[Final environmental impact statement: Flambeau Mining Co., copper mine, Ladysmith, Wisconsin]. 1990

Madison, Wisconsin: Department of Natural Resources, Bureau of Environmental Analysis and Review, 1990

ENVIRONMENTAL IMPACT STATEMENT PROCESS

Flambeau Mining Co., a wholly owned subsidiary of Kennecott Corporation, has applied to the Department of Natural Resources (DNR) for permits and approvals necessary to construct an open pit copper mine near Ladysmith, Wisconsin. Before the DNR can act on the permit applications, it must prepare an Environmental Impact Statement (EIS) on the project. The purpose of an EIS is to describe the company's proposal and the Department's analysis of the likely environmental impacts from that proposal. Although the EIS assists the Department in making regulatory decisions, the EIS does not determine whether the project is approved. Decisions on the project are made by reviewing permit applications and determining if the project would meet state regulations. If the technical review concludes that the project would meet the criteria established in the regulations, the Department must, by law, issue the permits.

A Draft EIS (DEIS) was published on September 6, 1989 and circulated for public and government agency review. The comments received on the DEIS were used to develop this Final EIS (FEIS). A summary of public comments, government agency comments, and DNR responses are contained in Chapter Five.

This FEIS is being circulated to government agencies and the public for review. Government agencies may provide written comments within 80 days of the issuance of the FEIS. Individuals may comment in writing within 120 days of the document's release.

A Master Hearing considering both the FEIS and the permit applications will be held approximately 120 days after the FEIS is issued. Individuals can provide verbal comments at this hearing. Scheduling and public notice of the hearing will be completed within 30 days after the FEIS release.

Specific questions relating to the FEIS for the proposed Flambeau mine, or to EIS procedures should be directed to Mr. Robert Ramharter of the Bureau of Environmental Analysis and Review at 1-608-266-3915.

Comments on the FEIS should be sent to:

Mr. George Albright, Chief EIS Development Section
Bureau of Environmental Analysis and Review
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

EIS SUMMARY

Note to the Reader: This Final EIS presents the project as proposed by Flambeau Mining Co. and the DNR's analysis of the potential impacts from that proposal. The proposal and associated impacts may change depending upon the final permit decisions and the conditions attached to any permits.

PROJECT DESCRIPTION

Flambeau Mining Co., a wholly owned subsidiary of Kennecott Corporation, proposes to mine by the open pit method a small copper ore deposit near Ladysmith, Wisconsin. The ore deposit contains economically valuable quantities of copper and gold. At its maximum size, the open pit would be 32 acres in size and would be approximately 550 feet wide, 2,600 feet long and 225 feet deep. The pit would be within 140 feet of the Flambeau River at its closest point. Ore produced at a rate of approximately 1,300 tons per day (320,000 tons/year) would be crushed and shipped via rail to an existing out-of-state processing plant.

Major project facilities, other than the open pit, include: stockpiles for ore, waste rock, glacial overburden, and topsoil; an ore crusher; a haul road; a wastewater treatment plant; runoff control basins; a rail spur; and various support buildings. About 181 acres in total would be physically disturbed by project activities.

Low sulfur waste rock, containing less than 1% sulfur, and glacial overburden would be stored on a 40-acre, 60-foot high, unlined stockpile north of the pit. High sulfur waste rock, containing greater than 1% sulfur, would be stored on a 27-acre, 70-foot high, lined stockpile located south of the pit. Surface runoff and groundwater inflow to the pit contaminated by contact with the high sulfur waste rock or the orebody would be treated in the wastewater treatment plant. This treatment plant has been designed to handle a maximum of 800 gallons per minute, with the open pit serving as a major storm emergency sump.

Ore removal is anticipated to last approximately six years. Full scale ore removal would be preceded by a nine-month construction phase and followed by a nineteen-month reclamation phase. During the construction phase, about 70 employees would be on-site. The project workforce would peak at 160 employees during a four-month period when facility construction and preproduction mining would occur simultaneously. About 60 people would be employed on-site during the operating and reclamation phases of the project. A majority of the employees would probably reside in or within 10 miles of the Rusk County border.

Reclamation of the project area would return the site to its approximate original contours. All waste rock, glacial overburden, and soils would be returned to the open pit in their approximate original sequence after mining has been completed. The high sulfur waste rock would be placed in the bottom of the mined out pit to minimize the potential for contamination of the overlying aquifers and surface water. The entire site would be replanted to grassland and trees. Wildlife habitat and passive recreation would be the final land uses. A 7.5 acre wetland would be created over the western end of the reclaimed pit.

Project monitoring would address groundwater, surface water, terrestrial ecology and meteorology. The company would be permanently responsible for monitoring and maintaining the site and for any environmental or property damage which results from the mine.

AFFECTED ENVIRONMENT

The proposed mine site is located in rural northwestern Wisconsin, about one mile south of the City of Ladysmith in Rusk County. The area's economy is sustained by agricultural, tourism and paper making activities. Land use at the project site consists of forest lands, old fields, and active farming areas. The

Flambeau River, directly west of the proposed open pit, has good water quality and supports a healthy warm water fishery. Groundwater occurs primarily in the glacial outwash and sandstone at the mine site. Groundwater quality is good. Groundwater is the source for the private (45 wells) and public water supplies in the area. No rare or endangered species are known to exist on the site though eagles in the area fish along the river.

ENVIRONMENTAL IMPACTS

The project would directly impact about 181 acres of land, including 8 acres of wetlands. An additional 11 acres of wetland may be indirectly impacted by the mine-induced decline in the groundwater table. No threatened or endangered species of plants or animals would likely be affected.

Waste rock from the mining operation would have the potential to leach contaminants to ground and surface waters. Segregating the high sulfur waste and storing it on a lined facility would limit the movement of contaminants to the groundwater during the mine operation. Backfilling waste rock into the pit during the project reclamation would minimize the flow of water through the waste over the long term. As a result, no widespread adverse impacts to groundwater quality would be expected.

Pumping water from the pit would cause a drawdown of the groundwater in the mine vicinity. The groundwater drawdown would continue to expand for several years after the project ends, and would extend up to about 1/2 mile from the edge of the pit. After the project, groundwater levels would recover relatively quickly, but may require several decades to actually reach pre-mining conditions. Water table elevations immediately over the pit would be permanently lowered by 1-4 feet. Several private wells north of the mine may experience 2-8 feet of drawdown and could be adversely affected. Flambeau Mining Co. would be responsible for replacing any water supplies impacted by the mining project.

Treated wastewater from the mining project would be discharged into the Flambeau River. Wastewater quality would have to meet regulatory limits and the proposed treatment system, if properly operated, appears capable of adequately treating the wastewater. Bioassay tests conducted by Flambeau Mining Co. on synthesized effluent indicated no acute or chronic effluent toxicity. However, the wastewater could nonetheless have unanticipated effects due to synergism or to the presence of unexpected chemicals. Monitoring, testing with bioassays, and prompt corrective actions would be necessary to insure that no adverse impacts to aquatic life would occur.

Impacts to stream and river flows would be minor. One intermittent stream would be removed by the project, and flows in two intermittent streams would be slightly reduced. No significant impacts to flows in the Flambeau River or in Meadowbrook Creek would occur.

The primary air pollutant emitted from the project would be dust. If dust suppression measures were used, total dust emissions would be about 53 tons per year and the project would not result in violation of any air quality standards.

Noise would be primarily generated from truck operations, ore crushing, and blasting. Residences north of the mine would experience increases in ambient noise levels from the mine. Noise impacts from blasting could extend to the hospital, convent and university campus along the north side of the Flambeau River. If properly controlled, blasting would not cause significant off-site seismic vibrations.

The reclamation plan is designed to create wildlife habitat and passive recreational opportunities. About 8.5 acres of wetland would be created to replace wetlands directly impacted by the project. The restored wetlands would serve biological and hydrological functions, although the quality of those functions would depend on successful establishment and revegetation of the wetlands. Revegetation of the upland site would utilize native plant species and, if successful, would provide valuable wildlife habitat.

The project would have short-term adverse aesthetic impacts from viewpoints along STH 27 and the Flambeau River. No impacts to known archeological or historic resources would occur.

The monitoring program should provide sufficient sampling to detect unexpected releases of contaminants to most environmental components. No air monitoring is proposed, and excessive emissions of particulates may not be detected.

The project would provide about 40 jobs to local residents during the mine operations. About 13 mine employees and their families would move into the study area. This level of immigration would not have a significant effect on housing, schools or other government services.

Tax revenues from the mine would be highly dependent on metals prices and the cost of transporting ore to the refinery. Total net proceeds tax payments could range from $0.6-24.4 million. Direct payments to local municipalities, either under the net proceeds tax or the local agreement, would total about $732,000 each to the Town of Grant and Ladysmith and $2.56 million to Rusk county over the life of the mine. Corporate income taxes paid to the state would range from $1.9-26.7 million. Additional tax revenues would accrue from employee income taxes, and state and county sales taxes.

ALTERNATIVES AND THEIR IMPACTS

The scope of the project could be expanded to include mining the minerals below the bottom of the proposed pit. This expansion would require substantial capital expenditures for concentrating facilities and tailings ponds, and would probably not be economically attractive. Due to the small size of the proposed project, a significant reduction in the scope is not feasible.

Alternatives for siting of surface facilities are limited by the location of the ore body. Sites to the north are limited by proximity to Ladysmith and private land. Siting facilities east of STH 27 would require a bridge, longer hauling distances, and higher pumping costs. A split site design, which would comply with most of the regulatory setback criteria, would have the same disadvantages as the eastern alternative.

High sulfur waste rock could be stored in the pit as mining progressed, eliminating the need for one of the surface stockpiles. This alternative would reduce surface disturbances and air emissions, but would introduce operating difficulties and safety concerns.

Wastewater treatment alternatives include ion exchange, reverse osmosis and brine concentration. While these technologies would produce a suitably clean effluent, they would also produce small amounts of hazardous waste. An alternative design for the settling ponds would be to install a low permeability liner on the pond bottoms to minimize seepage of wastewater to the groundwater. Sludge from the wastewater treatment plant could be disposed of in an off-site or on-site landfill.

The monitoring plan could be expanded to add additional sampling points, frequency and/or parameters. Collection basin lysimeters could be installed under the high sulfur waste rock stockpile or the settling ponds to monitor discharges to groundwater. Monitoring for Total Suspended Particulates could be employed to monitor and analyze dust emissions.

An alternative for reclaiming the pit would be to allow the pit to fill with water, forming a lake. A modification of this alternative would be to partially backfill the pit with waste rock, forming a shallower lake. Wetland restoration could be more extensive to create additional wetland acreage over the pit. Final land use alternatives could include forestry or agriculture. An alternative final use for the surface facilities would be for other industrial purposes.

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ERRATUM

A figure number was inadvertently omitted from the sequence of referencing in Chapter 3. As a result, references in the text regarding Figures 3-9 through 3-14 should actually refer to the next graphic in the sequence (e.g., a reference to Figure 3-9 should be 3-10). The number sequence on the figures themselves is correct.

CHAPTER ONE
DESCRIPTION OF THE PROPOSED PROJECT

INTRODUCTION

LOCATION

Flambeau Mining Company is a wholly owned subsidiary of the Kennecott Corporation which, in turn, is owned by RTZ Corporation. Flambeau Mining Company proposes to use open pit mining techniques to remove copper ore from the Flambeau deposit in northwestern Wisconsin. The orebody is located 1.6 miles south of Ladysmith and 0.3 miles west of STH 27 in the Town of Grant, Rusk County (Figure 1-1). The project site can be reached by traveling south on STH 27 from its junction with USH 8 in the City of Ladysmith.

Kennecott owns over 2,500 acres in the Town of Grant, including most of the land in Section 9, T34N, R6W. The 181 acre proposed mine site is completely owned by Kennecott, including both the surface and mineral rights. The same is true of Section 10 between STH 27 and the Wisconsin Central Ltd. main line track where the rail spur would be constructed.

Throughout this EIS, there are references to the "project area" and the "mine site". These terms refer to the following geographic areas.

- Project Area - This is defined as the area, about 300 acres, east of the Flambeau River, west of STH 27, north of the south line of Section 9, and south of Blackberry Lane (Figure 1-1). Also included is a 24 to 36-foot wide corridor east of STH 27 on which the railroad spur line is to be constructed.

- Mine Site - This is defined as an area of about 181 acres within the project area which would be regulated under the mining permit (Figure 1-2). The proposed open pit, stockpiles, wastewater treatment facilities, the rail spur, and other ancillary surface facilities would be contained in this area.

HISTORY

The copper-enriched Flambeau orebody was discovered by exploratory drilling in 1968. The size and quality of the narrow, steeply dipping deposit has been defined by drilling over 100 core holes into the orebody from the surface. Kennecott originally proposed in the mid-1970's to mine the orebody using a combination of open pit and underground mining techniques. The original proposal included ore concentrating facilities and permanent surface disposal of mineral wastes rather than backfilling the pit at the end of the project. Kennecott applied for the necessary permits and the Department prepared an EIS which was subsequently approved. The master hearing to determine whether the permits would be granted was in progress when County officials indicated the necessary zoning approvals would not be issued to Kennecott. The Department dismissed the applications in 1977. Interest in the project was revived in 1987 when copper prices markedly increased.

Kennecott submitted a notification of intent to collect data to support a mining permit application in July, 1987. The required mine permit application, an environmental impact report (EIR), and various wastewater, air pollution, groundwater, and surface water permit applications were submitted to the Department in April, 1989. In July, 1989 the Kennecott Corporation changed the name of the company from Kennecott Minerals Co. to Flambeau Mining Co. A Draft Environmental Impact Statement on the project was issued in September 1989. Revised permit applications for the project were submitted by Flambeau in December 1989 and January 1990.

The purpose of the project is to produce a profit for Kennecott Corporation. Need for the project is determined by market demand for the metals.

REGULATORY AUTHORITY

Flambeau Mining Company must satisfy a variety of federal, state and local regulations before mining can begin. These regulations include requirements for specific permits and plan approvals. The major permits and approvals required for the Flambeau Project are listed in Table 1-1. Flambeau Mining Company has already obtained a conditional use permit from Rusk County.

Table 1-1

Major Permits and Approvals Required for the Proposed Project

Statutory Authority	Administering Agency	Activity	Action
FEDERAL			
33 U.S.C. 1344	U.S. Army Corps of Engineers	Dredge or fill permits for activities in or affecting navigable streams and wetlands	Permit issuance
33 U.S.C. 1321	Environmental Protection Agency (EPA)	Spill prevention control and counter measure plan (40 CFR 112.7)	Have plan on file before operations begin
STATE			
Wis. Stat. 144.025(2)(e)	DNR (NR 112)	Mine dewatering	Plan approval
Wis. Stat. 144.04	DNR	Wastewater treatment system	Plan approval
Wis. Stat. 144.391 and 392	DNR	Air emission	Permit issuance
Wis. Stat. 144.44 and 46	DNR (NR 182)	Mine Waste Feasibility Report, Plan of Operation	Plan approval
Wis. Stat. 144.44	DNR (NR 502)	One-time disposal	Plan approval
Wis. Stat. 144.85 and 86(3)	DNR (NR 132)	Mining	Permit issuance and mining authorization
Wis. Stat. Chap. 147	DNR	Wastewater discharge	Permit issuance

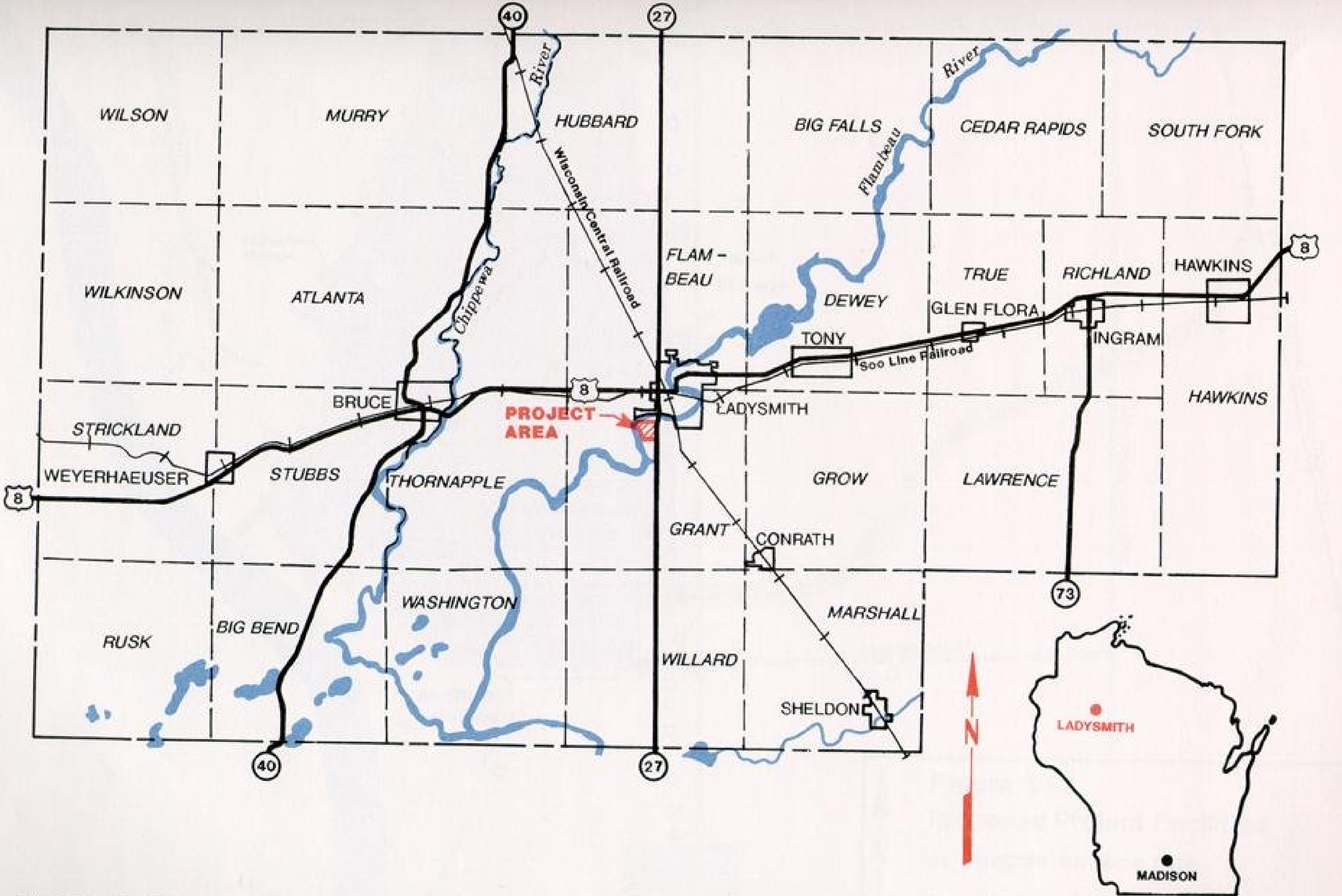


Figure 1–1
Project Location in Rusk County

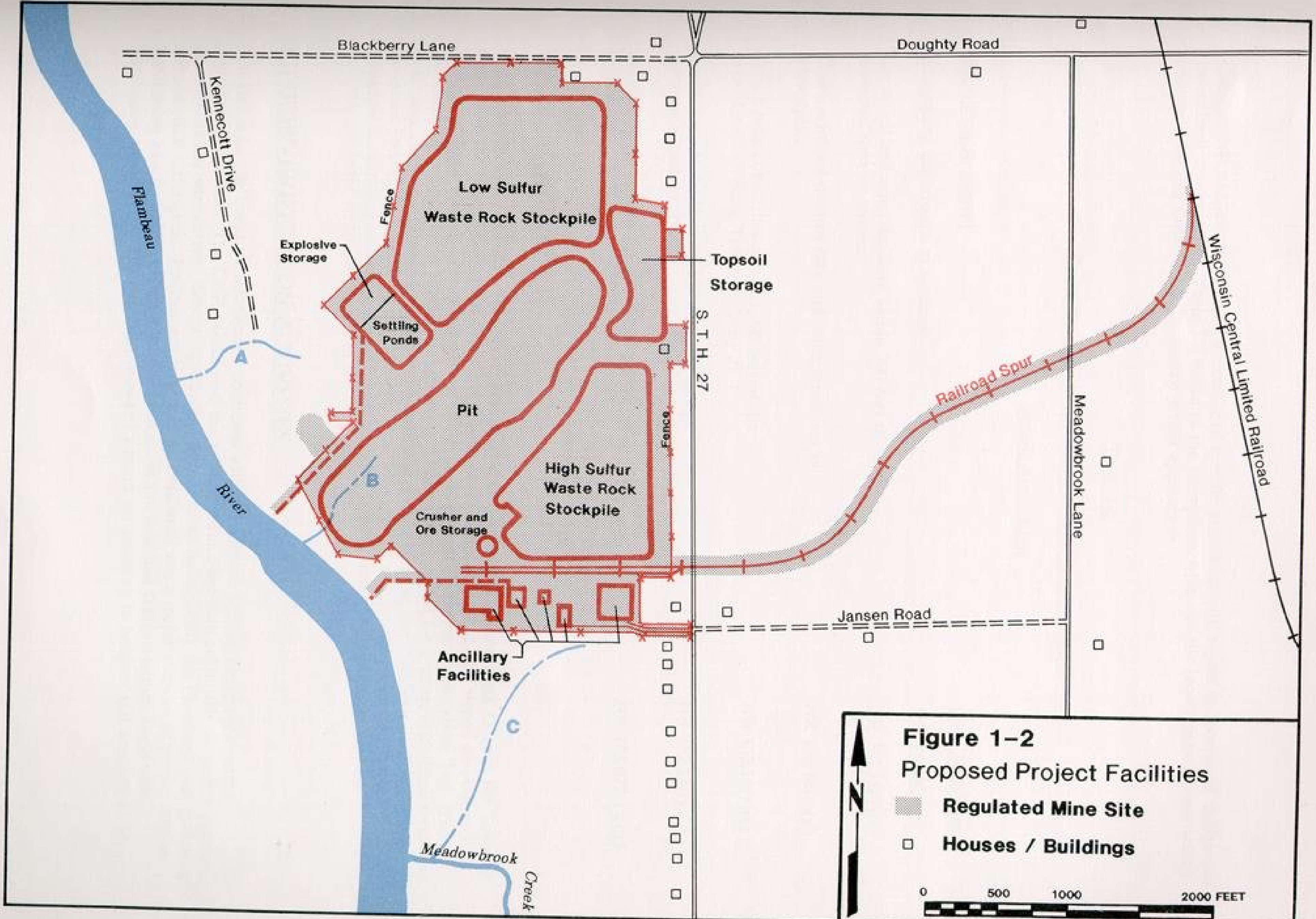


Figure 1–2
Proposed Project Facilities

Chapters NR 132 and 182 contain a number of specific provisions with regard to locational, design and operational requirements. Table 1-2 indicates the exemptions from specific requirements requested by Flambeau Mining Company in its mining permit application.

Table 1-2

Exemptions Requested in the Mining Permit Application

Permit Application

Exemption Requested	Code Reference
Minimizing disturbance to wetlands	NR 132.06(4)
Locate pit and other facilities within 300 feet of a navigable river or stream	NR 132.18(1)(c)
Construct flood control dike and other structures in a floodplain	NR 132.18(1)(d)
Locate project facilities within 1,000 feet of the nearest edge of State Trunk Highway 27	NR 132.18(1)(e)
Locate project facilities within wetlands, except pursuant to NR 132.06(4)	NR 132.18(f)
Monitoring for certain baseline water quality parameters	NR 182.075(1)(d)5

LOCAL AGREEMENT

In accordance with s. 144.839 Wis. Stats., a binding legal agreement between Rusk County, the Town of Grant, and the City of Ladysmith officials and Kennecott Explorations Ltd. was signed on August 1, 1988. Flambeau Mining Company is the successor in interest to Kennecott Explorations Ltd. This agreement, developed to facilitate the approval of local permits needed for mining, establishes terms and conditions Flambeau Mining Company must meet if it wishes to mine the Flambeau orebody. Some of the issues covered include hours of operation, local hiring goals, well/property value guarantees, municipal liabilities, grievance procedures and a mining impact fund. The agreement may be renegotiated under terms established in the document.

REVIEW/VERIFICATION ACTIVITIES

This EIS is largely based on information contained within Flambeau Mining Company's permit applications and EIR. The DNR determined the validity of the Flambeau submittals through a process of review and/or verification. Several approaches were used to review/verify the Flambeau data gathering and analytical techniques. Professional judgment by DNR staff was a major element of project review. Verification also included making joint observations in the field and taking samples along with Flambeau's consultants. This approach provided a check on sampling techniques and accuracy of lab results. In certain disciplines, the DNR independently evaluated background conditions (e.g., fisheries). These methods plus comments from other agencies and interested parties were used throughout the review process.

DESCRIPTION OF PROPOSED FACILITIES

To The Reader: The descriptions of the proposed mining activities in this chapter are taken from Flambeau Mining Company's permit applications and Environmental Impact Report. These descriptions attempt to concisely and accurately portray the company's mining proposal. The proposal and any potential impacts may change depending upon the actions of the company and whether the Department ultimately grants or denies the permit applications. Furthermore, if permits are issued, any conditions placed upon the permits would affect the potential impacts.

If the technical terms are unfamiliar, please refer to the Glossary. All time periods are stated in terms of project years or, less commonly, as project months. This relative time scale is used because the outcome of the permitting process and Flambeau's decision to start construction, if permits are granted, are not certain. All project years or project months refer to a time period occurring after project construction begins.

OPEN PIT MINE

Flambeau Mining Co. may operate the mine or hire a contractor to manage mine operations. In either case, the Local Agreement and permit conditions would remain applicable. The key features of the project include the open pit; haul road; ore crusher; stockpiles for ore, topsoil, and waste rock; settling ponds; rail spur, wastewater treatment plant, and administrative/maintenance buildings (Figure 1-2 and Figure 1-3).

The proposed open pit at its maximum extent would be 32 acres in size and involves removing the enriched, upper 150-200 feet of the orebody. It would be approximately 2,600 feet long, 550 feet wide, and would be excavated to a maximum depth of 225 feet. The southwest corner of the pit would be 140 feet from the high water mark of Flambeau River. A slurry wall and dike would be constructed at the southwest end of the pit to minimize water inflow. The pit would be excavated leaving a series of benches to maintain the stability of the bedrock walls and for safety purposes. Cross-sectional views of the pit and the slurry wall are shown in Figures 1-4 and 1-5.

If the mine operates as anticipated (one shift per day, five days per week, 250 days per year), it would result in daily average material movement of 7,200 tons (1,300 tons of ore plus 5,900 tons waste) for the first 3.5 years. After that time, ore removal would remain relatively constant until the last year while waste rock removal declines substantially. Total material movement would gradually decline to 6,400 tons per day from the balance of the third year and all of year four to an average of 3,450 tons per day in year five, and an average 2,150 tons per day during the last year. About 320,000 tons of ore would be removed per year except for the start-up year when the production rate would be approximately 240,000 tons. Over the life of the mine, approximately 1.9 million tons of ore would be removed from the pit. Non-ore material removed would total approximately 7.8 million tons. Summary statistics for the project are shown in Table 1-3.

