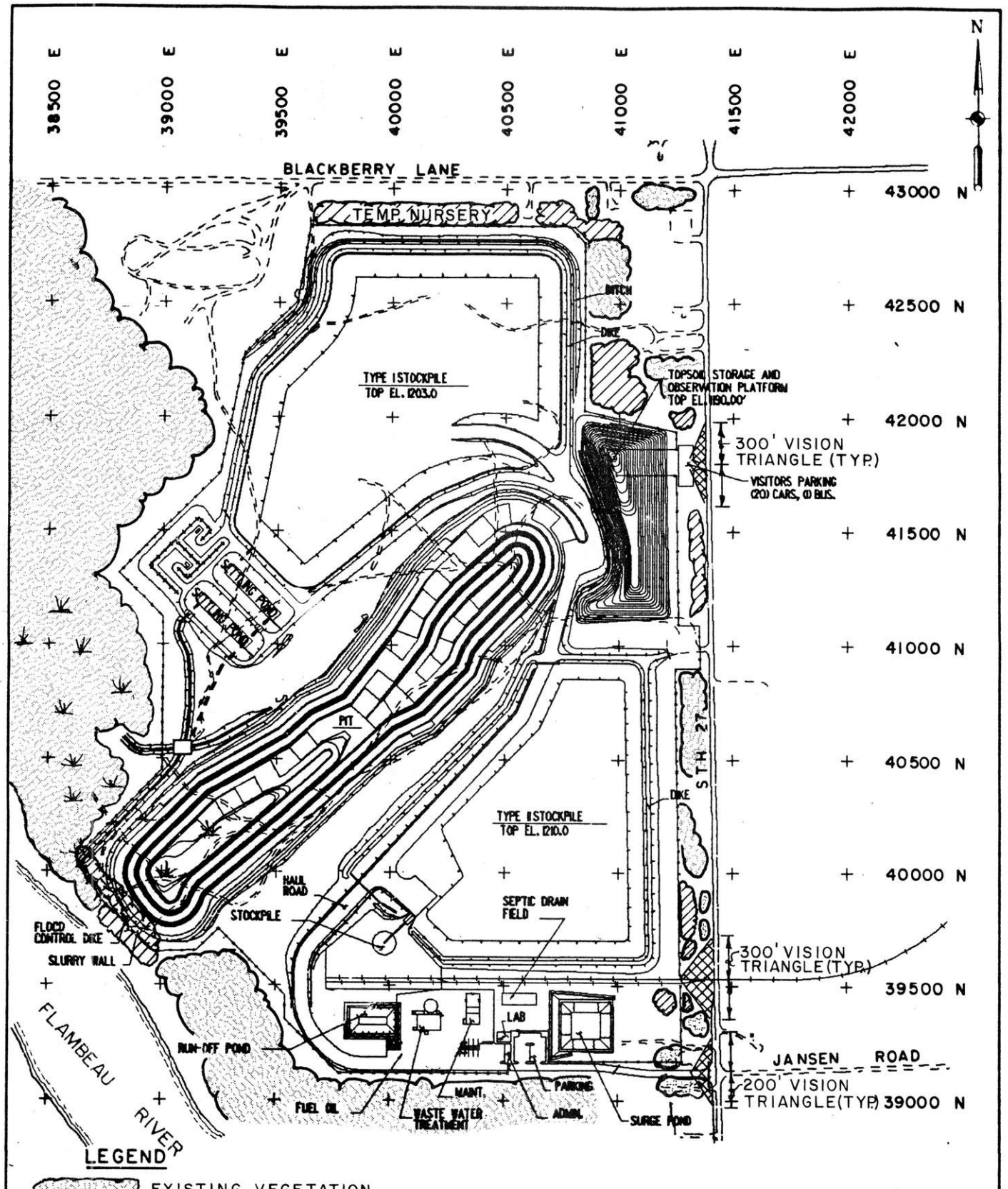
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NOTES	APPROVAL	DATE	FIGURE NO. 5.10-6 MITIGATION PLAN
	DESIGNED BY		
	DRAWN BY SJL	1/89	
	CHECKED BY PES	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 600'		Job No / Dwg No / REV

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