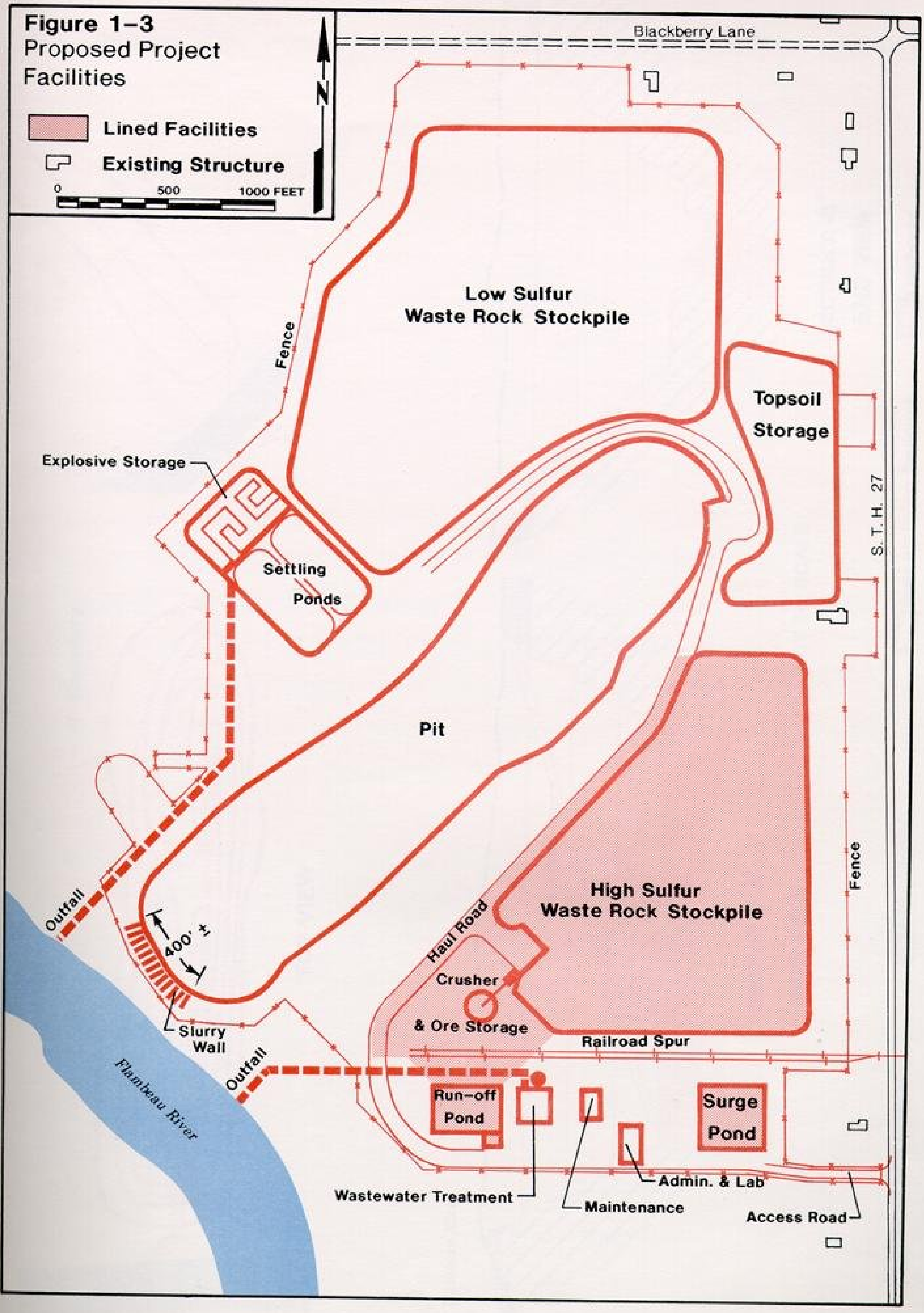


Figure 1–3
Proposed Project Facilities
Lined Facilities
Existing Structure
0
500
1000 FEET
N
Blackberry Lane
Low Sulfur Waste Rock Stockpile
Fence
Topsoil Storage
Surge Storage
Explosive Storage
Settling Ponds
S.T.H. 27
Pit
Outfall
400' ±
Fence
Haul Road
High Sulfur Waste Rock Stockpile
Crusher
& Ore Storage
Slurry Wall
Railroad Spur
Flambeau River
Outfall
Run-off Pond
Surge Pond
Admin. & Lab
Wastewater Treatment
Maintenance
Access Road

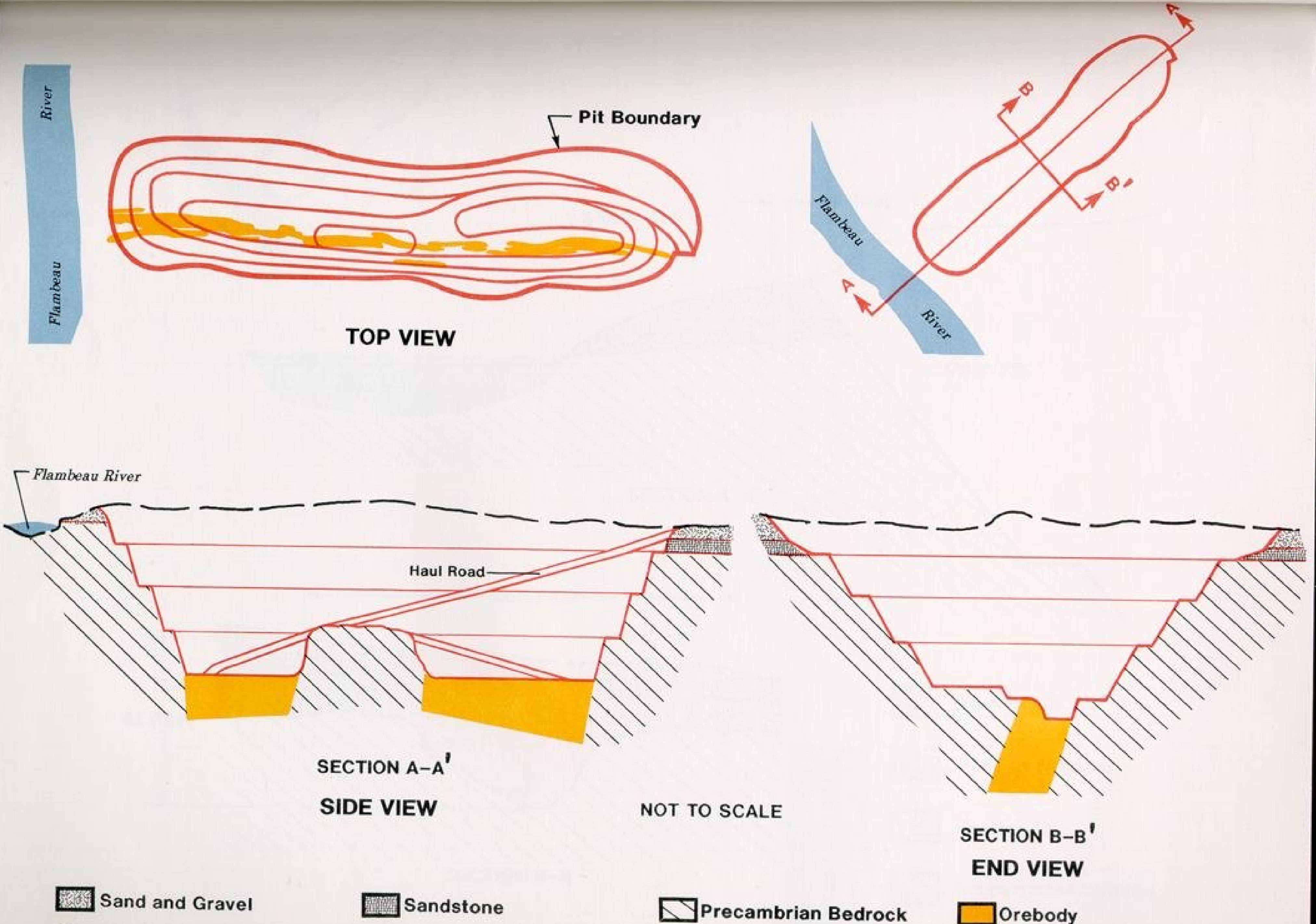


Figure 1-4 Open Pit Cross Sections

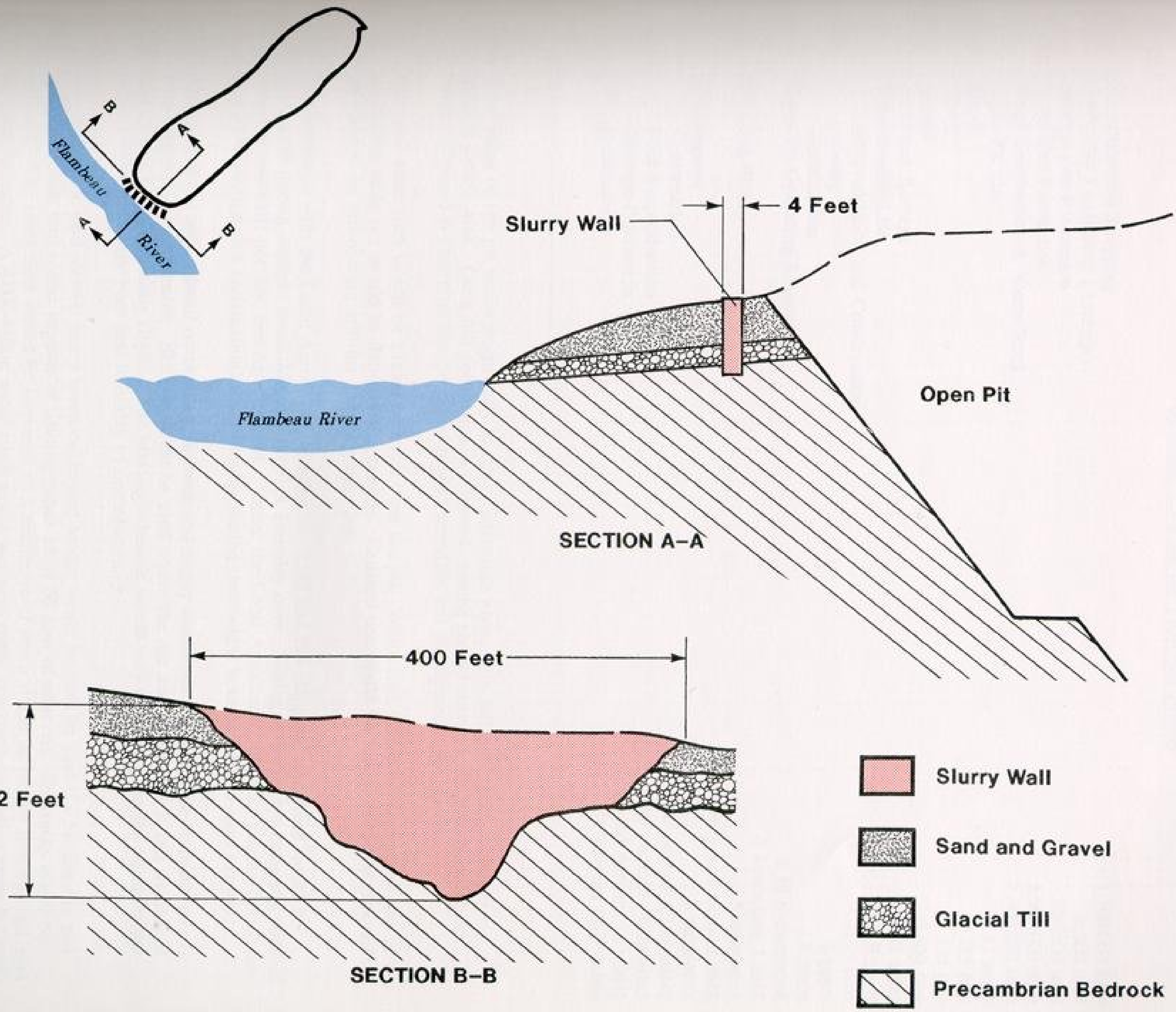


Figure 1–5 Slurry Wall Cross Section

TABLE 1-3

Summary Data for the Proposed Project

Preproduction Stripping	1,500,000 tons
Daily Ore Production (Average)	1,300 tons
Annual Ore Production	320,000 tons
Total Ore Production	1,900,000 tons
Total Overburden & Waste Rock	7,800,000 tons
Open Pit Size	32 acres
Depth	225 feet
Width	550 feet
Length	2,600 feet
Disturbed Acreage	181 acres
Total Project Life	8 to 9 years
Preproduction and Construction	0.75 year
Mining	6 years
Reclamation	1.5 years
Open Pit Operating Schedule	5 to 6 days/week
	8 hours/day, 1 shift
Crushing Plant	5 days/week
	4 to 5 hours/day, 1 shift
	5 days/week
Employment	
Construction	70 persons (5 months)
Peak Preproduction	160 persons (4 months)
Average Production	55 persons (6 years)
Reclamation	61 persons (1-2 years)

Excavation of the pit would begin early in the construction phase with full production expected by project month nine. Once full production is achieved, mining should conclude in approximately six years. Figure 1-6 illustrates the proposed project schedule and anticipated employment.

Ore and waste rock would be hauled by truck from the pit. Waste rock would be dumped at one of two stockpiles while ore would be dumped at a crusher. Crushed ore would be loaded onto rail cars and shipped to an out-of-state mill for further processing.

In accordance with the Local Agreement, blasting, crushing and rail shipping operations would be conducted during daylight hours Monday through Saturday only. Mining activities are currently planned to occur one shift per day, five day per week. Under the Local Agreement, all other mining operations (e.g. construction and reclamation) are allowable during three-eight hour shifts, 365 days per year.

Removal of the soils, glacial overburden, bedrock and highly weathered ore would be by bulldozers or other mechanical equipment. Blasting would be used where the ore and waste rock is less weathered and cannot be mechanically ripped. The blasting schedule would vary depending on the phase of the project but would vary from one blast/day to one blast/week.

Two four-cubic yard shovels and a seven-cubic yard loader would be used to load the broken ore and other materials into trucks capable of hauling either 35 or 50 tons of material. Six trucks would be required. The truck fleet would be increased to a maximum of seven trucks as the pit deepens and haul distance increases. A 4,000-gallon water truck would wet haul roads and truck unloading areas for dust control.

The anticipated types and quantities of mobile mining equipment to be used over the life of the project are shown in Table 1-4.

TABLE 1-4

Mobile Mining Equipment

		Project Year					
	Construction	1	2	3	4	5	6 *
Dozers	2	2	2	2	2	2	2
Hydraulic drill	1	2	2	2	2	2	2
Hydraulic shovels	2	2	2	2	2	2	2
Haul trucks	5	6	6	7	7	6	3
Loader	0	1	1	1	1	1	1
Grader	1	1	1	1	1	1	1
Water wagon	1	1	1	1	1	1	1
Dump truck	0	1	1	1	1	1	1

*For the first three quarters. Backfilling begins at end of third quarter. Required equipment for backfilling is not shown here.

HAUL ROAD

A gravel surfaced haul road would be constructed from the entrance of the open pit mine to the waste rock stockpiles and ore crusher (Figure 1-3). The haul road would be 60 feet wide and constructed from a combination of on-site and open pit materials as well as imported materials. An extension of the haul road would connect the open pit and crusher area to the equipment fueling and maintenance areas. The haul road between the high sulfur waste rock stockpile and the open pit (approximately 1,250 feet of the roadway) would be underlain by a 60 mil HDPE liner to contain potentially contaminated runoff.

Based on anticipated mine operations, approximately 220 round trips would be made daily between the open pit and the crushing facility or the stockpiles. Traffic is anticipated to be 46 vehicle round trips per hour during peak ore hauling. Additional traffic would consist of support operation vehicles for maintenance, supervision, and transporting of employees to mining equipment. Watering would be used to control dust on the haul road.

ORE CRUSHER AND CRUSHED ORE STOCKPILE

An ore crusher and crushed ore stockpile would be located southwest of the high sulfur waste rock stockpile (Figure 1-3). The crusher would operate five days per week for 4 to 5 hours per day during daylight hours to meet the proposed production goal (1,300 tons of ore per day). The 30 in. x 42 in. jaw crusher has a design capacity of 280 tons per hour and would crush ore to less than 12 inches in diameter. Crushed ore would be discharged onto a conveyor belt and transported to the crushed ore stockpile, where a front-end loader would load railroad cars at a rate of 10 to 12 cars per working day. From 15 to 24 loaded cars would be shipped from the mine every other operating day.

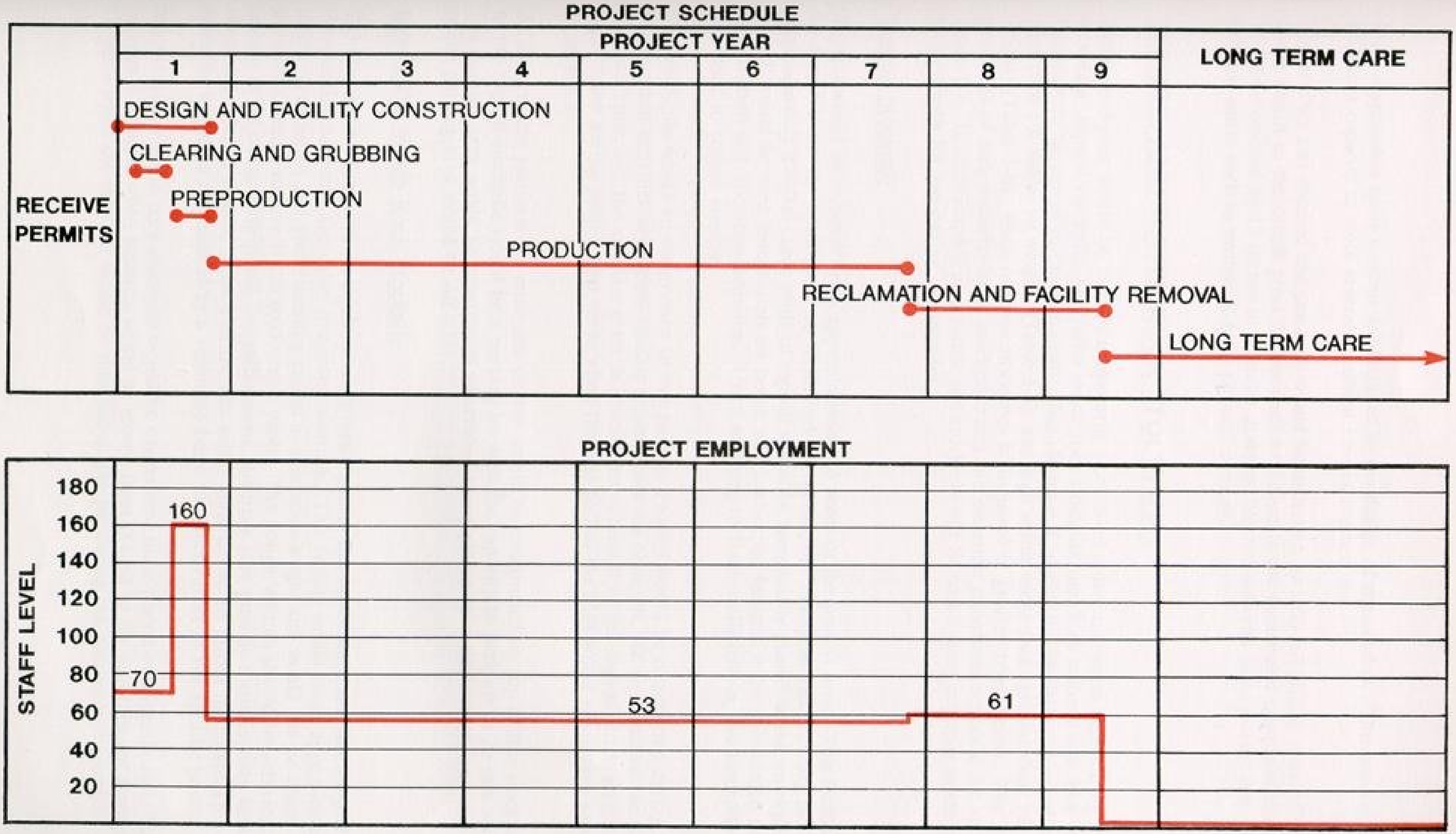


Figure 1–6
Proposed Project Schedule and Employment

Dust suppression spray systems are included in the design of the crusher. The ore stockpile would have sufficient capacity to store several thousand tons of crushed ore.

The crusher and crushed ore stockpile would be underlain by a 60-mil HDPE liner. This liner would direct runoff to the runoff pond for eventual treatment in the wastewater treatment plant. The liner would be covered by 12 inches of granular drainage blanket material (e.g., gravel) and 48 inches of selected waste rock to protect it from physical damage.

TOPSOIL AND WASTE ROCK STOCKPILES

Three stockpiles would be used to temporarily store overburden and waste rock during the project. They include a topsoil stockpile, low sulfur waste rock stockpile, and high sulfur waste rock stockpile. Materials to be stored in these stockpiles include topsoil, glacial till, sandstone, low sulfur waste rock (less than 1% sulfur by weight) (Table 1-5), and high sulfur waste rock (greater than 1% sulfur by weight) (Table 1-6). Each of these stockpiles is discussed in greater detail below. The approximate quantities of each material to be stockpiled and the materials movement schedule are shown in Table 1-7. In addition, a 1 acre hydric soil stockpile will be constructed adjacent to the pit to store wetland soils for use during reclamation.

Topsoil Stockpile

Topsoil would be removed from approximately 135 acres of the project area. This includes the areas to be disturbed for the open pit, both waste rock stockpiles, ore stockpile, and ancillary facilities. Approximately 220,000 cubic yards of topsoil would be temporarily placed in this stockpile. Some topsoil would be used immediately on berms and landscaped features to be revegetated during site construction and operation activities. Upon reaching its final configuration, the stockpile would be vegetated to reduce erosion.

This stockpile would be constructed in two phases. Phase I would be constructed during initial construction activities and would receive topsoil from the open pit, the west half of the high sulfur waste rock stockpile, and the ancillary plant facilities sites. Phase II of the topsoil stockpile would be constructed during project year three when the east half of the high sulfur waste rock stockpile is constructed.

An observation platform for mine site visitors would be constructed on top of this stockpile. Adjacent to the topsoil stockpile would be a parking lot with the capacity to park up to 20 cars and one bus. The parking area would be constructed of crushed stone placed on a subbase of sand and gravel. Access to the parking area would be off STH 27.

Low Sulfur Waste Rock Stockpile

The low sulfur waste rock stockpile would contain glacial till, sandstone, saprolite, (highly weathered Precambrian bedrock) and other low sulfur bedrock. This facility would cover approximately 40 acres, would be about 60 feet above existing grades at maximum height and would not be lined. The stockpile's design volume is 2,800,000 cubic yards. The design volume should be sufficient to allow storage of all of the anticipated low sulfur waste materials plus provide a contingency factor. Table 1-5 shows the relative volume of each of the low sulfur materials to be placed in the stockpile. The stockpile would be surrounded by a vegetated berm to direct runoff to the settling ponds.

The low sulfur waste rock stockpile would be operational for a period of approximately 7.25 years. This includes 5.75 years when material would be moved from the pit to the stockpile for storage, followed by 1.5 years when the material would be returned to the pit during the reclamation process.

The sequence for placement of the low sulfur materials would be as follows. Glacial till would be placed at the base of the pile in a nine foot thick layer to provide attenuative capacity for metals in percolating rainwater. The other materials would be placed in segregated areas over the till blanket. The remaining till would be piled over the western 45 percent of the stockpile. Sandstone would occupy the northeastern 15 percent of the stockpile and saprolite would cover about 20 percent of the east central area. Low sulfur waste rock would be piled in the southeastern 15 percent of the stockpile and would cover the top of the stockpile in an eight foot thick layer. Figure 1-7 shows a cross section of the proposed low sulfur stockpile design. This sequencing would facilitate the return of these materials to the pit in their original sequence during the reclamation phase.

TABLE 1-5

Volume of Low Sulfur Waste Rock Stockpile Materials

Type of Material	Volumes (Cubic Yards)
Glacial Till	1,240,000
Sandstone	340,000
Saprolite	490,000
Precambrian Rock	630,000
Total Volume	2,700,000

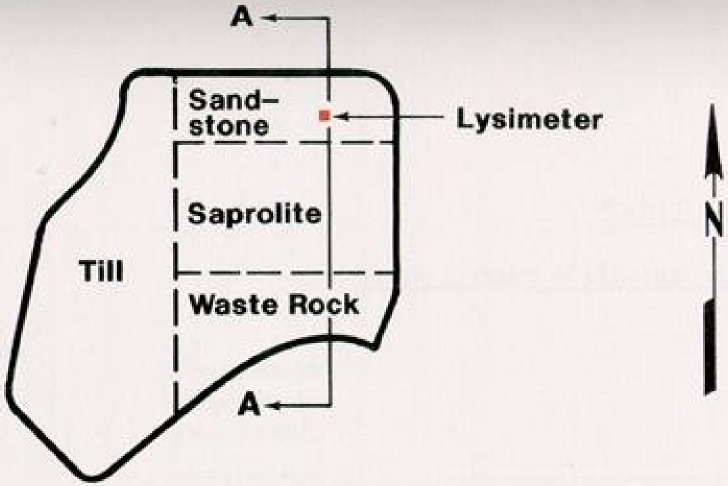
High Sulfur Waste Rock Stockpile

This stockpile would be 27 acres in size and approximately 70 feet above existing grades at maximum height. The operating life of the stockpile is approximately 7 years. This includes a period of 6 years when waste materials would be moving to the pile for storage, followed by approximately 1 year when these materials would be moved from the stockpile to the pit during reclamation. A design capacity of 2,200,000 cubic yards would be available for high sulfur waste materials (bedrock, sandstone, wastewater treatment sludges) (Table 1-6).

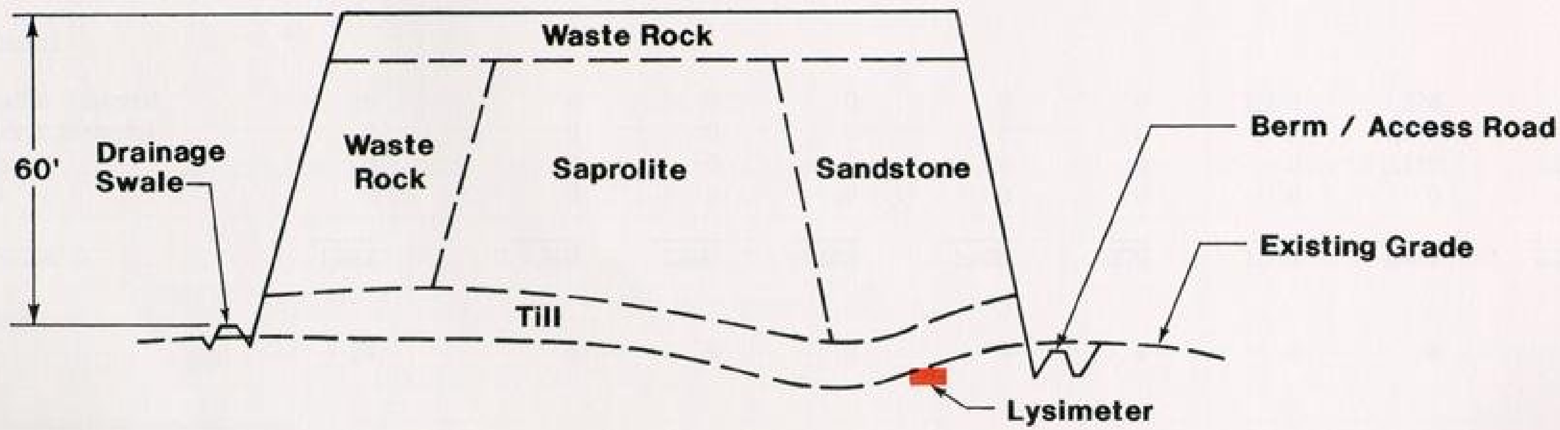
TABLE 1-6

Volume of High Sulfur Waste Rock Stockpile Materials

Type of Material	Volume (Cubic Yards)
Till	50,000
Sandstone	125,000
Sludge from Wastewater Treatment Plant	45,000
Saprolite	430,000
Precambrian Waste Rock	1,360,000
Total Volume	2,010,000



Location Map



Section A–A
(Vertically Exaggerated)

Figure 1–7
Low Sulfur Waste Rock
Stockpile Cross Section
(Not to Scale)

TABLE 1-7

Yearly Estimate of Materials Movement and Hours of Operation

Materials	Construction/ Preproduction Four Months	Operation 1	2	3	4	5	6	Reclamation 7	8
		(1,000 tons)							
Topsoil	180	0	0	0	0	0	0		
Overburden	1,444	935	1,053	792	13	0	0		
Low Sulfur Material	0	212	133	154	436	133	11		
High Sulfur Material	16	333	294	434	831	417	127		
Ore	42	320	320	308	320	320	210		
Reclamation									
High Sulfur Material	0	0	0	0	0	0	1,226	1,226	0
Low Sulfur Material	0	0	0	0	0	0	0	1,079	0
Overburden	0	0	0	0	0	0	0	2,119	2,119
Topsoil	0	0	0	0	0	0	0	0	180
TOTALS	1,682	1,800	1,800	1,688	1,600	870	1,574	4,424	2,299
Hours/day	24	8	8	8	8	8	8	24	24

A one foot compacted glacial till layer and a 60 mil HDPE liner along with a leachate collection system would be installed beneath the high sulfur waste rock stockpile. The liner would cover the entire base of this facility and the inside of the berms that encircle this stockpile. To minimize the quantity of leachate generated, this stockpile would be built in two phases. Phase one, the western half of the stockpile, would be operational for the first 2.5 to 3 years of operation. The eastern portion of the stockpile would remain in its natural state until its development during project year two. Figure 1-8 contains cross sections of the sub-base and base grades, including liner, of this proposed facility.

The base grade would have a ridge and valley pattern to direct leachate to the leachate collection system. This collection system would consist of a series of 6 inch diameter perforated PVC collection pipes located in the valleys as shown in Figure 1-8. The collection pipes would be covered by 18 inches of high permeability stone. Clean out risers, which are designed to permit the inspection and cleaning of the collection system by mechanical means or by high pressure water flow, are included in this design.

Drainage calculations indicate the collection efficiency of the liner should range from 96 to 99+%. The company's estimate of the average anticipated leachate head on the liner is 8.9 feet.

SURFACE WATER RUNOFF CONTROL

Storm water runoff control would be provided for all facilities. Storm water runoff would be controlled by temporary siltation basins and straw bale retention checks during the construction phase. The permanent control facilities for uncontaminated runoff are designed to accommodate a 25-year, 24-hour storm event (4.6 inches of rainfall for the Ladysmith area). The open pit would serve as an emergency reservoir for surge pond and runoff pond overflow.

Runoff and Surge Ponds

Water from the open pit, high sulfur waste rock stockpile, crushed ore storage area, haul road and maintenance yard would be treated in the wastewater treatment plant. Since a constant delivery rate to the wastewater treatment plant is desirable for optimum performance; water would be stored in the lined runoff and surge ponds prior to treatment (Figure 1-3). Contaminated water from the sources listed above is estimated to average about 300 gallons per minute on an annual basis while the proposed treatment plant has a maximum design treatment rate of about 800 gallons per minute. These ponds are designed to provide 1-3 days of water storage capacity under normal operating conditions to allow for maintenance work on the wastewater treatment equipment.

The surge pond would have a storage capacity of approximately 1.8 million gallons and would hold contaminated water coming from the high sulfur waste rock stockpile and the open pit. A 60 mil HDPE liner would be installed beneath the pond to contain the stored water. If a storm in excess of the design capacity occurs, overflow from the surge pond would go directly to the open pit through a 30 inch diameter buried pipe.

The runoff pond would have a capacity of 640,000 gallons and would be located directly south of the ore crusher, ore stockpile, and rail car loading area. This pond has been designed to store runoff from the crushed ore storage area, haul road and ancillary facilities located south of the rail spur and west of the parking lot. The pond would be lined with a 60 mil HDPE liner also. Water would flow from the runoff pond to the wastewater treatment plant via a buried 12 inch diameter pipe. Overflow water from the runoff pond would also go into the pit.

During the warm weather months, both the runoff and surge ponds would be used. During cold weather months, however, only the surge pond would be operational. The surge pond would be outfitted with agitators to minimize ice buildup during periods of freezing temperatures.

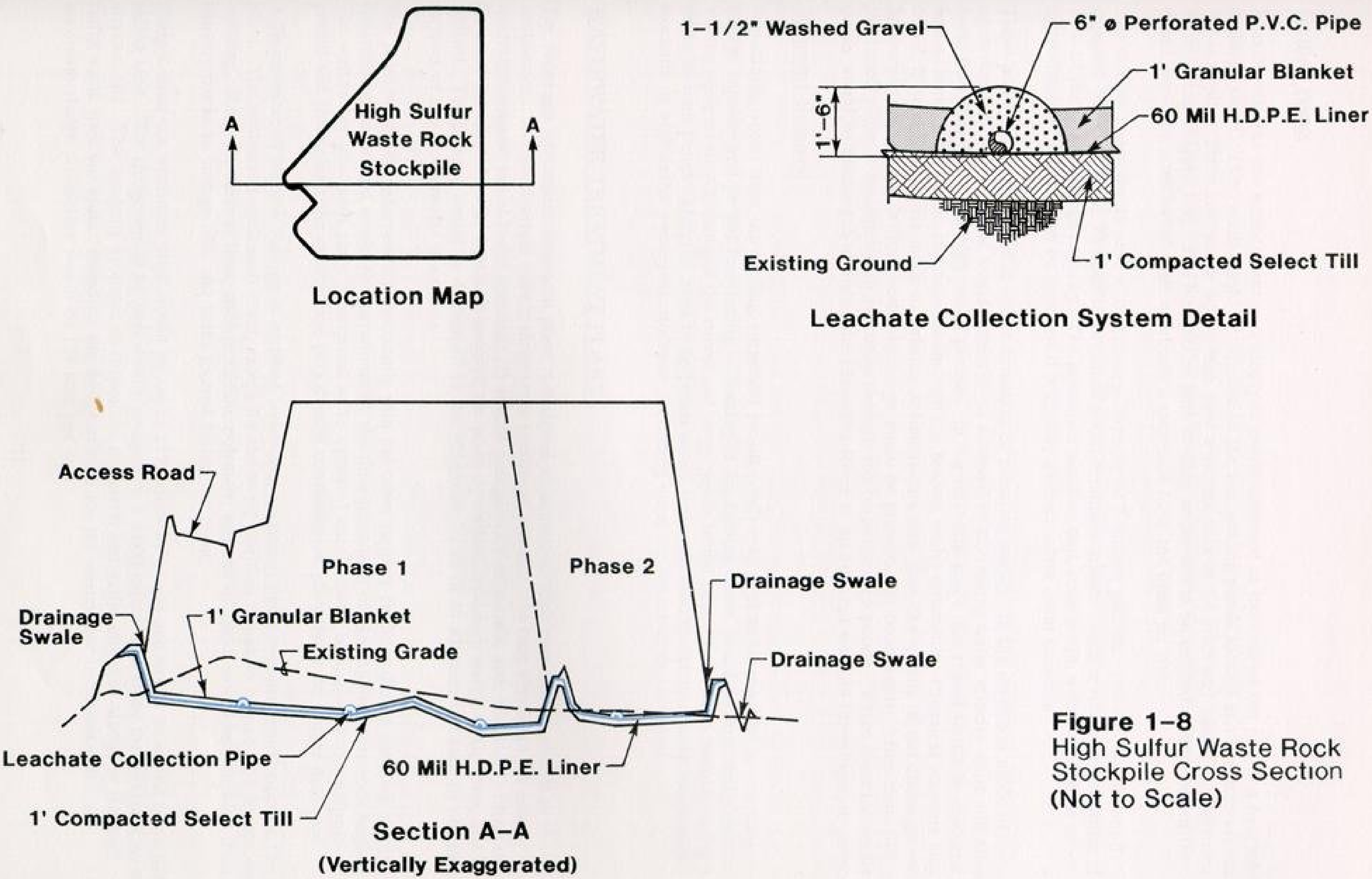


Figure 1-8
High Sulfur Waste Rock
Stockpile Cross Section
(Not to Scale)

Settling Ponds

Runoff from the low sulfur waste rock stockpile would collected at the base of the pile in a bermed drainage swale. This runoff would be directed to the two settling ponds located at the southwest end of the stockpile. These two ponds would each have a surface area of 1.4 acres and would be approximately 18 feet deep (Figure 1-9). The bottoms of both settling ponds would be unlined. The dikes of the ponds would be constructed from overburden excavated from the open pit site.

The settling ponds would have a total storage capacity of 7 million gallons. The volume of runoff expected from a 25-year, 24-hour storm totals about 5 million gallons. Such a storm would utilize about 70% of the ponds storage capacity. The ponds are sized so that, even if full, a detention time of approximately 34-hours can be expected if a 25-year 24-hour storm event occurred.

These ponds can be operated as either detention or retention basins. In the detention mode of operation, sediment removal would primarily be achieved by decreasing water velocity while still allowing some flow through during high runoff periods. In the retention mode, the runoff would be captured in one or both of the ponds and released through the bottom outlet structures. Chemical reagents may be added, if needed, in either mode to enhance sedimentation and, thus, the quality of the discharge water. Spillway overflows and bottom outlet discharge would be provided for both ponds. More than 10% of the runoff water is anticipated to percolate through the bottom of the ponds. Water from the settling ponds would be discharged to either the Flambeau River or an adjacent wetland for mitigation purposes.

Sediment Removal

Periodically, solids from the settling, surge and runoff ponds may need to be removed to maintain storage capacity and proper functioning. Cleaning of the settling ponds would be done using on-site mining equipment. Cleaning of the runoff and surge ponds would probably be done annually using a slurry vacuum pump. Material from these ponds would be transported to the low sulfur waste rock stockpile or high sulfur waste rock stockpile depending upon the nature of the material.

WASTEWATER TREATMENT PLANT

The proposed wastewater treatment plant is designed to neutralize acids and remove metals in the wastewater. The plant would have a three stage treatment process: (1) lime treatment for acid neutralization and initial metal removal; (2) sulfide precipitation of metals; and, finally, (3) filtration. Some of the treated water would be recycled for plant operations, make-up water, wash down, and dust control. The balance would be discharged to the Flambeau River or to adjacent wetlands to mitigate the impacts of the groundwater drawdown.

The plant would be constructed concurrently with the other support facilities during the nine month construction phase and would be operational by the time placement of high sulfur waste rock begins. The wastewater treatment plant is proposed to be operated continuously beginning in the preproduction period and throughout the reclamation period until contaminated pit water is no longer produced.

A Department of Natural Resources certified wastewater treatment plant operator would operate the plant. The wastewater treatment plant, except for the water clarifier, would be housed in a heated metal building. Reagents such as lime, sodium sulfide, polymers, and sulfuric acid, would be unloaded from delivery trucks to storage bins and tanks located within the plant.

Sludges from the treatment plant would be about 25% solids by weight and would be stored in an 8,000 gallon tank. The sludge would be periodically pumped to a 4,000 gallon tank truck for transport to the disposal site. The company proposes to dispose of the metal and sulfur enriched sludge in the high sulfur waste rock stockpile. Based on the design criteria for the wastewater treatment plant, the maximum sludge production would be 124 tons per day.

WATER FLOWS

A water flow schematic for the project facilities is shown in Figure 1-10. Flambeau Mining Co. anticipates the maximum groundwater inflow to the open pit would be approximately 300 gallons per minute. This is expected to occur early in the overburden excavation phase. The pit inflow at estimated steady state conditions is about 125 gallons per minute. Of the steady state inflow, approximately 95 percent would originate from the bedrock. The remainder would originate from the overlying sandstone and glacial sediments. Sump pumps at the bottom of the open pit would direct inflow water to the wastewater treatment system.

WASTEWATER DISCHARGE

Treated wastewater would be discharged at two points along the Flambeau River (see Figure 1-3). The outfall points are designed to discharge clarified and treated water from the mine site into the Flambeau River without eroding the riverbank or impeding river flow. Water from the treatment plant would be conveyed by an underground pipe to an outfall structure on the river's edge. The treatment plant outfall structure would have a concrete apron with riprap placed between the concrete apron and the river. The settling ponds outlet would be a riprapped drainage channel. The channel would lead to the Flambeau River or to a nearby wetland via a diversion ditch.

Discharges to the Flambeau River would follow the rain and snow melt patterns in the area of the mine. The annual average and peak discharges from the settling ponds are anticipated to be 29 and 8,100 gallons per minute, respectively. Peak discharges are based on the 25-year 24-hour storm event. In comparison, average and peak discharge flow rates for the treatment plant are projected to be 227 and 800 gallons per minute, respectively. Mitigation discharge to the wetland is expected to average up to 20 gallons per minute.

ANCILLARY FACILITIES

Ancillary project facilities consist of an access road, parking lot, gate house, administration/lab building, maintenance shop, fuel storage area, septic drainfield or holding tank, rail spur, and a fence to enclose and secure the 170 acre mine site. This site would contain all of the major and ancillary facilities with the exclusion of the three acre rail spur corridor running east to the Wisconsin Central Limited Railroad line.

The general arrangement of the plant facilities is illustrated in Figure 1-3. The ancillary facilities would cover approximately 8 acres.

Access Road

A paved access road would connect the plant site with STH 27 directly opposite Jansen Road. The road would consist of two 12-foot wide lanes with 3-foot wide shoulders. The access road would require the disturbance of 0.8 acres for the right-of-way.

Parking and Gate House

An employee and visitor parking lot with 60 vehicle capacity would be located east of the administration building as shown in Figure 1-3. The parking lot would have asphalt paving. Drainage from the parking area would flow into a natural drainage swale south of the site.

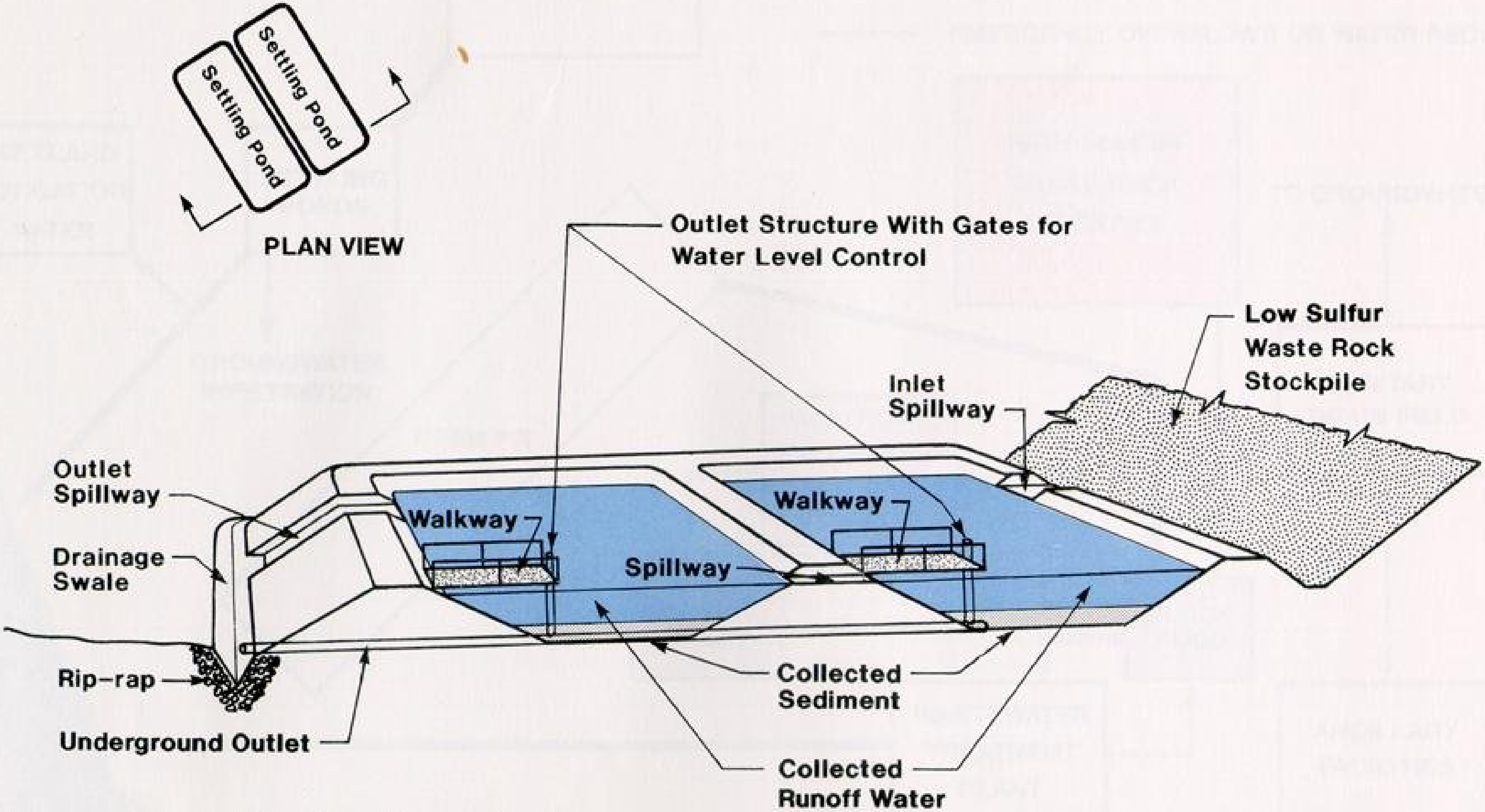


Figure 1–9 Settling Pond Cross Section
(Not to Scale)

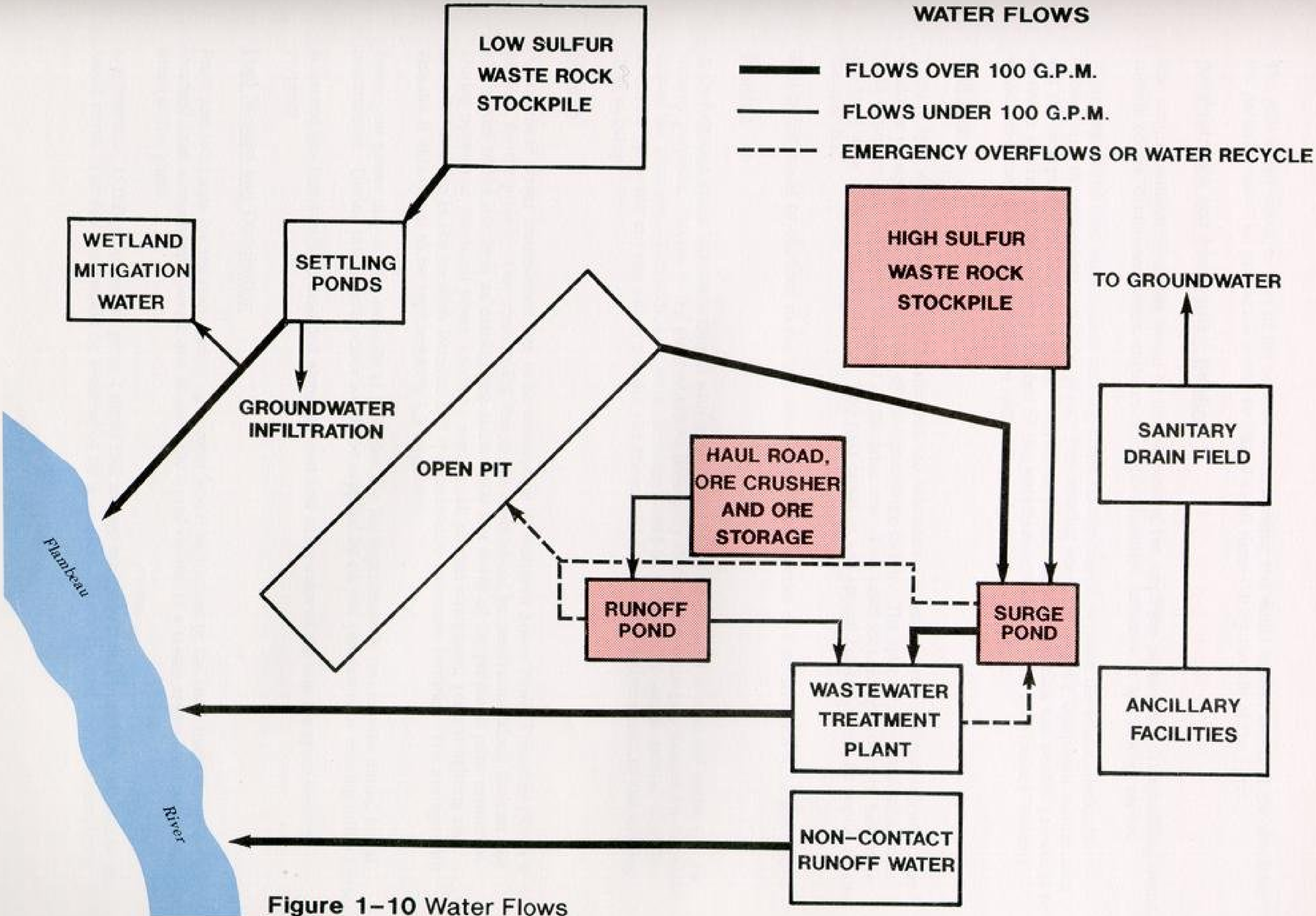


Figure 1–10 Water Flows

Lined Facilities

The gate house would be part of the administration building and would control access to the site from the parking area. The gate house would be staffed at all times during the life of the mine.

Administration and Maintenance Buildings

The administration/lab building would be directly west of the employee parking lot. This building would contain offices, conference rooms, engineering support facilities, laboratories and storage rooms.

A pre-engineered steel maintenance building would be constructed between the administration/lab building and the wastewater treatment plant. This building would be used for equipment maintenance and the storage of tools and spare parts. Lubricants, paints, cleaning materials and bottled gas would be stored in a small storage building attached to the maintenance building. The maintenance building would have concrete flooring to contain spills which might occur.

Rail Spur

The rail spur would connect the mine site with the Wisconsin Central Limited Railroad. Crushed ore would be transported by rail to an out-of-state processing facility. The spur would consist of a single track approximately 4,150 feet long east of the mine site. Two 1,600 foot sidings would be located in the plant area as shown in Figure 1-3. Two road crossings and several culverts would be required along the spur line.

Rail traffic would be confined to daylight hours with four deliveries and departures a week anticipated.

Fencing

A six foot high chain link fence topped with barbed wire would be installed around the entire site for security purposes. Access to the plant would be principally through the main gate located on the south side of the mine site. Two additional gates, however, would be installed for vehicle access. The first would be where the rail line enters the site and the second at the existing access road to the existing shop building.

Utilities

An overhead power transmission line to be constructed by Northern States Power Company (NSP) is planned for the project. The transmission line to the mine would be constructed along the east and south sides of the site from an existing line about 7,000 feet north of the proposed mine substation. During operations, electrical power would be used for all process equipment, general lighting and miscellaneous use in the ancillary facilities and the wastewater treatment facilities. The average daily demand is anticipated to be approximately 1.3 megawatts.

Permanent power may not be available at the mine site for approximately two months during initial construction. During this period, power would be supplied by on-site generators or existing utility lines.

A natural gas line would be extended along the east and south sides of the site for space heating purposes.

Fuel Storage and Distribution

Fuels and lubricants for the construction equipment would be trucked to the site. Fuels would be obtained from a commercial source and temporarily stored on-site in a tanker trailer during the construction phase.

A permanent, 15,000 gallon above ground diesel fuel storage tank would be constructed adjacent to the runoff pond. The fuel tank would be constructed on a concrete foundation and would be completely surrounded by an earthen containment berm of sufficient height to contain the entire contents of the fuel tank should a leak occur. The area within the berm would be lined with a 60-mil HDPE liner to prevent any leaked fuel from seeping into the subsoil. A 1,000 gallon above ground gasoline tank would be constructed in a similar fashion adjacent to the diesel storage tank.

Explosives Storage Magazines

Two magazines, each sized to store 15 tons of explosives, would be located southwest of the low sulfur waste rock stockpile. A blasting cap storage building would also be located in the area. Each storage magazine would be surrounded by 15 foot high earthen berms for safety and protection of the explosive storage areas. The magazines would be constructed and operated in accordance with applicable federal and state safety regulations.

Water Supply

A new potable water well would be constructed near the intersection of the proposed access road with STH 27. An existing potable water well, located near the proposed well, would be used to furnish both potable and construction water until the new well is constructed. Expected average water use is approximately 5 gallons per minute over the life of the project.

Sanitary Wastewater

Sanitary wastewater would be generated at the administration building. A per-day, per-person sanitary sewage waste generation rate of 45 gallons was assumed. This rate includes consideration for showers. Using these assumptions, the daily sanitary sewage flow is estimated to be 2,700 gallons or two gallons per minute.

Flambeau Mining Co. would use either a drainfield or holding tank to dispose of sewage. Sanitary wastewater would be transported to a holding tank via a buried pipe system and then pumped to a mound system drainfield. The proposed drainfield would be north of the employee parking area. If a drainfield is not approvable, a holding tank would be used. In the latter case, the effluent would be taken to a local sewage treatment plant.

The peak flows are anticipated to occur during mine construction. Portable toilets would be used at the mine site until sewer lines and permanent restrooms are constructed. During mine construction, assuming a peak work force of 160 people, approximately 875 gallons of sewage would be generated per day. A licensed septic tank pumping contractor would be used to service the portable toilets and the holding tank as necessary.

PROJECT WASTES

Refuse Handling

The largest volume waste materials are grit from the lime slaking operation at the wastewater treatment plant (maximum about 1.1 tons per day) and sludges from the clarifiers (up to 124 tons/day). Both are proposed to be placed in the high sulfur waste rock stockpile and ultimately returned to the pit during reclamation.

Refuse from construction activities would be hauled off-site to an approved disposal area. This refuse would consist of metal, rubber, wood and lubricants as well as daily trash and garbage typical of an industrial work force. Refuse would be accumulated in waste containers or areas for weekly disposal. Wood waste generated during the construction and grubbing of the mine site would be chipped and/or burned in accordance with approved burning permits.

The scrap metal waste would consist mostly of worn parts from process or production related equipment. Typically, this material would be collected in a specific location, periodically sorted and sold to scrap metal contractors.

The bulk of the scrap rubber would result from mobile equipment tires and process related equipment such as conveyer belts and air and water hoses. Used tires would be returned to vendors. Waste oil, hydraulic fluids, lubricating oils and other special lubricants would be returned to the supplier or special contractor for reprocessing or disposal off-site.

The total volume of unsalvageable waste during operation is estimated to be approximately 2.5 tons per year per employee. Assuming an average employment of 55 persons, the estimated annual waste generated would be approximately 138 tons.

CONSTRUCTION

Construction of the open pit and the surface facilities would utilize standard mining skills and procedures. The construction schedule is designed to support mine development and crusher facility installation as well as sequenced to assure availability of environmental protection systems in advance of the needed date. The construction period is estimated to take approximately nine months (see Figure 1-6) with preproduction mining overlapping the construction phase during the last four months.

Clearing and grubbing of the access road, the topsoil stockpile, the low sulfur waste rock stockpile, and the settling ponds sites would be the first construction activities undertaken. Clearing and grubbing for other site facilities would be conducted as the overall construction process proceeds and necessary support facilities are completed. Total site disturbance is shown in Table 1-8.

During the clearing process, marketable trees would be salvaged and sold. Other trees would be chipped, with the chips saved for soil stabilization use during construction and operation. The remaining trees, wood, and brush would be burned on-site. All clearing and grubbing activities will be preceeded or done concurrently with temporary erosion control practices.

TABLE 1-8

Approximate Disturbed Acreage

Facility	Acres
Total Disturbed Area	
Open pit	32
Low sulfur waste rock stockpile	40
High sulfur waste rock stockpile	27
Ancillary facilities	8
Crusher plus loadout area	3
Haul, service, and access roads	9
Settling ponds	6
Topsoil stockpile	8
Railroad spur within fenced area	2
Railroad spur east of fenced area	4
Parking and Access	2
Temporary Nursery	3
Other	37
Total	181

Temporary Facilities

Some temporary structures would be required during initial site construction activities. These facilities would consist of construction offices for Flambeau Mining Co. and construction contractor's employees. Also, storage and workshop buildings for the contractor's equipment, potable water supply, electric power and sanitary facilities would be required at the site until the permanent buildings are constructed.

A temporary parking area for construction personnel would be located on the south side of the mine site. Temporary storage areas for building materials and equipment would be adjacent to the structures under construction.

Fire protection for all temporary construction buildings would be provided by a water truck stationed on-site, and nearby municipal firefighting systems if needed.

Construction water would be provided by an existing on-site well. A new well to be located in the southeast corner of the plant site, would be constructed to supply potable water over the life of the mine.

Temporary on-site power would be furnished from the existing utility lines and/or by use of on-site generators until the planned power substation is completed.

Chemical toilets for construction personnel would be provided on-site with the wastewater disposed off-site by a contractor. When the sanitary disposal system is completed, sanitary wastes would be disposed of at this facility. The use of chemical toilets would continue throughout the construction period because some work locations would not be conveniently located near the permanent washroom facilities.

Flambeau Mining Co. or the project contractor would install temporary fences around the construction site for protection of equipment and supplies.

Preproduction Stripping

Preproduction stripping involves removing the soil, glacial overburden and waste rock to expose the orebody. The preproduction phase is scheduled to be completed within a four month period (project months 6 thru 9) so that the ore shipping schedule may be met. A portion of the glacial overburden and waste rock removed during preproduction stripping would be used for site construction to minimize the need for off-site materials.

During the preproduction period, the open pit would be excavated 24 hours per day (three, 8-hour shifts), seven days per week in order to meet the desired production goals. Approximately 1.5 million tons of material would be stripped during the preproduction phase. The vast majority of this material will be placed in the low sulfur waste rock stockpile.

Erosion Control

Site preparation would be performed in two stages:

A. Initially, the open pit, stockpiles and plant facilities sites would be cleared of shrubs and trees and then rough-graded.

B. Following clearing, grubbing and rough grading, disturbed areas not required in the early phases of development would be seeded and silt fences would be placed to control erosion and runoff.

To the extent possible, erosion control would precede or occur concurrently with construction and development activities.

Erosion control during rough grading would consist of construction of surface drainage ditches to channel runoff. Where portions of the permanent storm drainage system are not installed concurrently with the rough grading, separate provisions for runoff and erosion control will be made. Techniques that may be used include diversion dikes, filter fabric fences, sediment traps, straw bale barriers, silt fences, sediment ponds, slope benches, and riprap in conjunction with the engineered drainage systems. These practices are intended to reduce sediment flow into adjacent wetlands, river, and drainage areas. The practices to be used would be determined during construction on a site-by-site basis. Mulches and soil surface stabilizers would be applied as needed.

CLOSURE AND RECLAMATION

The intent of reclamation would be to return the mine site to a state that provides long-term environmental stability. Reclamation would consist of the removal of surface facilities, backfilling the pit, and returning the site to its approximate original contour. The entire area would be graded and planted to reestablish a landscape suited to wildlife habitat and passive recreation (Figure 1-11).

Upon completion of mining, the pit would be sequentially backfilled with the stockpiled waste materials. The sequence of backfilling would begin with the placement of high sulfur waste rock in the bottom of the pit. Lime would be added at a rate of 2.5 lbs/ton of high sulfur waste to reduce the formation of acid and groundwater contamination. About 1540 tons of lime would be required. Backfilling of the high sulfur waste would be followed by the placement of low sulfur waste rock and then the highly weathered bedrock (saprolite) from the low sulfur waste rock stockpile. Sandstone and then glacial till would be placed over the weathered bedrock, and finally the area would be topsoiled and revegetated.

Given the volume of ore removed from the pit compared with the volume of material imported for construction purposes, an excess of material should be available for backfilling the pit. By applying shrink and swell factors to the waste material removed from the pit, backfilling should occupy all but about 2,000 yd^3 of the volume created by ore removal. Since approximately 124,000 yd^3 of imported off-site material would also be disposed of in the pit, sufficient material would be available to mound material over the surface of the pit. Flambeau Mining Company proposes to mound material approximately six feet above the original elevation to allow for settling. Excess material would be distributed over the site while maintaining the approximate final contours.

BACKFILLING SCHEDULE

The backfilling operation is scheduled for three 8-hour shifts per day, five days per week, for 250 days per year. Backfilling would require approximately 1.5 years to complete. The rate would depend on the capacity of the equipment fleet on hand at the end of the pit excavation. This is projected to be two hydraulic shovels and seven haul trucks.

BACKFILLING TECHNIQUES

In order to achieve a reasonable degree of compaction, backfilled waste rock would be placed in layers approximately three feet thick. The operating procedure would be for the trucks to dump onto sloping benches. The load would then be spread with a dozer and compacted by the traffic.

The liners and over-lying drainage blankets and piping from the ore crushing, ore stockpile, ore loadout, high sulfur waste rock stockpile, rail spur and runoff pond areas would be placed in the pit with the high sulfur waste rock material. Base material from the ore haul road would be excavated to a depth sufficient to remove material contaminated by acids and heavy metals from the waste rock or ore. Haul road removal will commence at the maintenance shop and would progress into the pit. Additional material to be placed in the lower portion of the pit include wastewater treatment plant filter sands and sludges.

Placement and compaction of the low sulfur waste rock would be accomplished in a similar fashion to that described for the high sulfur waste rock material. Lime will not be added to these materials since they are not acid producing.

After the low sulfur waste rock is placed in the open pit, a continuous layer, approximately 8 feet thick, of saprolite would be placed and compacted by a dozer in shallow layers over the backfilled waste rock. This would reduce groundwater movement between the waste rock below and the main aquifers of sandstone and glacial till above.

Sandstone would then be placed on top of the compacted weathered bedrock layer followed by glacial till. When backfilling approaches the approximate original contours, soil would be dumped and graded as needed to achieve the desired final contours. Glacial soils would be mounded over most of the pit to allow for settling. The western 800 feet of the pit would be graded to design elevations for recreating a wetland. About 10 to 12 inches of topsoil will be replaced over the mound to facilitate the restoration of vegetation.

FACILITY DEMOLITION

Flambeau Mining Co. has proposed to reclaim the mine site by dismantling the facilities and revegetating the area to promote long-term environmental stability. If an approved alternate use is demonstrated and approved by the Department, certain ancillary facilities such as the plant access road, parking lot, rail spur, buildings and other facilities could be left in place.

In the absence of viable alternate uses, all ancillary facilities would be dismantled and removed from the mine site. During the removal of the ancillary facilities, building demolition wastes including concrete, riprap, asphalt, culverts and the septic tank would be placed in a one-time disposal site constructed within the perimeter of the settling ponds. Following removal of these facilities, the area would be returned to the original contour, topsoiled and revegetated.

Following crushing of the last ore, the crushing facility would be dismantled and all equipment and structural steel would be removed from the site.

During the final stages of the high sulfur waste rock stockpile removal, the retaining wall would be removed. The concrete retaining walls would be placed in the one-time disposal site.

All masonry structures and concrete would be removed and placed in the disposal site.

During dismantling of the wastewater treatment plant, the surge pond would also be removed. The HDPE liner for the pond would be placed in the backfilled pit. All underground pipes associated with the wastewater treatment plant would be left in place. Salvageable items would be hauled off-site and sold or otherwise recycled as appropriate. All chemical reagents and equipment would be removed prior to dismantling the wastewater treatment building.

The asphalt surface of the access road and parking lot would be buried in the one-time disposal site. The road bed material would remain in place, but would be scarified and covered with topsoil and then revegetated.

Rail corridor reclamation would consist of rail, tie, ballast, and base material removal and re-use. Rail materials in the vicinity of the load-out area would be placed in the disposal site. Topsoil replacement, regrading, and revegetation would complete the reclamation process.

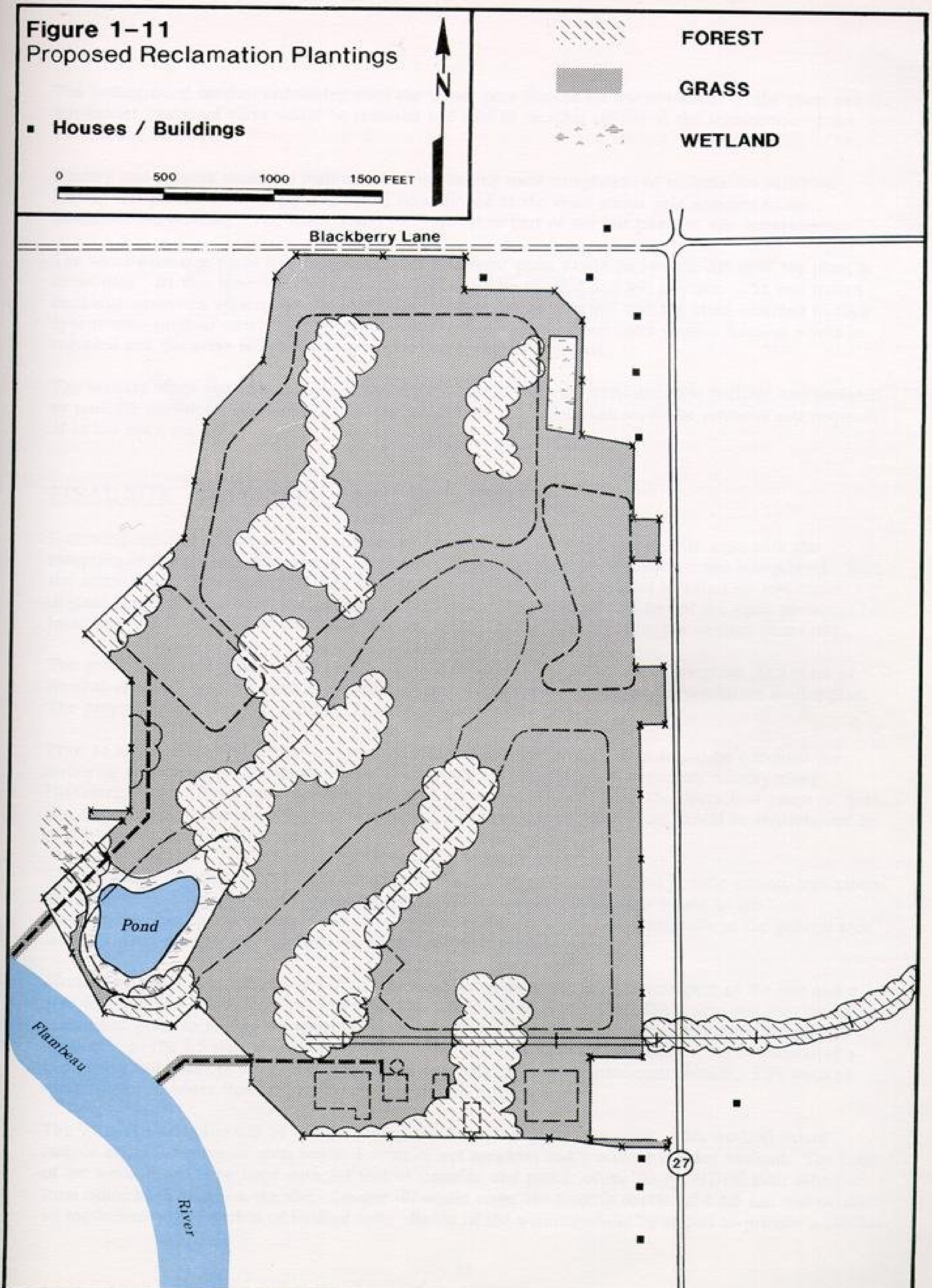


Figure 1–11
Proposed Reclamation Plantings
N
Houses / Buildings
0
500
1000
1500 FEET
FOREST
GRASS
WETLAND
Blackberry Lane
Pond
Flambeau
River
27

The underground conduit and wiring from the power pole located on the south side of the plant and the wastewater treatment plant would be removed and sold or recycled off-site at the termination of the reclamation process.

Fencing and security would be maintained at the facility until completion of reclamation activities. During this period, a security guard would be stationed at the main access gate adjacent to the administrative building. The fence would be removed as part of the last phase of site reclamation.

The water discharge pipes from the wastewater treatment plant would be operational until the plant is dismantled. At that time, the discharge pipeline would be plugged and left in place. The two outfall discharge structures adjacent to the Flambeau River would be removed and the areas returned to their approximate original state. As part of final site reclamation, all stormwater control features would be regraded and the areas returned to the approximate original contours.

The sanitary waste system would be removed concurrently with the administration building and replaced by portable facilities. The materials for the drain field or holding tank would be removed and disposed of in the open pit.

FINAL SITE TOPOGRAPHY AND VEGETATION

Following removal of the project facilities and backfilling of the open pit, the site area, with the exception of the backfilled pit, would be graded to approximate original contours and revegetated. With the exception of the western 800 feet, the open pit area would be backfilled to about six feet above original grade to compensate for anticipated settlement. The western 800 feet of the open pit would be backfilled to its approximate original grades and final contoured to facilitate the wetland restoration.

The general site revegetation plan entails establishment of about 140 acres of grassland, 32.5 acres of wooded savannah, and 8.5 acres of wetland. Figure 1-11 shows the proposed revegetation master plan. The proposed final land use is passive recreation and wildlife habitat.

Prior to and during construction of the project facilities, some existing trees would be relocated for screening or reclamation purposes. Some trees would be relocated to a temporary nursery along Blackberry Lane. These trees would be available for use as needed during the operations phase or final site reclamation. After the mine site is topsoiled and final graded, these trees would be transplanted as part of the reclamation process.

The woodland savannah would be planted in clumps, or "copses", designed to provide scenery and habitat for wildlife. Tree species would include a mixture of hardwood and conifers native to the area. Grassland species would include a variety of grasses and forbs which occur naturally in the general area. A list of plant species proposed for use is provided in Appendix A.

Wetland restoration would create a 1 acre wetland test plot in the northeastern part of the site and a 7.5 acre wetland over the western portion of the backfilled pit (Figure 1-11). The 1 acre test plot would be established prior to mining operations and used to evaluate construction and revegetation techniques applicable to the 7.5 acre wetland restoration. The test wetland would be constructed by excavating a depression and lining it with 1 foot of wetland soils salvaged during mine construction. This wetland would impound water from the realigned intermittent Stream A.

The 7.5 acre wetland would be created during the final stages of reclamation. This wetland would include about 3.5 acres of open water, 3 acres of wet meadow, and 1 acre of wooded wetland. The base of the wetland would be lined with 2-4 feet of saprolite and panels of the 60-mil HDPE liner salvaged from other lined areas on the site. On-site till would cover the liner to depths of 4-4.5 feet and would be topdressed with 8 inches of wetland soils. Banks of the wetland would be sloped to provide a shallow zone for emergent vegetation and an open water area of up to 6 feet deep. A weir would be installed in the flood control dike at the western end of the wetland to control water elevations and to serve as an outlet structure. Water from the reconstructed intermittent Stream B would replenish the wetland. A cross-section of the details of the proposed wetland and liner system is provided on Figure 1-12.

CONSTRUCTION AND OPERATIONS MONITORING

The construction and operations monitoring plan includes programs for monitoring groundwater elevations and quality, surface water, terrestrial ecology, meteorology, pit inflows, and low sulfur stockpile leachate. The monitoring program would begin with site construction activities and end when the initial revegetation of the site is completed. Subsequent monitoring is covered under **LONG-TERM CARE AND MONITORING.**

Figure 1-13 shows the proposed network of groundwater monitoring wells. All wells would be monitored quarterly for water elevation. Five wells/well nests would be sampled quarterly for the following water quality parameters: pH, specific conductance, total dissolved solids, iron, manganese, sulfate, copper, total alkalinity and total hardness.

Wetland surface water elevations would be monitored to detect mine-related changes. Gages would be installed in Wetlands 1, 5c, 6c and 10a and read monthly from March through December. Wetland gage locations are shown on Figure 1-13.

The Flambeau River monitoring program would include sediments, fish, macroinvertebrates, water quality and habitat characteristics. Sediment, fish and macroinvertebrates would be sampled annually at upstream and downstream locations, and analyzed for metals. Macroinvertebrates populations would also be characterized once per year. Water chemistry would be analyzed quarterly at upstream and downstream locations. River bottom habitats downstream from the site would be evaluated annually. Sampling locations for the surface water monitoring program are shown on Figure 1-14.

Other monitoring would include aerial and color infrared photography to monitor terrestrial ecology, meteorological monitoring of wind and precipitation, and measuring pit inflows. Proposed blast monitoring sites are shown on Figure 1-15.

LONG-TERM CARE AND MONITORING

Under the long-term care provisions of the mining regulations, Flambeau Mining Co. would be responsible for maintaining the sites of the open pit, waste stockpiles and the settling ponds in perpetuity. Flambeau would also be responsible for reclaiming the entire mine site, and would have to maintain a portion of the reclamation bond for 20 years following the Department's determination that reclamation is complete. Flambeau Mining Co. and its parent company would remain permanently liable for any environmental personal or property damages resulting from the mine.

Monitoring would continue in most components of the operations monitoring program. Groundwater level monitoring would continue in each well until levels stabilized. Similarly, groundwater quality monitoring would continue quarterly for the 5 wells/well nests shown in Figure 1-13. In addition to the parameters analyzed during operations, 1 round of samples per year would be analyzed for a variety of metals.

Two well nests would be installed in the backfilled pit. These wells would be monitored for water quality quarterly for the first 2 years, annually for the next several years, and once every 5 years thereafter or until the monitoring data demonstrates that the backfill would not affect groundwater quality.

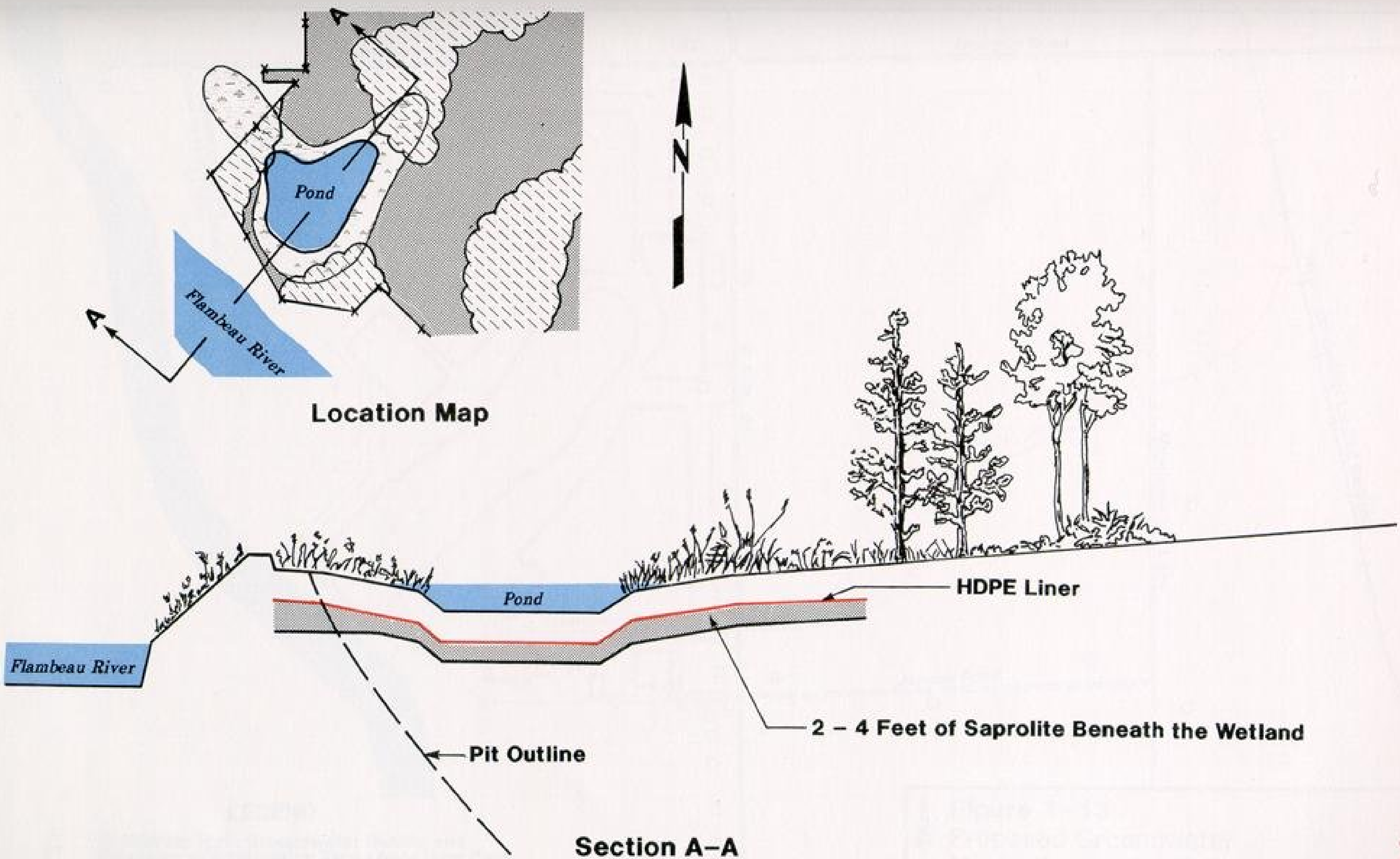


Figure 1–12 Wetland Restoration Cross Section

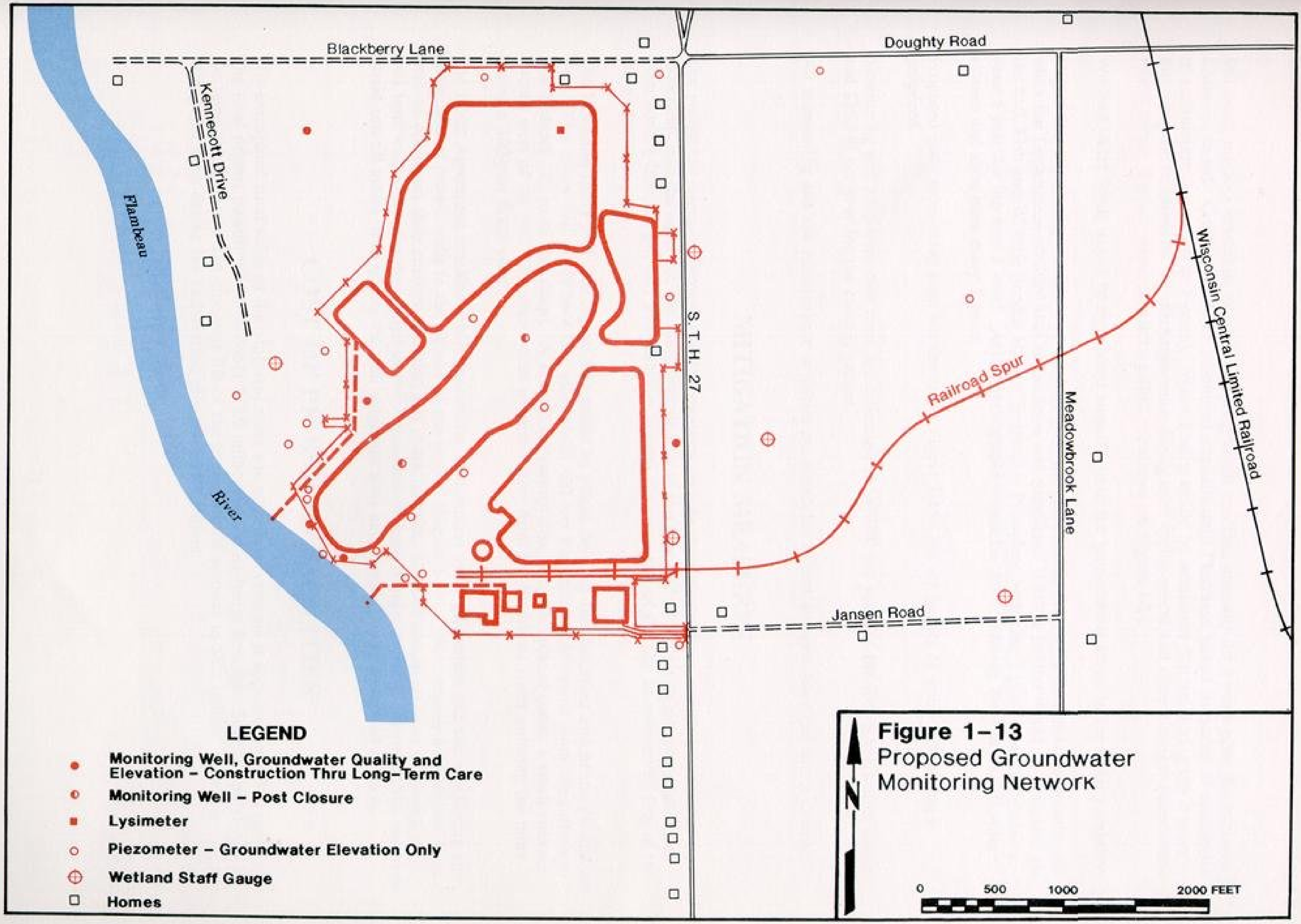


Figure 1–13
Proposed Groundwater Monitoring Network

Sediment, macroinvertebrate, and fish sampling would continue annually for 2 years after the wastewater discharge ended. Crayfish would be monitored annually until Flambeau issued its notice of completion of reclamation (estimated at 4 years). Water quality would be monitored 3 times during the 2 years following the cessation of the discharge; once during each spring runoff and once during a stormwater runoff event. Surface water monitoring sites are shown on Figure 1-14.

Wetland water levels would be monitored annually until the groundwater levels in the vicinity stabilize.

Vegetation monitoring would occur annually after the reclamation planting is complete and would end when the Department certified that reclamation was complete. Wildlife habitat would be evaluated via the U.S. Fish and Wildlife Service Habitat Evaluation Procedure beginning 2 years after revegetation, once a year for the next 3 years. Aerial photographs would be taken annually for 4 years following closure and then once every 5 years.

Proposed blast monitoring sites are shown on Figure 1-15. No air quality or noise monitoring is proposed.

Monitoring and long-term care costs are estimated at $47,070 per year for the first 6 years after closure and $15,840 per year for the ensuing period.

All monitoring and site maintenance activities are scheduled to end 40 years after the site is closed.

MITIGATION MEASURES

The mitigation measures proposed by the company include the slurry wall to impede groundwater movement into the open pit, the flood control dike at the west end of the pit to prevent river floods from flowing into the pit, and tree plantings around the perimeter of the site to reduce visibility of the mine operation.

The bentonite slurry wall (see Figure 1-5) would be placed between the southwest end of the pit and the river. This slurry wall would be 4 feet wide, about 400 feet long and would extend from the surface to firm bedrock (12 to 46 feet deep). A small flood control dike would be placed across a small channel directly west of the pit. This dike would prevent waters from the Flambeau River entering the mine during a 100-year flood event.

The Local Agreement contains several provisions for property value guarantees and the monitoring and protection of private wells in the vicinity of the project (Figure 1-16). The company has sampled these wells to document their current condition and characteristics. If, after commencement of mining, any well tests within the area designated by the Agreement indicate contamination is occurring, the company would test all active wells within the well guarantee area and remedy any mine-related impacts.

COST OF PROPOSED FACILITIES

The anticipated total value of the proposed mine site with improvements is approximately $20 million. The total project payroll would be about $13.9 million, including fringe benefits. Supplies purchased by the mine operator over the nine year life of the project would amount to $8.5 million. Overall anticipated costs during the reclamation phase are $8.7 million.

WORK FORCE CHARACTERISTICS

During the construction phase (8-9 months) and the mine preproduction phase (4 months), the project would employ about 70 people and 160 people, respectively. During the six year operations phase, Flambeau would employ an annual average of 55 persons. It is estimated that Flambeau would employ an average of 61 persons over the final 19 months of the reclamation phase (Figure 1-6).

The mine would require a variety of different labor skills including secretaries, truck and heavy equipment operators, drillers, blasters, lab technicians, maintenance personnel, and managers.

PROJECT TRAFFIC

The maximum increase in traffic is expected during the overlapping preproduction and construction phase early in the project. This is anticipated to increase traffic on STH 27 north of the site by about 255 vehicles per day and 115 vehicles per hour during the PM peak hour. The latter would increase peak hour traffic to about 345 vehicles per hour. Traffic from the mine entrance is anticipated to provide about 33% of the peak hour traffic on STH 27 for a short period during the preproduction period. During mine operation, the maximum employment level of 57 persons would increase traffic on STH 27 north of the site by 85 vehicles per day and 41 vehicles per hour in the PM peak hour. The latter would increase PM peak hour traffic to 307 vehicles per hour. The maximum employment forecast of 63 persons during the reclamation phase could increase traffic on STH 27 north of the site by 106 vehicles per day and 48 vehicles per hour in the PM peak hour. The latter would increase peak hour traffic to 314 vehicles per hour.

An increase in semi-tractor trailers and 10 yd^3 truck traffic would occur on STH 27. The biggest increase would occur in project month one when project truck traffic would reach 84 trucks/day. This level would diminish substantially to 8-14 trucks/day during project months 2 and 3. Project traffic would increase to 26-32 trucks/day during project months 4 and 5. For the balance of the construction and the operational periods, 8 trucks/day are anticipated.

ENERGY USE

Energy usage would vary depending on the phase of the project and the types of activities considered. The following table summarizes anticipated energy use over the life of the project.

TABLE 1-9

Total Energy Use By Phase

	Construction	Operation	Reclamation
Diesel (gal)	207,000	1,965,000	715,000
Gasoline (gal)	6,700	120,000	17,200
Natural Gas (therms)	0	960,000	61,000
Electric (Kilowatt/hr)	0	21,760,000	3,220,000

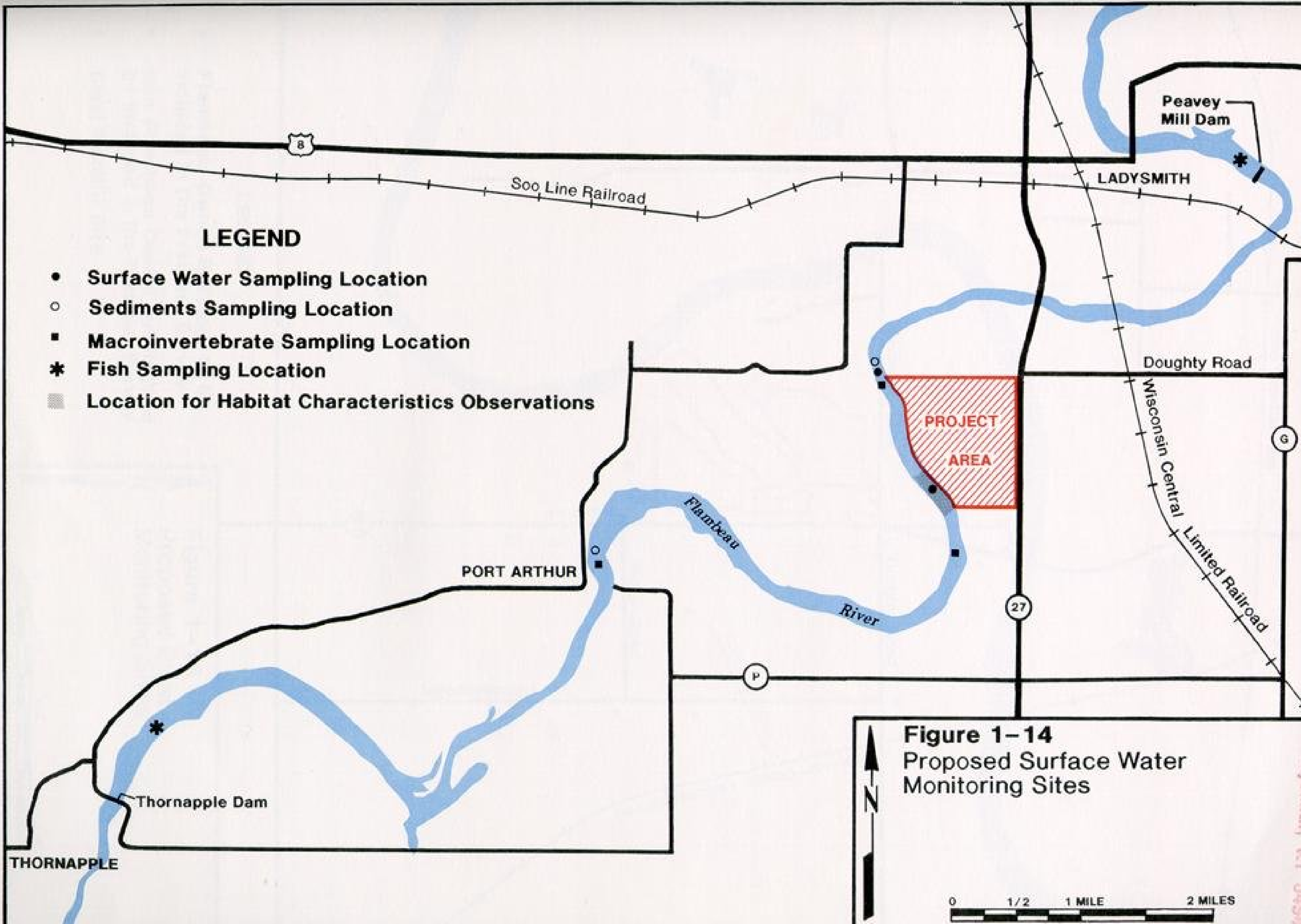


Figure 1–14
Proposed Surface Water Monitoring Sites

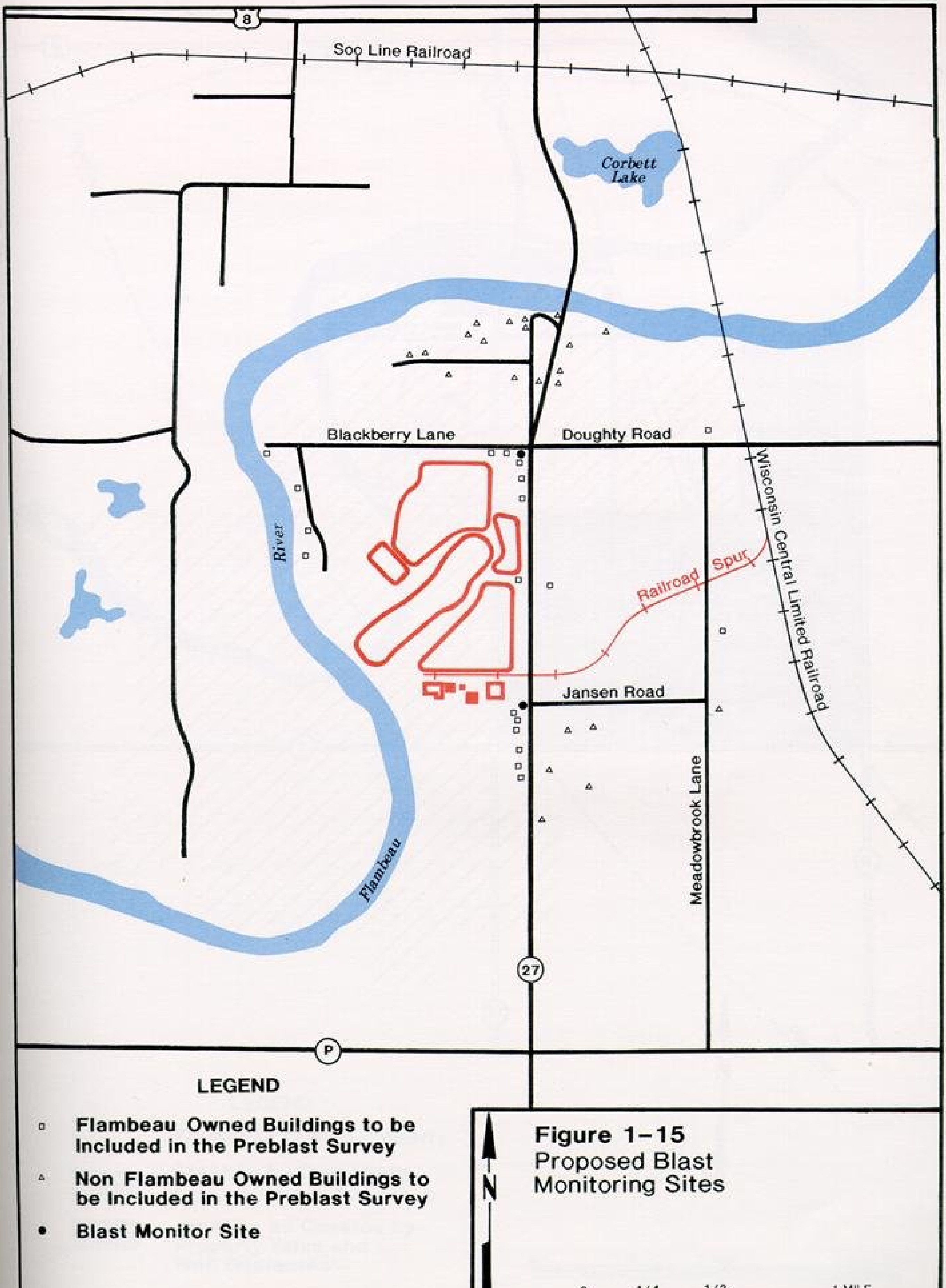


Figure 1–15
Proposed Blast Monitoring Sites

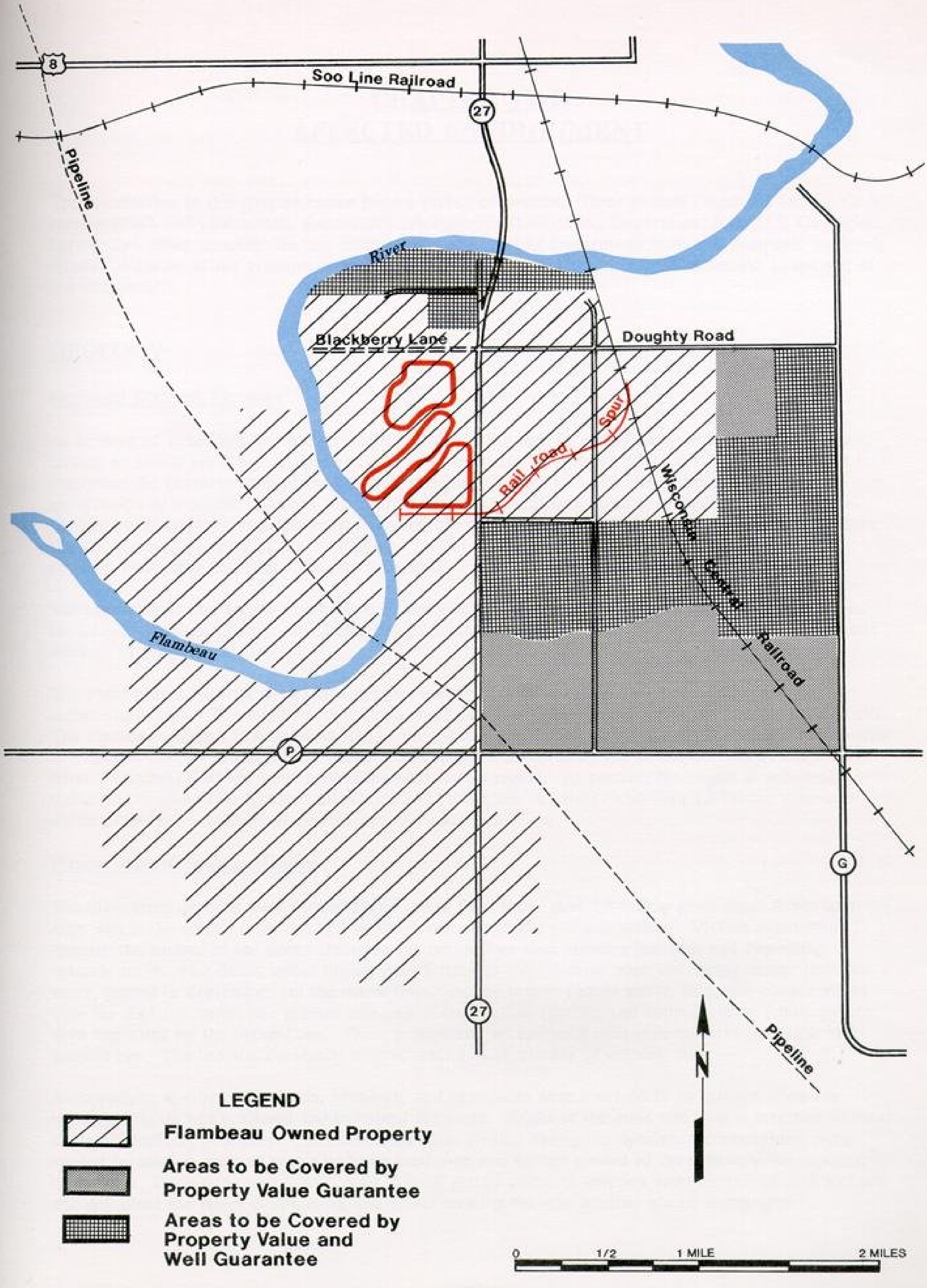


Figure 1–16 Property Ownership and Well / Property Value Guarantee Area

CHAPTER TWO
AFFECTED ENVIRONMENT

The information in this chapter comes from a variety of sources. These include Flambeau Mining Co.'s current (1987-1990) submittals, Kennecott's prior project (1972-1976), Department files, U.S. Geological Survey files, other scientific studies, professional judgement of Department staff, and computer modeling efforts. A listing of the principle sources is contained in the Information Sources section at the end of this document.

GEOLOGY

Regional Bedrock Geology

As in most of Wisconsin, the bedrock of this region is covered by glacial deposits of Pleistocene age (1 million to 10,000 years before present). Due to the scarcity of bedrock outcrops, it is often difficult to determine the characteristics of the bedrock. Techniques used to assess the bedrock include direct examination of available outcrops and bedrock samples obtained by drilling as well as indirect means, particularly through various geophysical studies. Past investigations have revealed that bedrock in Rusk County generally consists of steeply dipping Precambrian metamorphic rocks overlain in places by younger, essentially flat-lying Cambrian sandstone.

The sandstone in the area is Cambrian-age, and grades from a pebbly sandstone to a very fine grained sandstone. In Rusk County, the Cambrian-age sandstone varies from a few feet thick to about 100 feet thick.

The Precambrian bedrock in the area consists mainly of metamorphosed volcanic, granitic and sedimentary rocks. The middle Precambrian rocks occur as steeply dipping east-northeast trending belts. The Flambeau deposit is situated in one of these belts, (Figure 2-1), that extends from the Pembine area in Florence County to Ladysmith. Other mineral deposits, including the Crandon (Exxon) and Pelican River (Noranda) deposits, have been discovered in this region. At present, the region is seismically stable, but it underwent dynamic metamorphism (mountain building) more than 1.8 billion years ago which tilted the rocks to their current near-vertical orientation.

Project Area Geologic History

The orebearing deposits were formed on an ocean floor more than 1.8 billion years ago. A hot spot deep within the earth's crust resulted in the development of a volcanic system. Violent explosions beneath the surface of the ocean shattered the ocean floor rock creating fractures and depositing volcanic rocks. Hot fluids, called brines, passed through the fractured rock and, being denser than sea water, pooled in depressions on the ocean floor. As the brines, rich in sulfur, iron, and copper mixed with the cool sea water, fine grained minerals of iron sulfide (pyrite), and copper sulfide (chalcopyrite), were deposited on the ocean floor. These precipitates accumulated over time to form the sulfur rich massive ore. The ore was eventually covered with a thick blanket of volcanic rock.

Subsequently, northern Wisconsin, Michigan, and Minnesota were involved in an intense mountain building episode which altered and deformed the rocks. Rocks at the mine site were overturned by these mountain building processes. Later, the mountains created during the dynamic metamorphism were leveled by erosion, covered with Cambrian sandstone and further eroded to the relatively flat topography seen today. During the past 70,000 years, several glacial advances stripped away weathered rock and soil and deposited the layers of silt, sand, and gravel creating the now familiar glacial topography.

Local Geology

Precambrian volcanic rock, Cambrian sandstone, and Pleistocene glacial and water-washed sediments are present in the project area. The geological strata of the area have been defined from many soil borings and core samples drilled on-site and from scattered rock outcrops along the banks of Meadowbrook Creek.

The Pleistocene deposits consist predominantly of sandy loam or loam till and well to poorly sorted glacial outwash. The soils at the ground surface formed in brown or red-brown silty material over loamy till. Some fine-grained, well-sorted waterwashed sediments also are present. These soils are typically less than 5 feet thick, but are of variable distribution over the project area.

The Pleistocene deposits are underlain by the flat lying Cambrian age sandstone. The sandstone is not found throughout the entire project area and varies in thickness (0-34 feet). The sandstone is thickest in the northwest portion of the project area and thins to the south and toward the Flambeau River. The sandstone is composed of fine to coarse-grained quartz sand with variable amounts of fine material and is typically poorly cemented. The lower part of the sandstone contains highly weathered material eroded from the underlying Precambrian bedrock.

The Precambrian bedrock, including the Flambeau orebody, is a complex of interfingered, metamorphosed volcanic flows, ash, and other ejected volcanic material. The volcanic deposits have been strongly altered and subjected to intense folding and faulting. Over time, the volcanic rocks have been eroded, weathered, and the top of the deposit has been supergene-enriched (Figure 2-2).

Supergene enrichment is a process in which fluctuating levels of mildly acidic groundwater weathers the rock to form a different suite of minerals. This process has altered the bedrock to depths of 50 to 400 feet below the bedrock surface. The upper 10 to 20 feet of the volcanic rock has been intensely altered by near-surface weathering to form a very weak, silty-clay rock called saprolite. The saprolite grades into less intensely weathered volcanic rock with depth.

Orebody Description

The Flambeau deposit is generally tabular in shape and occurs within a distinctive assemblage of volcanic-sedimentary rocks termed the mineralized horizon. The Flambeau deposit is about 2,400 feet long, ranges in thickness from 20 to 200 feet and extends to a depth of about 800 feet. Dominant rock types within the mineralized horizon are quartz-rich sediments and volcanic ash, massive sulfide, semi-massive sulfide, and chert. The economically valuable minerals consist mainly of copper sulfide minerals; chalcocite (Cu_2S), bornite (Cu_5FeS_4) and chalcopyrite ($CuFeS_2$) with trace amounts of gold and silver. Significant sulfide mineralization has not been intersected by coreholes drilled west of the Flambeau River or east of STH 27.

The upper portion of the deposit, up to 30 feet in thickness, has been intensely weathered to an iron oxide-rich gossan. Below the gossan, the deposit has been altered through supergene weathering processes to produce higher grade copper minerals to a maximum depth of 225 feet. Chalcocite and bornite in a matrix of pyrite and chert make up the enriched portion of the deposit. Lower grade copper sulfide minerals are present below the supergene-enriched zone. The proposed project will recover ore primarily from the supergene-enriched portion of the deposit.

Rock cores from the orebody and surrounding rocks indicate asbestos minerals are not present in the ore or bedrock. Evaluation of these cores, along with an analysis of the genesis of the orebody, indicate radioactive materials are not present in concentrations beyond normal background levels.

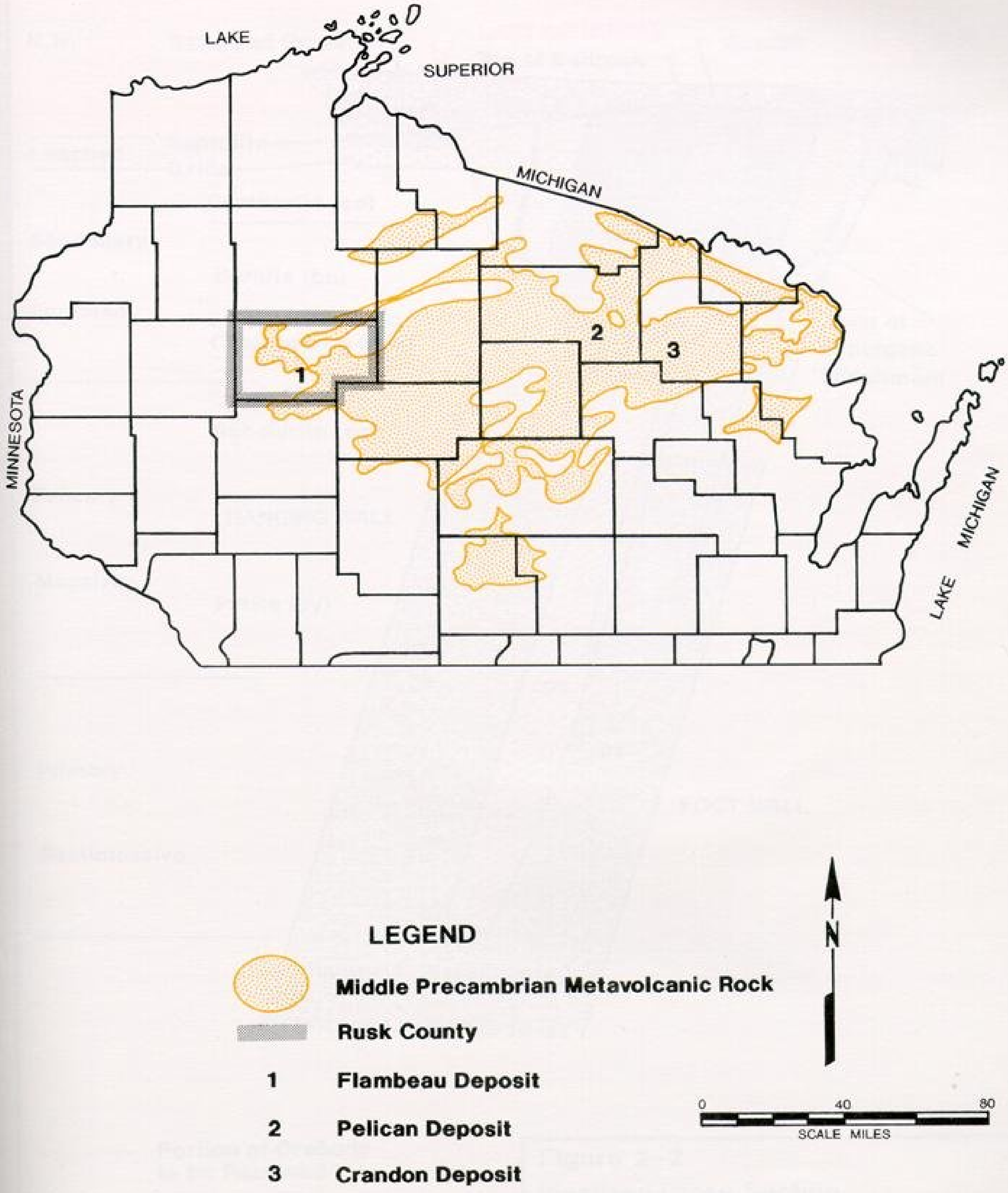


Figure 2-1
Distribution of Middle Precambrian Metavolcanic Rocks in Northern Wisconsin

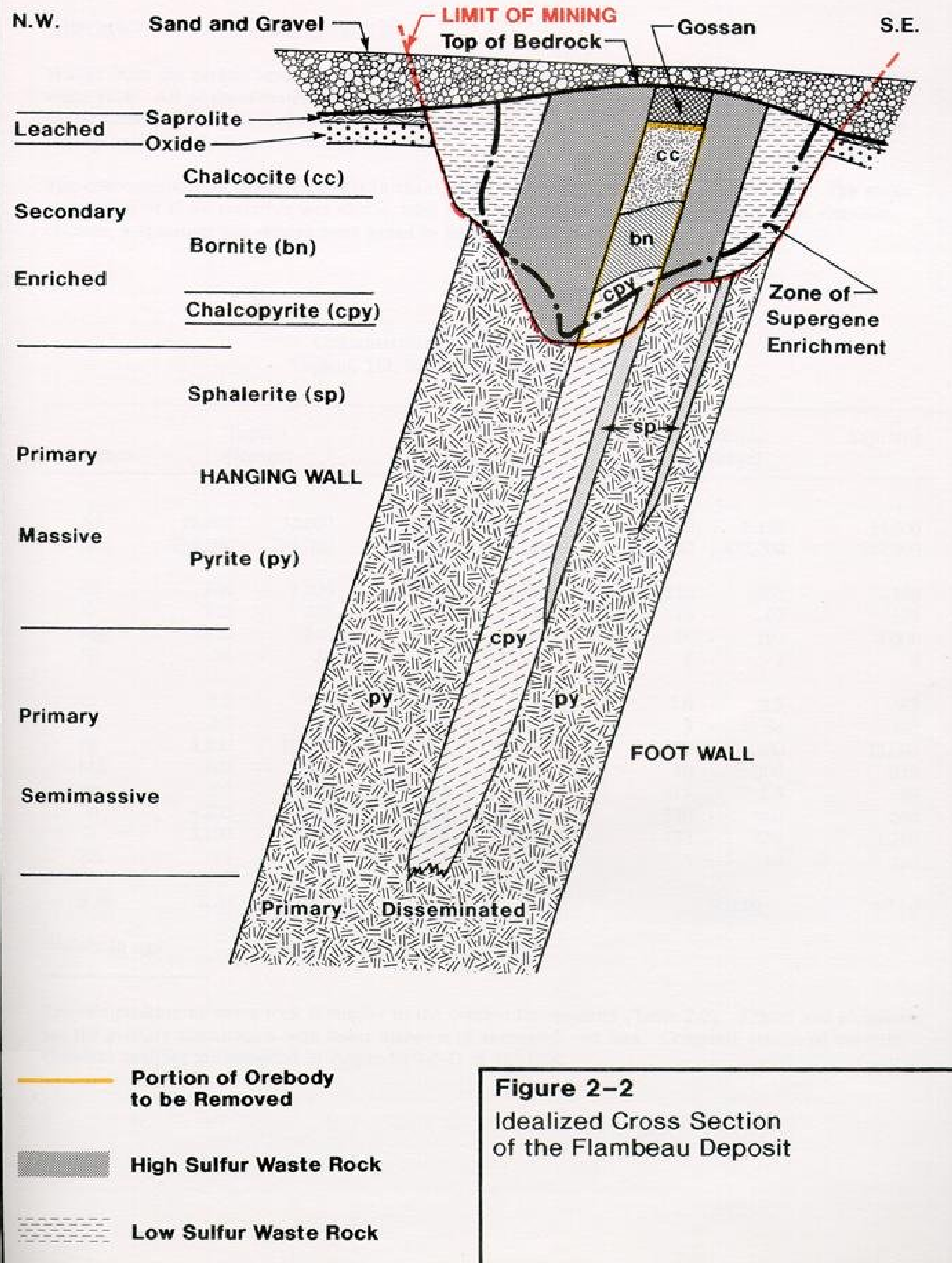


Figure 2–2
Idealized Cross Section of the Flambeau Deposit

Characterization of Waste Material

Wastes from the project would include topsoil, glacial till, sandstone, saprolite and low and high sulfur waste rock. All of these materials were subjected to laboratory analysis to ascertain their chemical characteristics. Analyses included bulk chemical analyses, acid production potential and neutralization testing, and leachate characterization.

The concentrations of major elements in the overburden materials are shown in Table 2-1. The major constituent of these materials was silicon, with lesser amounts of aluminum and iron. Tin, titanium, calcium, magnesium and copper were found in most samples in minor amounts.

TABLE 2-1

Concentrations of Major Elements in the
Topsoil, Till, Sandstone, and Saprolite Samples[1]

Parameters	Topsoil (Range)	Till (Range)	Sandstone (Range)	Saprolite
A1	28,000 - 32,600	38,900 - 52,600	5,440 - 6,140	34,800
Si	259,000 - 295,000	318,000 - 344,000	376,000 - 437,000	347,000
Ca	800 - 1,200	1,700 - 2,600	110 - 560	2,100
K	110 - 260	170 - 310	16 - 69	130
Mg	620 - 840	1,400 - 3,000	46 - 190	1,000
Na	16 - 22	6 - 14	6 - 7	6
Cr	6.0 - 9.5	9.1 - 11	1.6 - 2.3	9.2
Cu	2.7 - 4.0	13 - 83	3 - 34	160
Fe	4,400 - 10,000	5,700 - 10,000	430 - 1,100	12,000
Mn	280 - 610	160 - 460	10 - 200	310
Pb	5.0 - 10	2.3 - 3.5	0.4 - 1.3	29
Sn	<200 - 233	620 - 1,900	570 - 960	560
Ti	3,100 - 3,190	1,800 - 4,100	180 - 630	1,300
Zn	17 - 19	18 - 22	3 - 10	110
S %	0.20 - 0.21	<0.10	<0.10	<0.10

[1]Values in ug/l

The composition of waste rock is similar to the overburden material (Table 2-2). Silicon and aluminum are the primary constituents with lesser amounts of aluminum and iron. Complete results of the bulk chemical analyses are provided in Appendix 3-5-O of the EIR.

TABLE 2-2

Concentrations of Major Elements in the Waste Rock Samples[1]

	WASTE ROCK SAMPLE				
	WR-1	WR-2	WR-3	WR-4	WR-5
Al	109,000	122,000	124,000	108,000	109,000
Si	357,000	330,000	336,000	349,000	269,000
Ca	5,200	1,500	2,300	1,800	252
K	700	590	360	870	118
Mg	9,400	6,400	7,100	8,900	345
Na	45	62	43	38	22
Co	18	28	60	35	23
Cr	24	29	25	17	2.3
Cu	540	2,700	3,900	5,000	6,400
Fe	33,000	38,000	42,000	45,000	38,000
Pb	9	16	60	24	7
Mn	310	160	130	180	19
Ni	7.1	14	31	11	6.1
Sn	2,600	<300	680	<300	460
Ti	2,600	3,000	2,900	2,600	2,000
Zn	1,200	98	7,900	830	41
S %	<0.10	0.49	0.70	2.0	4.8

[1]Values in ug/l

Acid production studies were conducted on powdered waste rock to determine the materials' capability of producing acid. These tests indicated that waste rock with sulfur content of 2% or less would not be expected to produce acid.

Two different leaching tests on waste materials were performed. A wet/dry leach test simulated the natural precipitation cycle which the materials would be exposed to while stored on the surface. The second test evaluated leachate produced by continued saturation of the materials, simulating the backfilled pit after flooding with groundwater. Results from the leach testing are provided in Section 3.5.6.3.3 of the Mining Permit Application.

TOPOGRAPHY

The entire region has been glaciated and most of the land forms in central Rusk County are of glacial or water-worked origin. The surface elevations at the mine site range from 1,090 feet at the Flambeau River to 1,160 feet in the uplands. Figure 2-3 illustrates the range and location of the various topographic elevations and geologic surfaces. The proposed rail spur, all of the ancillary facilities and most of the stockpiles will be located on upland areas ranging in elevation from 1,140 feet to 1,160 feet. The uplands are underlain by a layer of loamy till 30 to 40 feet thick.

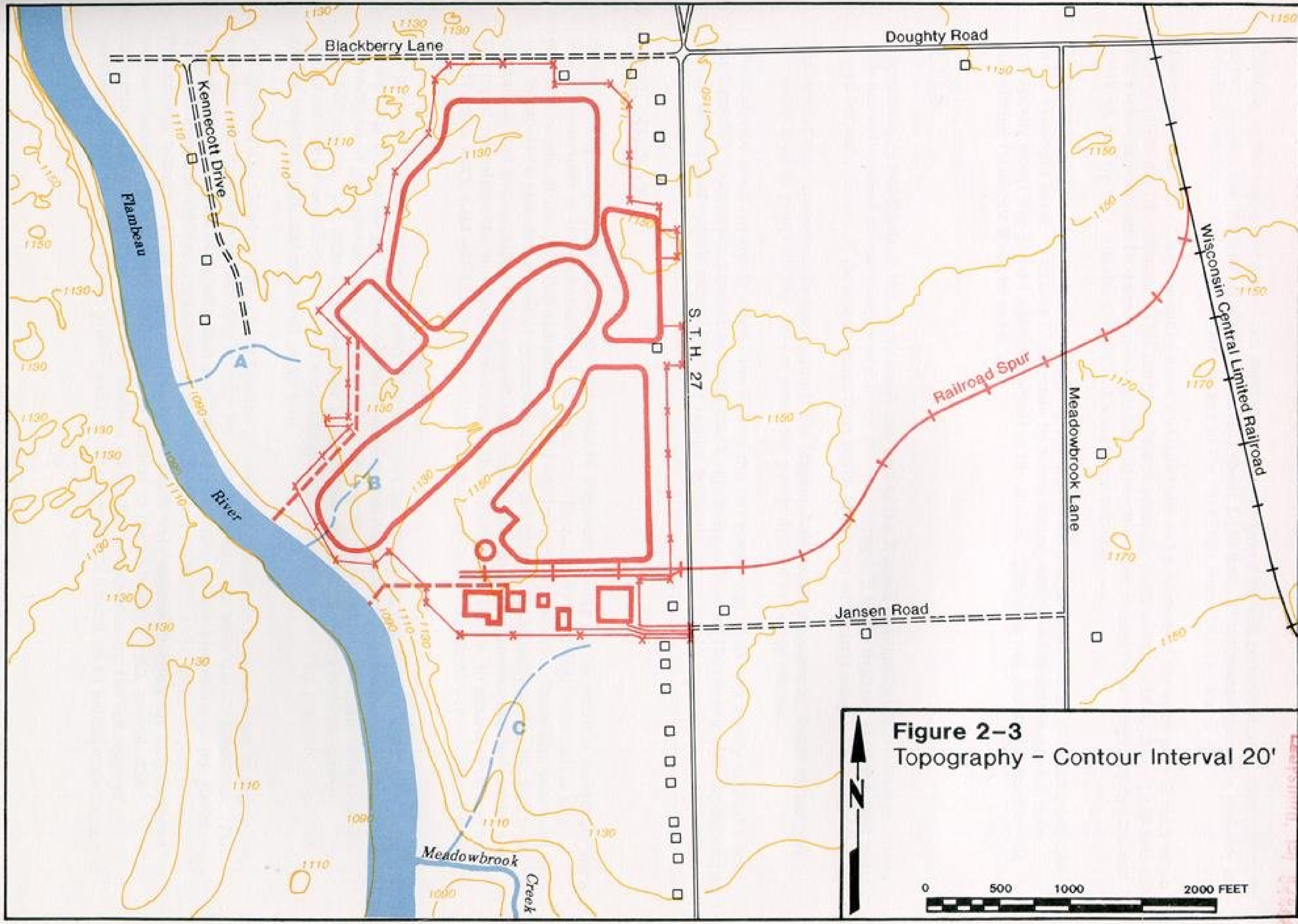


Figure 2–3
Topography - Contour Interval 20'

Portions of the high-sulfur waste rock stockpile and the proposed pit will be located on a dissected terrace surface, the elevation of which is generally about 1,140 feet. The dissected terrace is probably an erosional feature cut by the glacial melt-waters of the Flambeau River into the loamy till.

The western portion of the low-sulfur waste rock stockpile and a portion of the open pit will cut into an area of pitted glacial sediments. This pitted surface is generally at an elevation of 1,120 to 1,130 feet. The surface is underlain by coarse-grained glacial and water-worked sediments, is irregularly bedded and stratified, and typically contains cobbles and some large boulders.

Another geomorphic surface is a low, relatively flat area (elevation of 1,090 feet to 1,110 feet) adjacent to the Flambeau River. The area is underlain by poorly sorted, water-worked sediments with some geologically recent fine-grained alluvial material at the surface. This area was probably formed by the meandering Flambeau River in recent time.

SOILS

Approximately two-thirds of the mapped soils are part of the Rosholt-Bevent-Chetek association. These soils are well-drained to excessively well-drained and have formed in loamy deposits overlying sand and gravel outwash. Slopes of these soils range from gently sloping to moderately steep.

The second most common soils association is the Magnor-Auburndale association. These upland soils are nearly level to gently sloping and are somewhat poorly drained to poorly drained.

The Seelyville muck commonly adjoins the soils of this last association. This very poorly drained muck has formed in topographic depressions under marsh vegetation. These mucks contain high concentration of well decomposed organic material in their surface horizons.

GROUNDWATER

Several hydrogeologic studies have been conducted by Flambeau Mining Co. to ascertain the quality and flow characteristics of the groundwater at the mine site. Extensive hydrogeologic information was collected as part of the 1976 EIS and mining permit application preparations. These data were used in part to provide a historical record of groundwater flow, elevations and chemistry within the glacial overburden and the sandstone of the project area. Secondly, a computer groundwater flow model was developed to evaluate the anticipated drawdown in the project area. Thirdly, to expand upon and verify this previous work, field and laboratory investigations meeting current standards were conducted from 1987 to 1989.

The purposes of these additional studies were to: 1) define the nature and orientation of the groundwater flow in the glacial overburden, sandstone, and Precambrian bedrock units and 2) establish the background groundwater quality at the project site and of the private water supply wells near the proposed project. The current hydrogeologic investigations included: soil and bedrock borings; groundwater level measurements; the 12-month baseline groundwater monitoring program; single-well aquifer response tests; and multi-well pump tests.

In September and October 1987, fifteen baseline groundwater monitoring wells as shown in Figure 2-4, were installed to provide groundwater samples for establishing baseline water quality conditions. The wells are grouped in six nests; with each nest having a water table well, a piezometer in the glacial fluvial sediments or Cambrian sandstone, and/or a piezometer installed in the upper 50 feet of the Precambrian bedrock. These groundwater monitoring wells were sampled monthly for 12 consecutive months (October 1987 to September 1988). In addition to the 15 baseline wells, several other monitoring wells and 4 private wells were sampled during the investigation for the full range of parameters. In addition, 45 more private wells were sampled for a limited set of indicator parameters as part of Flambeau Mining Company's well guarantee program. The locations of the groundwater monitoring wells and private wells are shown on Figure 2-5. A summary of the groundwater quality is contained in Appendix B.

Wells used to estimate the permeability and transmissivity of the glacial overburden, Cambrian sandstone and Precambrian rock in the project area are shown in Figure 2-6. Pumping and/or bail down tests were conducted in 1971-73 on 30 wells and 1987-89 on 54 wells in the project area. The permeability of the geologic units is discussed in the following **GROUNDWATER FLOW** section.

Groundwater levels in these monitoring wells were measured monthly from September 1987 through September 1988, and in November 1988 and January 1989.

Groundwater Quality

Groundwater in the Ladysmith area is of generally good quality, but typically has total dissolved solids concentrations in excess of 300 ppm. Studies conducted by the U.S. Geological Survey indicate iron and manganese concentrations are high in the Ladysmith area groundwater. Six private wells and one public well within 5 miles of the proposed mine site had levels of iron and manganese which exceeded the U.S. Public Health Service secondary drinking water standards. The source of these high concentrations is believed to be the aquifer materials and is thus a natural occurrence.

Depth to Groundwater

Depths to groundwater in the area are relatively shallow, usually less than 20 feet. The three main reasons for this are: 1) the regional topography is relatively flat, with less than 100 feet of total relief between the recharge zone and the discharge zone; 2) average precipitation results in groundwater recharge (of approximately 5 inches per year) sufficient to create a mounded watertable condition; and 3) the glacial till is the uppermost aquifer over a majority of the region. The low permeability of this till enhances the mounding effect caused by precipitation recharge.

In order to evaluate the effect of dam-controlled fluctuations of the Flambeau River level on groundwater levels, simultaneous water level measurements were taken on a sandpoint well adjacent to the river and at several monitoring wells and piezometers near the river in September and October of 1988. Water levels of the river vary 0.5 to 2.0 feet twice-daily due to the hydropower releases. The pressure wave created by the increased flows causes slight groundwater elevation changes in wells located within 400 feet of the river.

Groundwater Flow

Groundwater movement in the region normally flows from recharge (i.e., upland areas) to discharge zones (i.e., flowing rivers, streams, springs, or wetlands). In certain localized areas, however, groundwater flow toward man-made discharge zones, such as the cones of depression created by active water supply wells or an open pit mine, will occur.

With one exception, groundwater at the proposed mine site flows west toward the Flambeau River. At the northern edge of the project area, along Blackberry Lane, the water table contour line bends toward the east, paralleling the eastward bend in the river. In this area, flow is to the northwest and north (Figure 2-7).

Project area groundwater movement is dominated by four principal aquifer units: the Precambrian bedrock; the Cambrian sandstone; the glacial till; and the glaciofluvial sediment. Major characteristics of these materials are shown in Table 2-3. These aquifers are discussed in greater detail in the following sections.

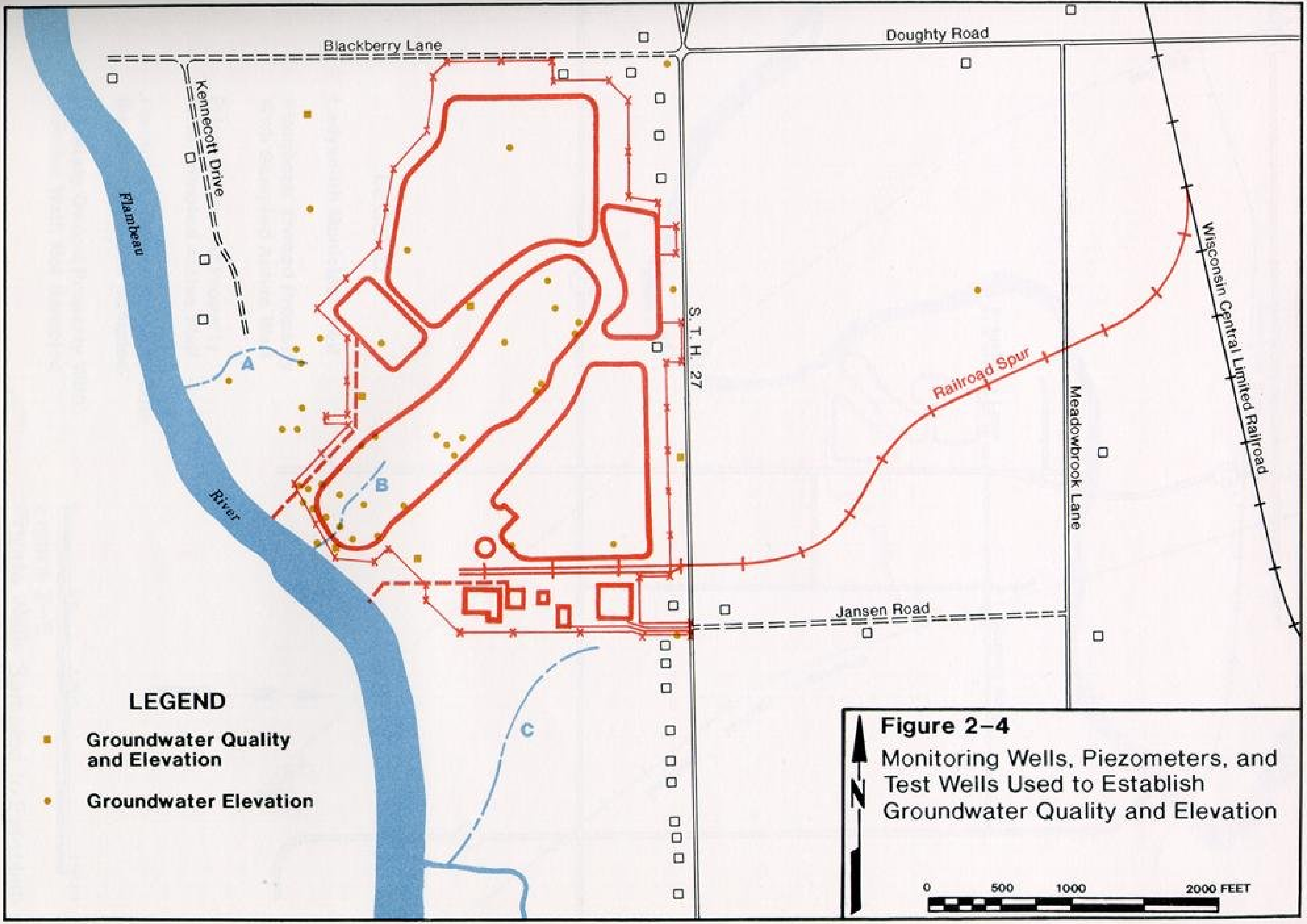


Figure 2–4
Monitoring Wells, Piezometers, and Test Wells Used to Establish Groundwater Quality and Elevation

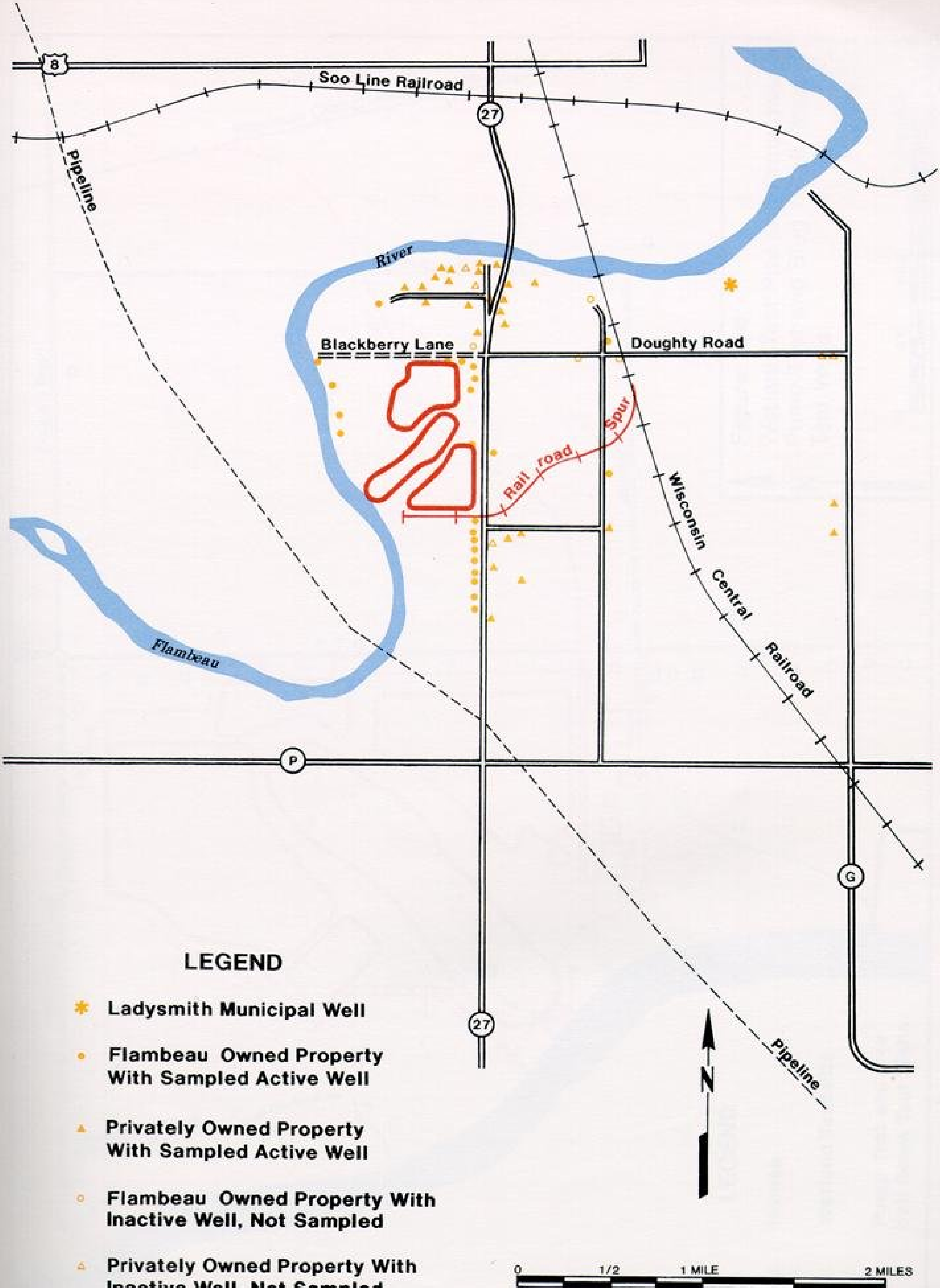


Figure 2–5
Private Wells Sampled to Establish Baseline Conditions

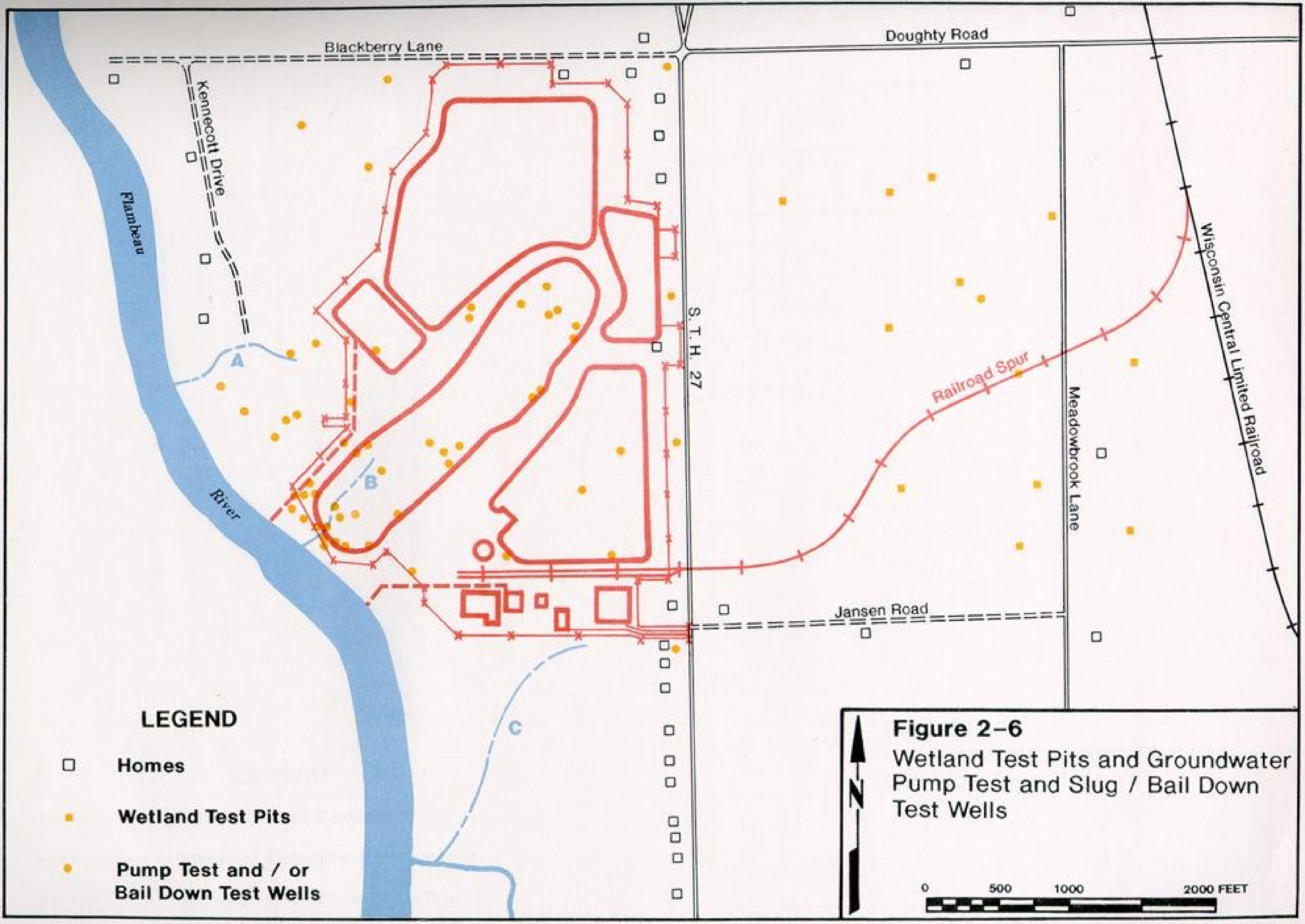


Figure 2–6
Wetland Test Pits and Groundwater Pump Test and Slug / Bail Down Test Wells

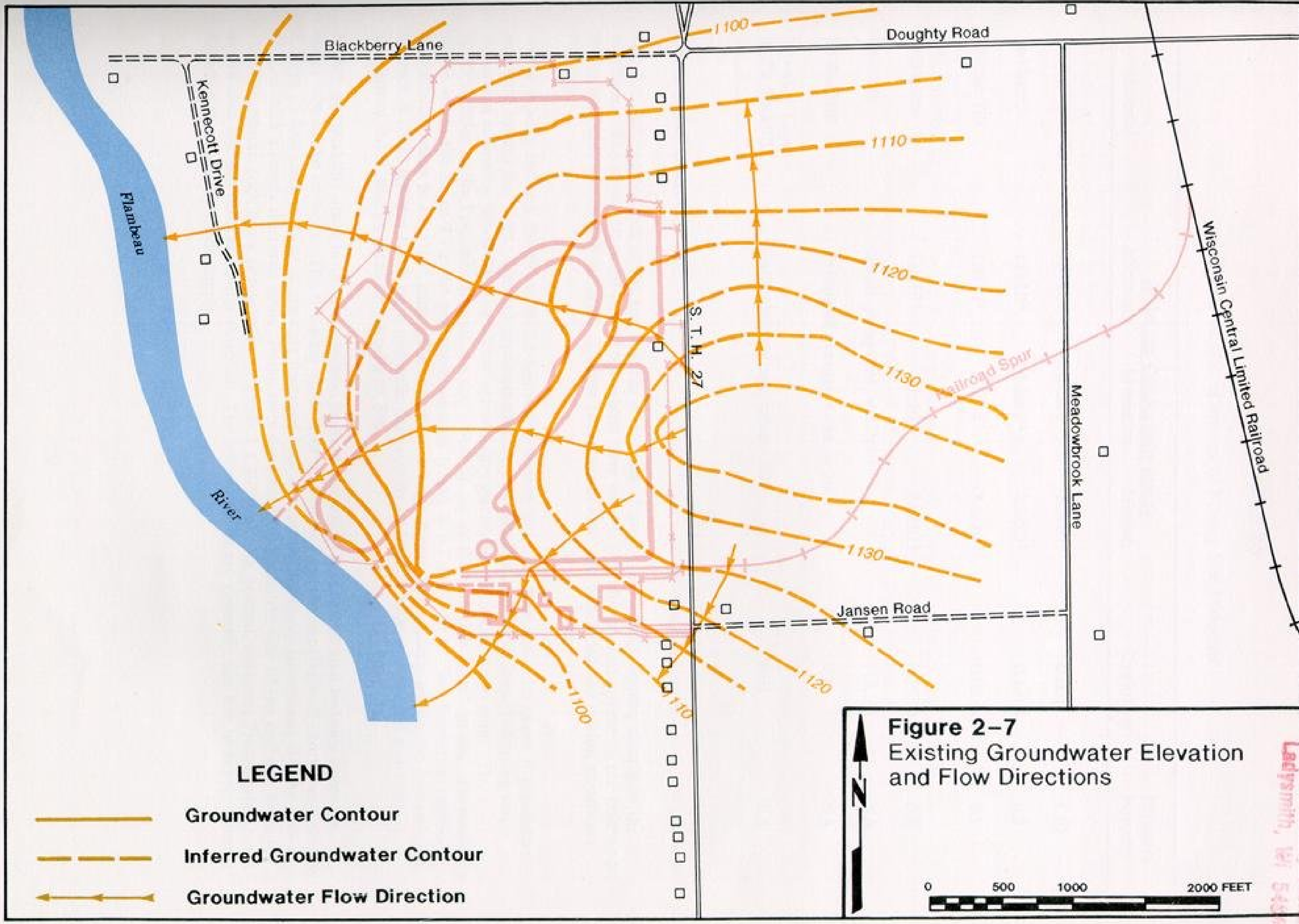


Figure 2–7
Existing Groundwater Elevation and Flow Directions

TABLE 2-3

Hydraulic Characteristics of Mining Site Materials

Material	Hydraulic Conductivity (cm/s) Minimum	Maximum	Median	Storativity	Effective Porosity
Precambrian Rock	$7.9x10^{-8}$	$6.2x10^{-4}$	$1.3x10^{-5}$	0.001	0.05
Sandstone	$1.0x10^{-4}$	$1.8x10^{-3}$	$1.1x10^{-3}$	0.1-0.3	0.3
Glacial Till	$1.4x10^{-5}$	$5.5x10^{-3}$	$3.6x10^{-4}$	0.05-0.1	0.1
Glaciofluvial Sediments	$1.0x10^{-5}$	$1.7x10^{-1}$	$2.6x10^{-3}$	0.15 to 0.25	0.2
Orebody	Single pump test = $1.0x10^{-4}$			NA	NA
Pit Backfill	Estimated average value = 10^{-3}			0.1	NA
Saprolite Layer In Pit Backfill	Estimated average value - 10^{-5}			0.01	NA

Precambrian Bedrock

The Precambrian bedrock at the site consists of a series of overturned schists dipping steeply to the northwest. The upper 10 to 50 feet of the schists have been highly altered, and appear in the field as a rather soft, almost clay-like material. Deeper zones are harder, less weathered and exhibit significant jointing.

Water moving through the Precambrian bedrock is limited and what flow that does occur is generally westward toward the river. Upward gradients also were observed in most locations, indicating water movement is flowing upward to the higher permeability glacial-fluvial or sandstone units. The permeabilities in the Precambrian unit are the lowest of any of the materials found on-site. Permeability values are in the range 7.9×10^{-8} centimeters/second (cm/s) to 6.2×10^{-4} cm/s. The formation median permeability value is 1.3×10^{-5} cm/s. The calculated average linear flow velocity within the Precambrian bedrock is 0.022 feet/day based on a hydraulic conductivity of $1.6x10^{-5}$ cm/s, a measured hydraulic gradient of 0.025, and an effective porosity of 5%.

Higher permeability areas in the Precambrian bedrock are found within fractured bedrock zones on either side of the orebody. The ore zone appears to be bounded on the hanging-wall (northwest) side by a 20-to 35-foot-thick interval of strongly fractured rock and on the foot-wall (southeast) side by a 40-to 70-foot-thick strongly fractured zone. Pump tests conducted on the north side of the orebody indicate the Precambrian rock has a permeability of about 1×10^{-4} cm/s. In general, however, Precambrian rocks in this area are not used as aquifer material. The normal yields are generally too low to support even a domestic single family home supply.

Sandstone

Overlying the Precambrian bedrock in most of the project area is the Cambrian sandstone. The sandstone varies from friable to well-cemented. The sandstone is absent near the river and is about 34 feet thick in the central part of the proposed mine site. The permeabilities in this unit range from 1.0 x 10^{-4} cm/s to 1.8 x 10^{-3} cm/s with a median formation permeability of 1.1 x 10^{-3} cm/s. Groundwater movement through the sandstone is west toward the river and parallel to the general trend of the water table. The calculated average linear flow velocity within the sandstone is 0.17 feet/day based on a hydraulic conductivity of 7.3x10^{-4} cm/s, a measured hydraulic gradient of 0.025, and an effective porosity of 30 percent. Because of limited thickness, sandstone yields in the project site area are limited but are generally suitable for a private household supply.

Glacial Till

The glacial till overlies the sandstone and generally lies to the east of the glaciofluvial material. The till lies over the orebody and is thickest (about 70 feet) immediately east of the proposed open pit. The till is significantly less permeable than the glaciofluvial sediment. Permeabilities range from 1.4 x 10^{-5} cm/s to 5.5 x 10^{-3} cm/s with a median formation permeability of 3.6 x 10^{-4} cm/s. The average linear flow velocity within the till is calculated to be 0.19 feet/day using a hydraulic conductivity of 2.7x10^{-4} cm/s a measured hydraulic gradient of 0.025, and an effective porosity of 30 percent.

The suitability of the till as an aquifer is limited. The occasional thin sand lenses can provide sufficient water for a private residence.

Glaciofluvial Sediments

The glaciofluvial sediments consist of inter-bedded sands, gravels, cobbles, and boulders. These sediments are predominantly found adjacent to the river and are thickest northwest of the proposed open pit. Occasionally, glaciofluvial sediments are present in thin layers beneath the glacial till. These sediments are moderately to highly permeable and are most promising as an aquifer for public and industrial uses.

The permeability of this material is somewhat variable due to the interbedding of well-sorted and poorly-sorted units. The in-field testing of the piezometers indicates the range of permeabilities is 1.0 x 10^{-5} cm/s to 1.7 x 10^{-1} cm/s. The formation median permeability value is 2.6 x 10^{-3} cm/s and the calculated average linear flow velocity is 0.60 feet/day using a hydraulic conductivity of 2.1x10^{-3}, a measured hydraulic gradient of 0.02, and an effective porosity of 20 percent. Thus, despite the permeability variations, much of this material would be useful as an aquifer for modest amounts of groundwater withdrawal.

Aquifer Use

An evaluation of water supply well logs indicates almost 95% of the private wells in the area obtain their water either from the glaciofluvial aquifer or from thin lenses of permeable material in the glacial till. A few wells were drilled as deep as the sandstone and the Precambrian bedrock. An evaluation of well logs for approximately 200 private wells within a 2 to 3 mile radius of the proposed mine indicates 5 (2.5%) are completed in sandstone and 6 (3%) in the Precambrian bedrock.

SURFACE WATER

The Flambeau River originates in the Turtle-Flambeau Flowage in Iron County. The river has a drainage area of approximately 1,840 square miles. It flows southwesterly through the counties of Ashland, Price, Sawyer, and Rusk before entering the Chippewa River above Lake Holcombe in the southern part of Rusk County. The proposed mine site is located approximately 15 miles above the confluence of the Flambeau River with the Chippewa River. The river is a meandering, low-gradient (3 feet/mile) stream whose course near the proposed mine site has apparently changed little during post-glacial time.

The watershed above the mine site is relatively undisturbed except for scattered agricultural areas and the Ladysmith urban area. The upper region of the Flambeau River lies within the Flambeau River State Forest.

Surface Water Uses

The Flambeau River in Rusk County is used for power generation, disposal of treated municipal and paper mill wastewater, recreation (e.g., fishing and boating), and wild and domestic animal use. The river is not used for domestic water supplies or for commercial navigation.

Ecological Relationships in the Flambeau River

In general, the Flambeau River supports a diverse, high quality macroinvertebrate community with a composition indicative of relatively clean, fast flowing, unpolluted water conditions. The common occurrence of mayflies and stoneflies at all stations in the 1987-88 sampling indicates clean water conditions. This abundant and healthy insect community provides the fish community with an important food source.

Available data indicates a healthy and diverse fish community is present in the river and the Thornapple Flowage. Fish populations move upriver and out of the flowage during high water. Under low flow conditions, however, fish move back to the flowage due to fluctuating water levels and poor habitat in the form of shallow pools and limited cover.

Water Quantity

River flow past the project area is unimpeded by impoundments, but upstream dams contribute to fluctuating water levels. The nearest dams are the Thornapple Dam (13 foot head) located approximately nine river miles below the proposed mine site and the Peavey Mill Dam (17 foot head) located approximately 3.8 river miles above the mine site in the City of Ladysmith (Figure 2-8).

River flows at the project area are influenced by rainfall and the operation of several power plants upstream from the project area, especially the Dairyland Dam. The three impoundments on the Flambeau River above the mine site within Rusk County; Big Falls Flowage (50-foot head), Dairyland Flowage (68-foot head), and the previously mentioned Peavey Mill Dam influence water levels. Daily fluctuations of several feet in river levels at the project area accompany surges of power generation from the Peavey Dam.

The stream reach adjacent to the project was influenced by the Port Arthur Dam. This dam, however, was removed in 1968. The highest measured water level at the mine site since 1969 has been 1,091 feet MSL. A field inspection by the DNR in 1973 indicated an average water level adjacent to the mine site of 1,085 feet MSL, with a normal high-water level of 1,086 feet MSL.

There are no 100-year flood records for the Flambeau River in the vicinity of the project area. The estimated 100-year flood elevation at the site is 1095.44 feet MSL (Appendix 3.7-A, EIR).

River flow records over a thirty-six year period (1951-1987) from the U.S. Geological Survey's Thornapple Gauging Station indicate the 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. A base flow analysis of stream flow indicates about 25% is surface water runoff and 75% is groundwater inflow.

Tributary Streams

The only continuous flow tributary stream in the vicinity of the project area is Meadowbrook Creek. The Creek flows from east to west and enters the Flambeau River about 0.5 mile south of the project area.

Three intermittent streams are located at the proposed mine site with only stream C considered navigable (Figure 2-9).

Surface Water Quality

Surface water sampling was conducted on the Flambeau River at two locations, approximately 0.8 mile upstream and 2.5 miles downstream from the proposed outfall locations (Figure 2-8). This sampling indicated the Flambeau River has soft, well-oxygenated water 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, and total suspended solids were recorded in samples taken during the late summer. Ranges for these parameters were: pH (6.2 to 8.0); dissolved oxygen (6.0 to 12.0 mg/l); total suspended solids (about 1 to 15 mg/l). A summary of the monitoring results from the two stations is contained in Appendix C.

The chemical characteristics of both sites did not vary significantly. Of the 43 parameters sampled, 15 have water quality criteria proposed under NR 105 (Wis. Adm. Code) (Table 2-4). Of these 15 parameters, only copper and zinc were ever measured in concentrations above the proposed toxicity thresholds. Exceedance occurred once for each metal. Trace concentrations of copper and zinc are not uncommon in surface waters of the area.

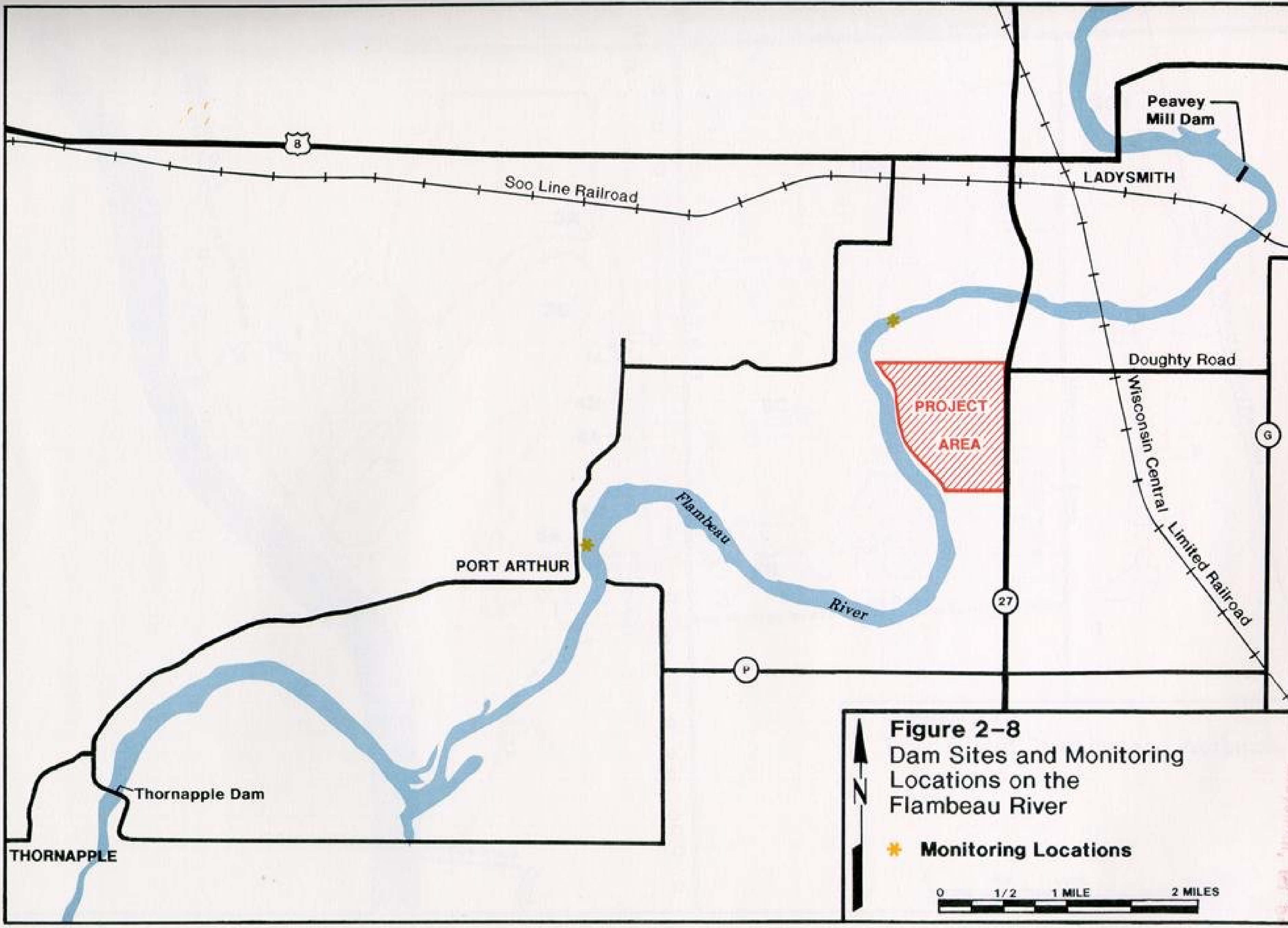


Figure 2–8
Dam Sites and Monitoring Locations on the Flambeau River

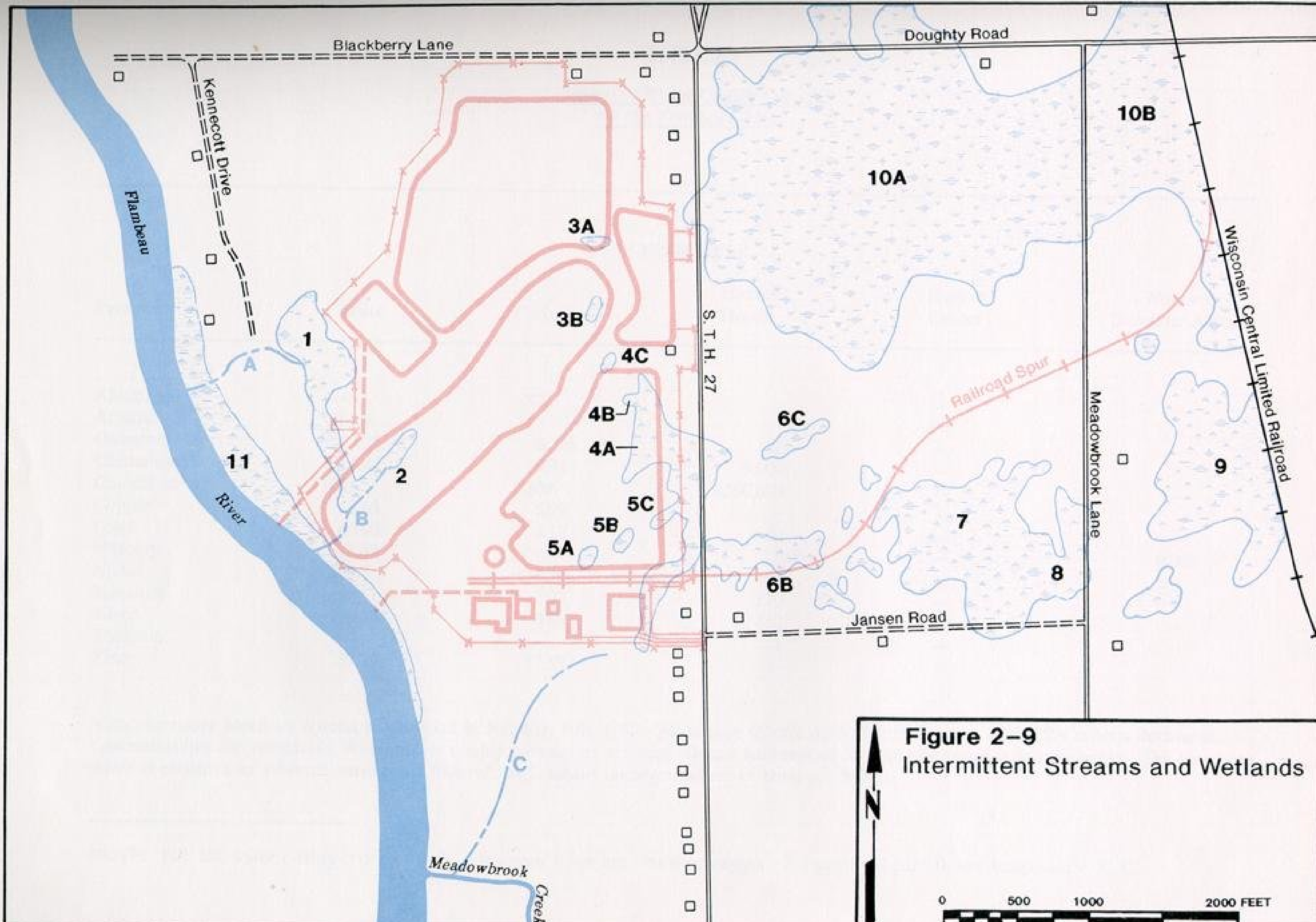


Figure 2–9
Intermittent Streams and Wetlands

TABLE 2-4

Estimated Water Quality Criteria
for the Flambeau River

	Criteria (μg/L)[1]				
Parameter	Acute	Chronic	Human Health	Human Cancer	Wild and Domestic Animal
Aluminum	748	87	--	--	--
Arsenic	363.8	153	--	50	--
Cadmium	13.25	0.216	82	--	--
Chromium^{+6}	14.2	9.74	9,000	--	--
Chromium^{+3}	1061	30.6	9,500,000	--	--
Copper	8.63	5.99	--	--	--
Lead	69.96	4.17	50	--	--
Mercury	1.53	--	0.08	--	0.002
Nickel	599.5	36.79	460	--	--
Selenium	58	7.07	170	--	--
Silver	0.885	0.885	430	--	--
Thallium	--	--	11	--	--
Zinc	57.39	27.57	--	--	--

[1]Concentrations based on criteria as provided in NR 105, Feb. 1989. Aluminum criteria derived from August, 1989 EPA criteria document. Concentrations are estimates. Where water quality parameters are applicable, a hardness of 50 ppm was assigned as reasonable. The Flambeau River is classified as a "warm water sport fishery." μg/L means micrograms/liter or parts per billion.

NOTE: NR 102 water quality criteria for the Flambeau River are dissolved oxygen - 5.0 ppm; pH 6.0-9.0; and temperature 32°C.

River Sediment

The river bottom is generally made up of gravel, cobbles, and boulders with some minor areas of sand and silt. In the vicinity of the project area, the bottom types are estimated to be 50% gravel, 35% sand, 10% cobble and boulders, and 5% muck based on habitat characterization in the field.

There is very little fine-grained sediment in the Flambeau River adjacent to the project area due to the scouring action of the river. Sediment samples collected at the two surface water sampling sites and the Thornapple Dam impoundment indicated the sediment was within normal ranges for all parameters sampled, except mercury levels appear to be elevated. The mercury concentrations may be normal for the Flambeau River or may be due to past discharges from the upstream paper mill.

WETLANDS

Eleven wetlands in the vicinity of the proposed mine have been identified (Figure 2-9). They are classified into six ecological types: northern wet forest; northern sedge meadow; northern wet-mesic forest; alder thicket; northern mesic forest; and bog. The largest wetland, covering 58 acres, is located east of STH 27 and north of the proposed rail spur. This is a perched wetland with a combination of bog, alder thicket, and northern wet forest plant communities. The largest undisturbed wetlands on the mine site are Wetlands 1 (5.4 acres) and 2 (2.5 acres). They are classified as northern wet-mesic forests. The remaining wetlands have been disturbed by human activity and are found in isolated depressions in upland areas. Wetland 11 occurs along the Flambeau River floodplain, is influenced by the river, and has been historically inundated by the former flowage caused by the Port Arthur dam.

Groundwater/Wetland Relationships

Wetlands 1 and 2, northwest of the proposed open pit, are supported by groundwater, but are not groundwater discharge wetlands themselves. Both wetlands are located at the western edge of the till, at the foot of a sharp drop in slope. The land surface drops too quickly for the water table surface to conform and, as a result, a seep discharge occurs along the eastern edge of the wetlands. However, as the groundwater continues to flow to the west under the wetlands the water table continues to drop off. Monitoring information indicates the sediments underlying the wetlands are of low permeability. This means the seepage on the eastern side of the wetlands, is sufficient to maintain wetland conditions, even though the majority of these wetlands occurs over a groundwater recharge zone (i.e., perched wetland conditions).

As previously mentioned, Wetland 10 is likely perched above the water table. There is no direct information on the groundwater elevations beneath the other site wetlands. Wetlands 5c and 6c lie in areas that the groundwater elevation is close to the surface and may be partially supported by groundwater.

VEGETATION

Terrestrial Vegetation

The project area supports a combination of natural communities and disturbed areas. The natural communities in the study area include alder thickets, northern mesic forest, northern sedge meadow, northern wet forest, northern wet-mesic forest, and open bog.

The disturbed areas include: upland forests; lowland forests; coniferous plantings; old field; active agricultural lands; wetland; and residential/industrial. These areas have been affected by logging, farming, drainage, sand and gravel mining and road construction.

Upland forest is the largest community found in the project area, comprising 35% of the total. This community includes northern hardwood and aspen stands. Dominant species present are sugar maple, red maple, basswood, white birch, quaking aspen, and large-toothed aspen.

Lowland forest covers a very small percentage (about 3%) of the project area. This forest type is classified as a northern wet-mesic forest community and lies directly over the west end of the open pit. Major canopy trees include balsam fir, white cedar, black ash, and hemlock.

Conifer plantings cover a total of 28 acres (12% of the project area) and are scattered about in ten separate plantations. The predominant species are white spruce, red pine, jack pine, and white cedar. Most of these stands range from 15 to 20 years in age.

The old-field community consists of old agricultural fields left idle for several years. This cover type includes about 55 acres (20%) of the project area. This is the second-largest community on the site and includes invading early successional trees, shrubs, herbaceous plants, and grasses. Some of the common plants include quaking aspen, large-toothed aspen, white birch, staghorn sumac, choke cherry, and numerous forbs and grasses.

Active agricultural fields cover 57 acres (20%) of the project area. Crops grown include alfalfa, corn, oats, and wheat.

Commercial/industrial areas found at the mine site include an inactive gravel pit south of Blackberry Lane and a garage along STH 27. Residential areas are found along roadways. These land uses cover 32 acres (about 10%) of the project area.

Aquatic Plants

Algal species, particularly those attached to rocks and sediment, are the predominant plant at both of the sampling stations in the Flambeau River. The communities at both locations were similar in abundance and taxa, but were very limited in diversity compared to 1973 results. The extremely low flow conditions experienced in 1988, especially during the late summer, probably contributed to these results. Studies from the first mining proposal in 1973 found 28 diatom species and one green algae species in this segment of the river.

WILDLIFE

Wildlife species (e.g., mammals, amphibians and reptiles) observed at the mine site are similar to those of the surrounding region because of similar land uses and forest habitats. Game species observed at the site include waterfowl, upland game and white-tailed deer.

Birds

Surveys conducted in the mine site area in 1972-73 and 1987-88 identified 84 and 75 bird species, respectively. The birds found in 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 study area are summer residents, 30% are permanent residents, 5% are migrants, and 1% are winter residents.

Game species using the site include wood duck, mallards, American golden eye, and bufflehead. In addition, ruffed grouse and American woodcock are upland game birds commonly observed in the area. All of these game birds, except the ruffed grouse, are migratory.

The largest population of non-game bird species are found in the northern hardwoods/aspen-old field habitat directly over the proposed open pit. 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 non-game species.

Fish

During the 1987-1988 study period, fish were collected in the Flambeau River between the Peavey Mill and Thornapple Dams. Common species included white sucker, yellow perch, and creek chub. No unusual occurrences were observed during the sampling period. Sturgeon and muskellunge 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 metal analysis.

The most common species observed by the DNR while boomshocking between the old Port Arthur Dam and Thornapple Dam in 1972 were black bullhead, walleyed pike, yellow perch, red horse, northern pike, and white sucker.

Heavy metal analysis was performed on fillets and livers of selected fish collected from the study area during the fall of 1987 and spring and summer of 1988. Trace metals tested for included mercury, nickel, copper, lead, selenium, chromium, cadmium, arsenic, silver, zinc, and uranium. The results indicate the metal concentrations in fish tissues are within acceptable ranges.

Benthic Macroinvertebrates

The major groups of insects identified in benthic studies of the Flambeau River, were Chironomids, Ephemeropterans, and Tricopterans. The change in abundance of specific species in the 1987-1988 surveys in comparison with the earlier studies is indicative of good water quality and an improvement in water quality since the 1970's.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered plant or animal species are known to inhabit the project area or the Flambeau River adjacent to the mine site. Three fish species - lake sturgeon, redside dace, and river redhorse - which inhabit the Flambeau River are considered rare in parts of their range.

The wood turtle, considered a threatened species by the Wisconsin Heritage Program, probably occurs in Rusk County, but has not been observed at the mine site. Habitat suitable for wood turtles exists near the mine site.

There is one active bald eagle nest located about 1.0 mile downstream from the project area. An inactive nest site is located approximately 1.7 miles downstream from the site. It is likely that the eagles now using the active site have relocated from the inactive site. The proposed open pit is within the eagle's hunting territory. Bald eagles were observed hunting along the Flambeau River west of the pit area in November 1988.

CLIMATE

The climate of the region is temperate continental characterized by moderately warm summers and long, cold winters. Summer weather is generally mild; temperatures rarely exceed 95 degrees during the day while night temperatures range between 50° F to 60° F. Winter temperatures range from 0° F to 25° F and occasionally fall below -30° F. The wind directions are primarily from the south and west in the summer and north in the winter.

The average annual precipitation for the Chippewa/Flambeau River basin is 31 inches. The range within the basin is from 21 inches to 45 inches.

AIR QUALITY

Based on sampling conducted in the summer of 1988, the background total suspended particulate levels were determined to be 60 μ/m^3 (microgram/cubic meter of air) which is indicative of good air quality. The background monitoring stations were located at the corner of Jansen Road and STH 27, and the Rusk County Hospital. Certain natural and human related events were observed during the monitoring study which contributed to an occasional elevated TSP concentration. These events included demolition of a concrete bridge adjacent to the hospital; reconstruction of STH 27; and construction activities at the nursing home across from the hospital. Other activities which may have contributed to occasional high dust levels include general construction activity, batch processing of cement, gravel mining, and agricultural plowing and tillage activities.

NOISE

Twenty-seven sites were monitored for background noise in 1987-1988 (Figure 2-10). These sites were representative of the land uses and vegetation types in the project area or were noise sensitive receptors. The noise levels monitored during the summer and winter are shown in Figures 2-11 and 2-12, respectively.

In general, noise levels are strongly influenced by the proximity of STH 27, the principle noise source 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.

Noise levels at most locations are somewhat higher during the winter months due to greater noise propagation resulting from the absence of leaves on vegetation. The difference at these locations is usually only 1 to 3 decibels due, in part, to the sparse to moderate vegetation prevalent in the project area.

At some locations, noise reductions, rather than increases, 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. Bare-branch conditions in these situations result in a significant drop in ambient noise levels during winter months. These noise levels are typical for rural areas.

Applying established noise criteria to the pre-project noise environment in the project vicinity indicates homes adjacent to STH 27 are already subject to noise levels in excess of the 65 dBA standard. A total of five residences are located in an area where average noise levels range from 65 to 75 dBA during winter conditions. Only one residence is adversely affected during summer conditions. Noise levels elsewhere appear to be within acceptable limits.

SOCIOECONOMICS

INTRODUCTION

The socioeconomic study area for the proposed open-pit mine includes the mine site within the Town of Grant, the nearby City of Ladysmith and Rusk County. Figure 2-13 shows the location of the proposed mine in relation to Ladysmith, the only city in Rusk County, and identifies the townships surrounding the Town of Grant and eight villages within the county.

The following descriptions of the affected environment and most of the subsequent impact analyses focus on the Town of Grant, the City of Ladysmith, or Rusk County. The one exception to this is in the analysis of employment impacts. In the Local Agreement between the City, Town, County, and applicant, the local area for hiring purposes is described as Rusk County plus the area within ten miles of the county borders. This expanded study area includes the communities of Birchwood, Exeland, and Raddison to the north, Rice Lake, Cameron, and Chetek to the west, New Auburn, Cornell, Holcombe, and Gilman to the south, and Catawba and Kennan to the east. These communities surrounding Rusk County include an estimated population of more than 15,000, which is equal to the population of Rusk County.

LOCAL AGREEMENT

The Local Agreement is a signed agreement between Rusk County, the Town of Grant, the City of Ladysmith, and Kennecott Explorations, Ltd. It was signed August 1, 1988, and is reproduced as Appendix B in the December 1989 Mining Permit Application to the Department of Natural Resources. The Local Agreement establishes the physical limits of mining, how mining would be conducted, and numerous other activities associated with the proposed project. Many of the Local Agreement provisions are related to potential socioeconomic impacts; for example, hours of mine operation, employee hiring, compensation for loss of property value, the closing plan, and payments to local units of government. The provisions which have direct impacts upon the socioeconomic environment will be referred to further in this analysis.

EMPLOYMENT

Total employment in Rusk County during 1988 averaged 6,800, about the same as it was in 1982. Covered employment, that is, employees covered by Wisconsin's unemployment compensation law, is highest in the manufacturing and government sectors followed by retail trade and service sectors. Covered employment in the county is about 4,300. Among the manufacturing industries, the forest products-related sector such as furniture and fixtures, and lumber and wood products, has grown rapidly and is the number one manufacturing industry in Rusk County. In the Town of Grant, the two largest employment categories are durable manufacturing and retail trade. Unemployment in Rusk County has decreased steadily from the peak figures in 1982 (16.5%) and 1984 (11.1%) to the current 7-8% in 1988. Current unemployment is substantially higher than the 4.9% state average.

POPULATION

Figure 2-13 shows the population by selected townships, villages, and the City of Ladysmith in the area surrounding the proposed mine. The total population of Rusk County is estimated at 15,456 people. A nearly equal number of people reside in the cities and villages up to ten miles beyond Rusk County. The population in Rusk County has been declining in every decade since 1940, when it was 17,737, or 15% greater than in 1988. Similarly, the City of Ladysmith population has declined since 1950, and the

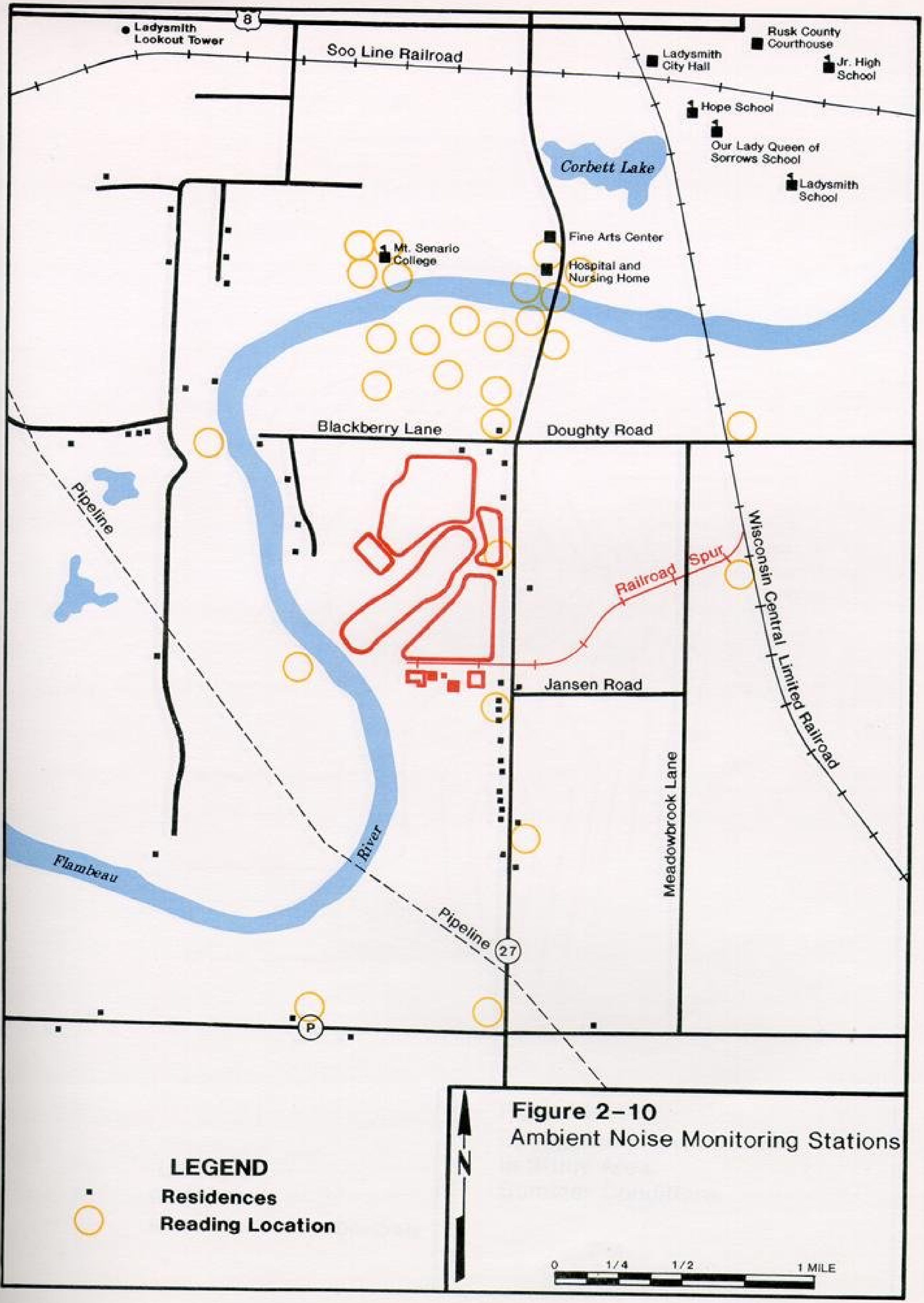


Figure 2-10
Ambient Noise Monitoring Stations

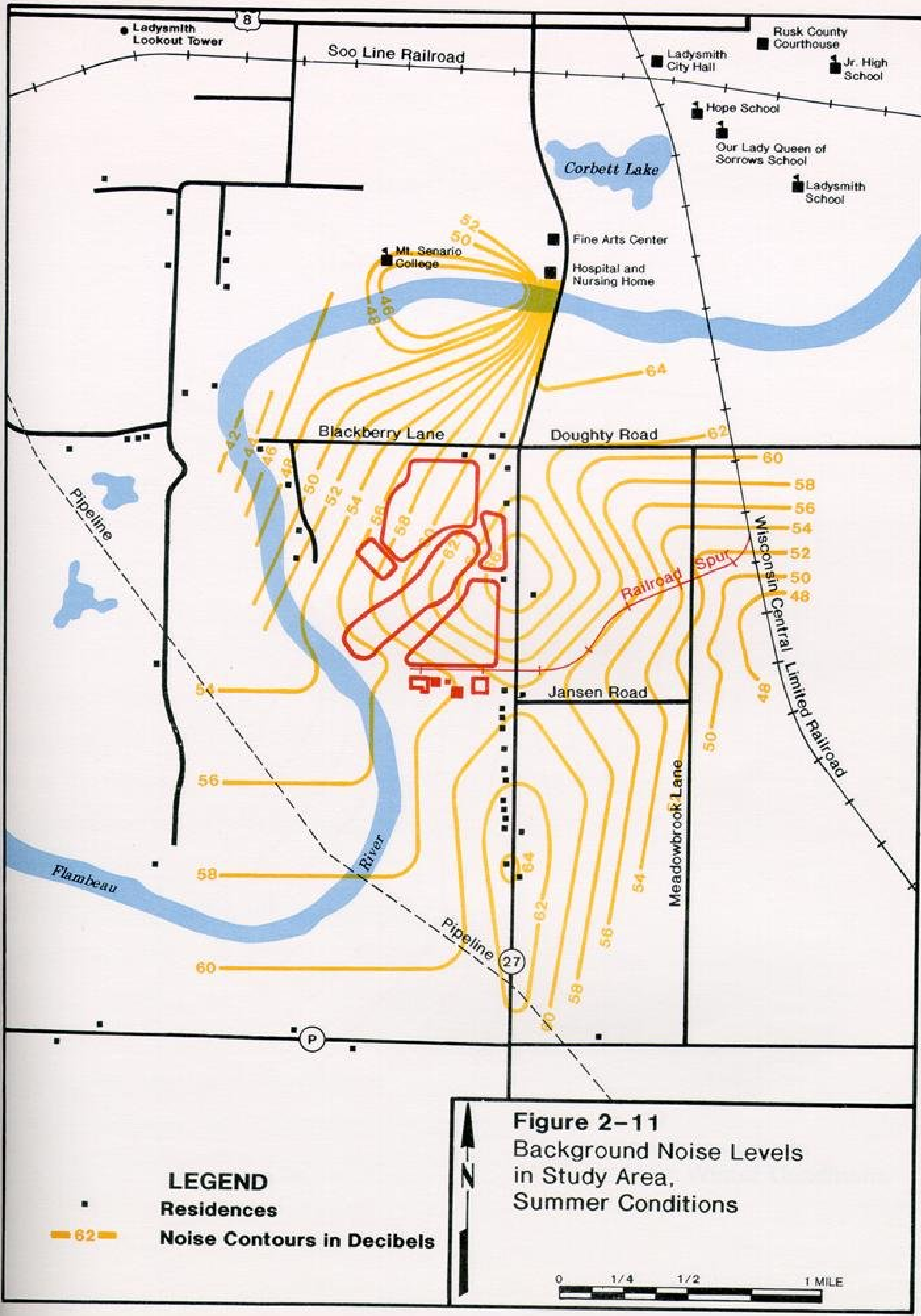


Figure 2–11
Background Noise Levels in Study Area, Summer Conditions

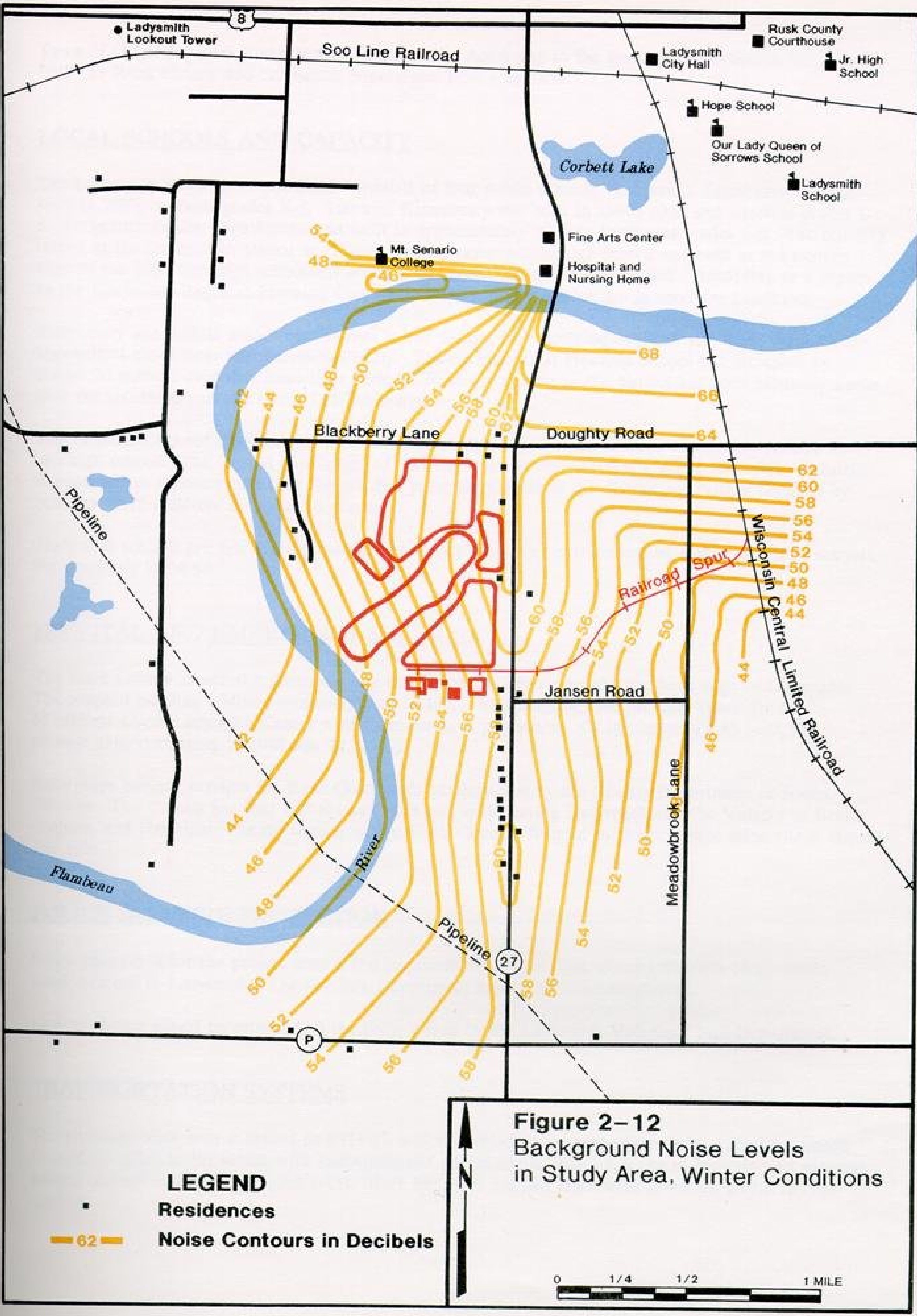


Figure 2–12
Background Noise Levels in Study Area, Winter Conditions

Town of Grant population has declined since 1960. According to the most recent estimates, however, both the Rusk County and Ladysmith populations have stabilized.

LOCAL SCHOOLS AND CAPACITY

The Ladysmith-Hawkins school district consists of four public schools. Ladysmith Elementary School, built in 1957, contains grades K-5. Hawkins Elementary 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. According to a report by the Northwest Regional Planning Commission, the school facilities are in excellent condition.

Elementary and middle school enrollments in the district 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 in the district 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.

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

HOSPITAL AND EMERGENCY SERVICES

The Rusk County Hospital is located along the Flambeau River near the southern edge of Ladysmith. The hospital building addition was completed in 1975. The building also provides space for the Marshfield Clinic-Ladysmith Center with room for nine physicians. Of the hospital's 43 beds, the average daily occupancy in 1988 was 12 (28%).

Emergency medical services for Rusk County are administered by the County Department of Social Services. The County has four ambulances, with one each serving Ladysmith and the Villages of Bruce, Sheldon, and Hawkins. The distance from the Rusk County Hospital to the proposed mine site is about one mile.

POLICE AND FIRE PROTECTION

Police protection for the project area is the responsibility of the Rusk County Sheriff's Department headquartered in Ladysmith. The Sheriff's Department has 18 full-time employees.

Fire protection would be provided to the project area by the Ladysmith Volunteer Fire Department.

TRANSPORTATION SYSTEMS

The proposed mine area is served by STH 27, which is adjacent to the project area. STH 27 connects Cornell, 23 miles to the south, with Ladysmith and points north. USH 8 is the major east-west highway passing through Ladysmith (Figure 2-13). Both highways are two lanes wide and have ample reserve capacity.

The Wisconsin Central Limited Railroad track, formerly the Soo Line, lies about 0.75 miles east of the proposed mine site. A spur line from the railroad would be constructed across STH 27 to the proposed mine area to haul ore from the mine.

HOUSING

According to the 1980 census data, the total number of occupied housing units in Rusk County was 5,336, in the Town of Grant was 310, and in Ladysmith was 1,426. In the Town and County, 80% were owner occupied, while in Ladysmith 59% were owner occupied. Over 50% of the housing in the county was constructed before 1940. A significant percent of the area housing is identified as inadequate by the Department of Development. Inadequate housing is determined by low value, lack of plumbing facilities or low rental value.

Temporary housing is available in the five hotels and motels in Ladysmith, two in Bruce, and two near Holcombe. Additional hotel and motel capacity exists south of the project in Cornell (23 miles) and to the west in Cameron and Rice Lake (30-40 miles). The nearby lodging facilities provide a total of 95 one-bed rooms and 86 2- or 3-bed rooms or cabins. Additional capacity is provided by rental houses, apartments, rooms and resort cabins in the immediate area.

PUBLIC FINANCE

Mining Impact Fund

The State of Wisconsin established the Mining Investment and Local Impact Fund to: "...assure that monies will be available to such municipalities for long- and short-terms costs associated with social, educational, environmental and economic impacts of metalliferous mineral mining." (Section 70.37(1), Wisconsin Statutes). The Mining Impact Board (MIB) manages funds generated by Wisconsin's net proceeds tax on mines and distributes them to local governments to mitigate metallic mining impacts. The funds are distributed to local communities both through legislative authorization (Section 70.395, Wisconsin Statutes) and through discretionary grants by the MIB. The direct payments are made to localities where mining is occurring or is proposed. Discretionary payments also can be made to communities in the area surrounding those localities.

When construction of a mine begins, the mining company would pay to the MIB a one-time construction payment (indexed) of $100,000 for each municipality (Ladysmith, the Town of Grant, and Rusk County) containing at least 15% of the orebody.

Following the construction period payments, "first dollar" payments of $100,000 per year (indexed) would be made to the same municipalities. In addition, Rusk County is eligible to receive 20% of the net proceeds tax collected or $250,000, whichever is less. The first dollar payments and additional funds to Rusk County are dependent upon sufficient net proceeds tax revenue from the mine, and thus, unlike the construction period payment are not guaranteed by statute.

Net Proceeds Tax

There is a net proceeds occupational tax on metalliferous mineral extraction (s. 70.37, Wisconsin Statutes). This tax is a graduated mine profits tax to compensate the state and local municipalities for the loss of irreplaceable minerals. The tax rates vary from 3% on amounts up to $5 million to 15% on amounts exceeding $25 million. Sixty percent of the net proceeds tax is deposited in the Mining Investment and Local Impact Fund to mitigate the negative impacts of mining. The remainder is

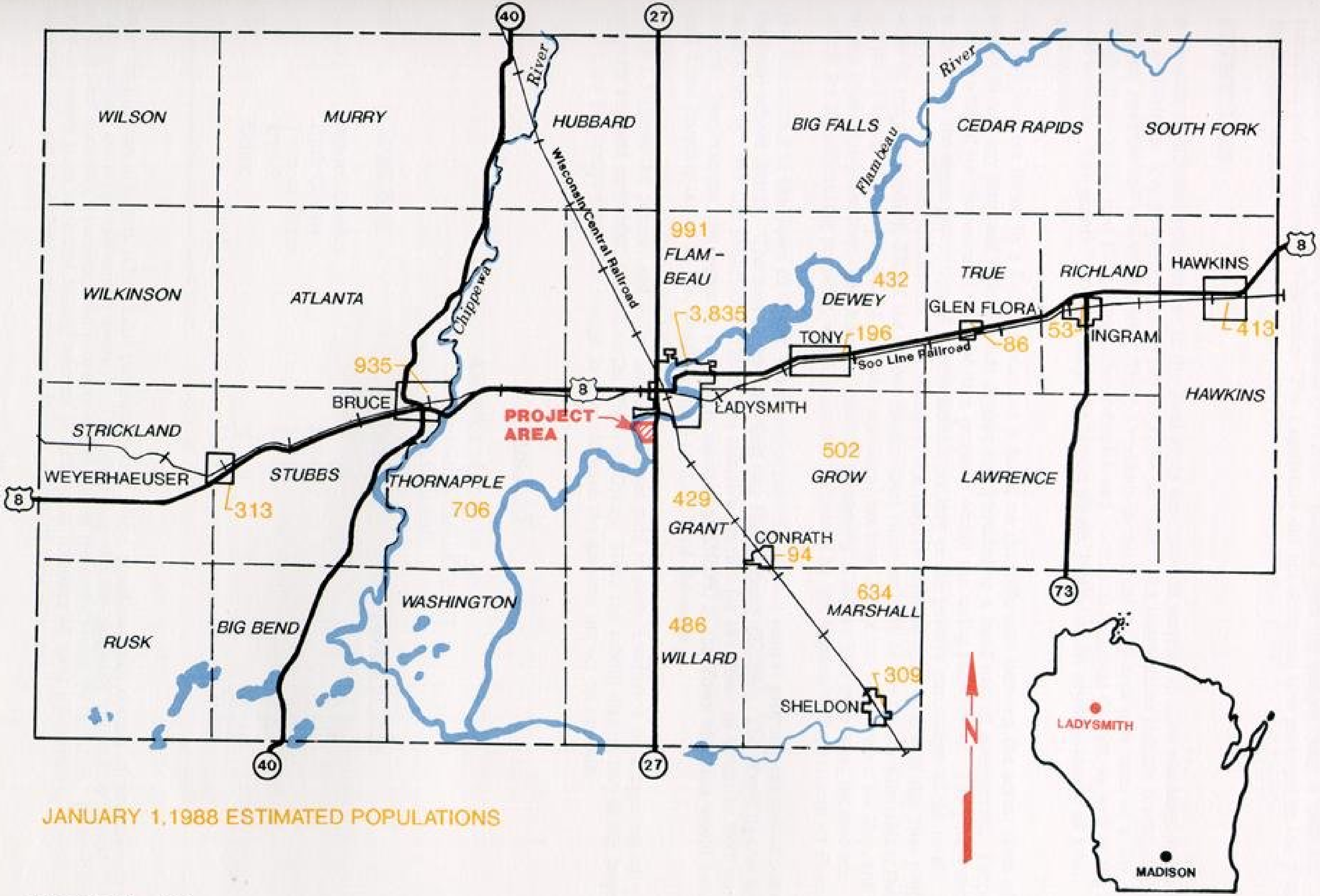


Figure 2–13
Populations of Selected Jurisdictions Near the Proposed Mine

deposited in the Badger Fund, a dedicated trust fund. Interest from the Badger Fund is used for recreation and education in Wisconsin. The Legislature did not designate how principal in the Badger Fund would be used.

Property Taxes

A number of different jurisdictions in the local study area provide services to their residents and have the authority to levy property taxes to pay for those services. The jurisdictions include towns, cities, villages, counties and school districts. Thus, a resident in the local study area pays taxes to a city, village, or township, plus the county, school district, and vocational-technical district, as well as the State of Wisconsin. The general property tax is the largest single, locally raised revenue source of local governments.

The property tax levied by a local government is based on the difference between the actual costs of the service minus any state and federal funds or user fees provided to a local unit of government. Property taxes are based on the assessed value of each property within the taxing jurisdiction. The parcel owner is liable for the same percentage of a jurisdiction's tax levy as the parcel's percentage of the total property value in their jurisdiction. For example, if a parcel's value is equal to 3% of the total property value in the municipality, 2% of the school district total value and 1% of the county total value, then the parcel's owner must pay 3% of the total municipal tax levy, 2% of the total school tax levy, and 1% of the total county tax levy. The assessed value of a property is determined by a local tax assessor except for manufacturing property, which is assessed annually by the Wisconsin Department of Revenue.

For landowners in the Town of Grant, the majority (65.7%) of their annual property tax was allocated to the local school district. The next largest recipient was Rusk County (22.2%). The above figures are for taxes levied in 1987 and collected in 1988. The effective tax rate for the Town of Grant in 1987 was 2.752%. For example, the owner of a property assessed at $50,000 in the Town of Grant would have paid a net property tax of $1,376, which is equal to 2.752% of the value.

Table 2-5 shows the percent and dollar amount of taxes paid to each jurisdiction on a hypothetical property assessed at $50,000 located in the Town of Grant. Since the school district levy is the largest of the tax bill components, any change in it would have the greatest impact on tax bills.

TABLE 2-5

Allocation of Property Tax
on a Hypothetical $50,000 Property
Town of Grant

Taxing Body	Amount	Percent of Total
School District	$ 904	65.7%
Rusk County	$ 306	22.2%
Town of Grant	$ 82	6.0%
VTAE	$ 75	5.4%
Other	$ 9	0.7%
Totals	$1,376	100.0%

State equalization aids help offset local property taxes. These equalizing aids consist of payments to municipalities, counties, and school districts. The equalizing aids are primarily affected by a local jurisdictions' spending, revenues, and property values within the jurisdictions in the state. In addition, other payments from state and federal sources contribute to revenues of local governments. Local municipalities are dependent upon revenues from a variety of state sources.

PROPERTY TAXES PAID BY KENNECOTT

The state has been assessing the value of the Kennecott property in the Town of Grant since 1974. For 1988, the full value of the property was: $2,686,100 in land, $678,600 in improvements, and $2,100 in personal property for a total of $3,366,800. This was roughly 22% of the total full value for the Town of Grant. Table 2-6 indicates the 1988 property taxes levied on Flambeau's property.

TABLE 2-6

Existing Property Tax on the Flambeau Property

	Full Value	Property Taxes
Land	$1,560,500	$41,837
Mineral Value	1,125,600	30,177
Total Land	$2,686,100	$72,014
Improvements	678,600	18,193
Personal Property	2,100	56
Total	$3,366,800	$90,264

Flambeau paid about $90,000 in property taxes in 1988, with roughly $30,000 levied on the value of the orebody. The value of the orebody will be removed from the property tax roll when mining operations begin. When the land is reclaimed, the value of the land will be roughly equal to that of the surrounding land.

GROSS VALUE OF THE OREBODY

The following calculations (Table 2-7) on the gross value of the orebody were developed largely from published data but should be viewed as preliminary only. More definitive information on the gross value of the orebody would have to be based on careful analysis of drilling data. However, that information was not available to the Department of Natural Resources. The assumptions used for calculating the gross value of the orebody are explained below.

Recoverable quantities of copper, gold, and silver are contained in the estimated 1.9 million ton orebody. An August 1989 report published in the Engineering and Mining Journal characterized the orebody as containing 10.5% copper, 0.1 troy ounces of gold per ton of ore and 2.1 troy ounces of silver per ton of ore. These quantities were used to calculate the following gross values of the orebody.

The value of copper, gold, and silver will fluctuate prior to and during the estimated six-year mining operation, and because it is difficult to predict future metals prices, it is difficult to ascribe a value to the orebody. There are many ways the orebody could be valued. The following is one method to indicate a possible range of gross values for the orebody.

A minimum gross value of the orebody was calculated based on a copper value of $0.85 per pound, gold at $350 per troy ounce and silver at $5.00 per troy ounce. A copper price of $0.85 was selected as a minimum price because at that price Flambeau has agreed to pay Rusk County 100% of the payment schedule as indicated in the local agreement. Based on these metal prices, the minimum gross value of the orebody is about $425 million in 1989 dollars.

TABLE 2-7

Minimum Gross Value of Orebody

		Gross Value (Millions)
Copper:	1,900,000 tons x 10.5% metal x 2,000 lbs/ton x $0.85 =	$339
Gold:	1,900,000 tons x 0.1 oz/ton x $350 =	$66
Silver:	1,900,000 tons x 2.1 oz/ton x $5.00 =	$20
		$425

The value of the orebody at current prices is about $540 million as shown below:

TABLE 2-8

Value of Orebody at Current Prices
(January 1990)

		Gross Value (Millions)
Copper:	1,900,000 tons x 10.5% x 2,000 lbs/ton x $1.10 =	$439
Gold:	1,900,000 tons x 0.1 oz/ton x $422 =	$80
Silver:	1,900,000 tons x 2.1 oz/ton x $5.30 =	$21
		$540

A maximum gross value of the orebody calculated at 20% above current prices is $648 million. Gross value does not reflect the cost of mining the orebody, transporting, concentrating and refining the metals or reclaiming the mine site. Also, not all of the metal content of the ore can be recovered. A calculation of the net value of the orebody would have to value all costs associated with the project.

AESTHETICS

The project area is a mixture of cropland, abandoned farm fields, second growth forests, single family residences, wetlands, and an abandoned gravel pit. The general character is rural in nature, but strongly influenced by prior human activity.

Most views along the County and State highways and town roads in the project area consist of forest land, occasionally interrupted by open land, agricultural land, and stream or wetland vistas.

The proposed project area contains visual amenities common to northern Wisconsin. The rivers, forests, and gentle terrain contribute to the scenic diversity of the area. These features plus the low population density make the area well adapted to existing forestry/agricultural use.

LAND USE AND ZONING

Land use for three areas - Rusk County (590,295 total acres) Grant Township (23,013 total acres) and the project area as described under the conditional land use permit (300 total acres) - will be discussed. Lands around the project area fall under the jurisdiction of either the Rusk County ordinance or the City of Ladysmith zoning ordinances. Lands within the project area are controlled by the Local Agreement and a conditional land use permit.

Zoning in the vicinity of the proposed mine is shown in Figure 2-14. The entire project area is zoned I-1 Industrial. The current City of Ladysmith limits and the area recently annexed by the City are shown in Figure 2-15.

Rusk County

Approximately 380,000 acres (64%) of the 590,295 total acres in Rusk County are classified as forest lands. The second largest land use classification is agricultural land, which includes pasture land. Approximately 147,200 acres (25%) are in agricultural use. 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. Milk cows constitute the primary livestock, with beef cattle the second largest livestock type.

Developed areas account for approximately 12,000 acres (2%) of the county total. This total acreage includes Kennecott land holdings which have not been actively developed. Approximately 20,700 acres is nonassessed public acreage, such as rivers and lakes, parks, roads, railroad and transportation rights-of-ways, and other public and semi-public lands.

Town of Grant

Of the 23,000 acres in Grant Township, 8,043 acres (35%) of the total land area is assessed as forest land. The second largest land use classification category is agricultural. This category includes both tillable and pasture acreage and accounts for 7,450 acres in the township (32%). A total of 3,330 acres was not assessed throughout the township in 1987. These areas include state and county-owned forest lands, lakes and rivers, roads, and other tracks used for public purposes.

Project Area

The project area (approximately 300 acres) is contained within the boundaries established by the conditional land use permit. The largest land use category is forest land which accounts for 50% of the project area. Pasture/old fields and active agriculture each account for 20% of the land uses in the project area. The remaining 10% of the project area is considered developed. In general, the project area land and immediately adjacent lands have only a very small percentage of land available for active development because of soil limitations for on-site sewerage systems. In addition, only 20 acres of developable land are not under Kennecott ownership.

RECREATION AND TOURISM

Leisure activities in the Ladysmith area include a variety of outdoor recreational activities. Almost 16% of the county's acreage is open to the public for outdoor recreation and another 1.8% of the county acreage is lakes and streams. Hunting, fishing, hiking, snowmobiling, skiing, canoeing, and other outdoor recreation activities are permitted on most of these publicly owned lands. Camp and picnic sites have been developed at some scenic areas in the county.

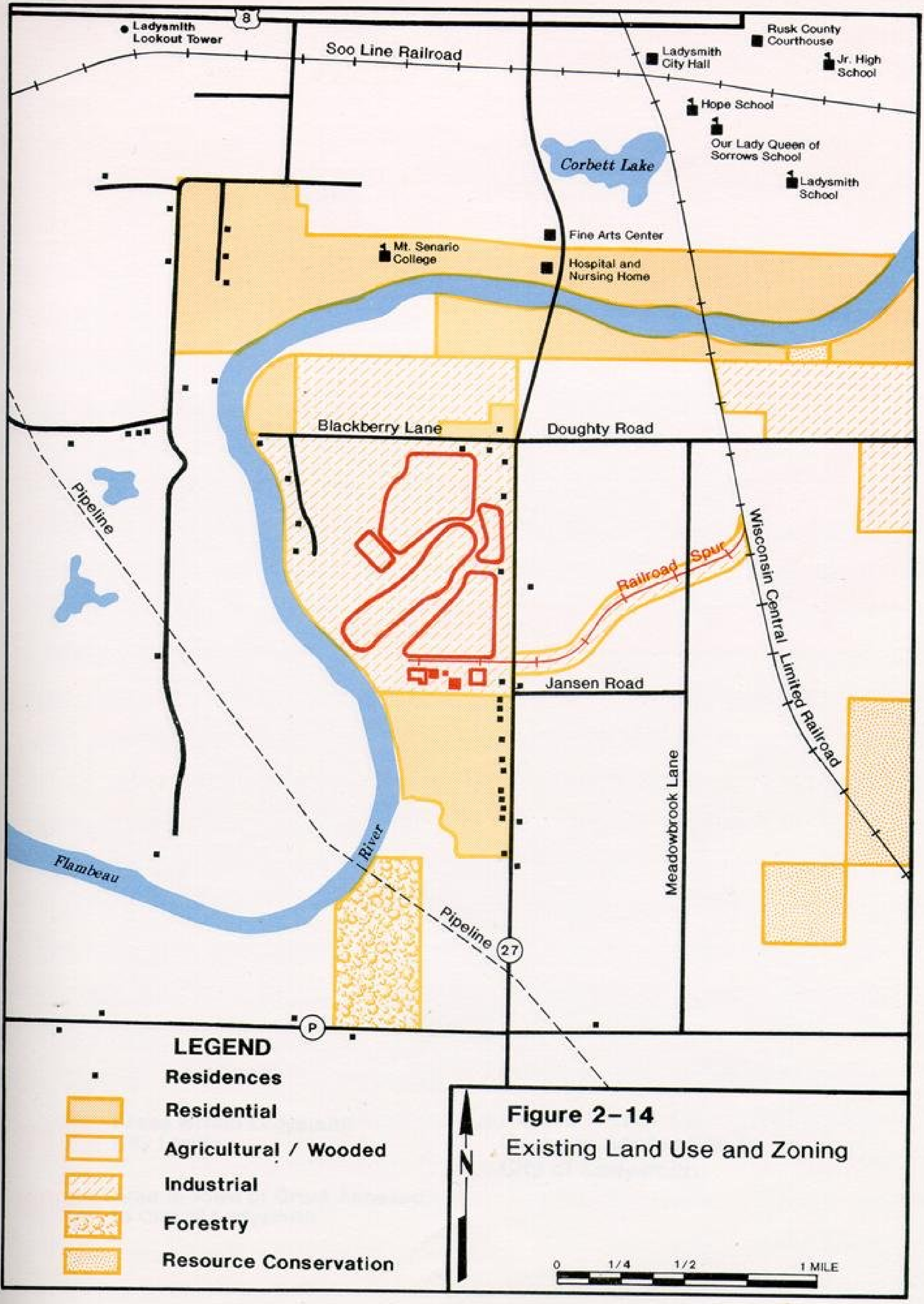


Figure 2–14
Existing Land Use and Zoning

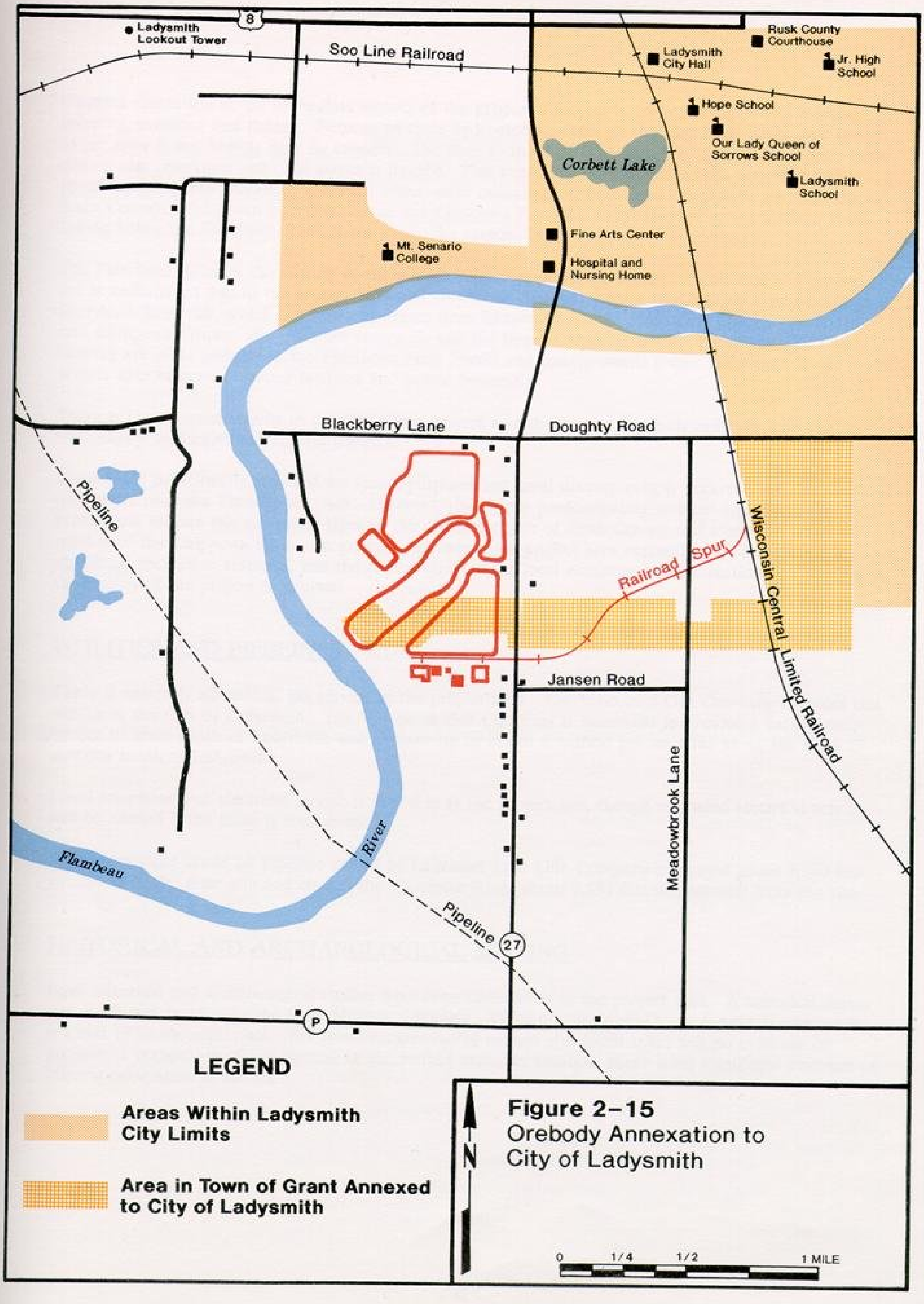


Figure 2–15
Orebody Annexation to City of Ladysmith

Outdoor recreation in the immediate vicinity of the proposed project is limited to incidental hunting, trapping, canoeing and fishing. Because of three hydroelectric dams on the Flambeau River, this stretch of the river is not heavily used by canoers. The river in the area fluctuates substantially on a daily basis due to dam operation and river access is limited. This stretch of the Flambeau does not offer white water canoeing, and canoeists who want white water canoeing can find Class 1 rapids in northeastern Rusk County. Fishermen normally choose the Chippewa River for uninterrupted canoe fishing. Bank fishing below the Flambeau River dams is popular seasonally.

The Flambeau River in the vicinity of the mine has good populations of smallmouth bass and musky, but is underfished due to the access, dams and river level changes. Motor boat fishing is popular in the Dairyland Reservoir, which is 4 miles upstream from Ladysmith, on the Holcombe flowage just south into Chippewa County, and on other reservoirs and the larger Chippewa River. Camping, hiking and hunting are more popular in the Flambeau State Forest and county-owned public lands than in the project area because of better facilities and public ownership.

There is little tourist activity in the immediate project area due to the relatively ordinary land use, topography, landscape and natural features.

Local roads occasionally are used for scenic purposes and local development is occurring on the river's west shore near the Thornapple Dam. However, resorts are predominately situated away from the project site around the numerous lakes in the southwest part of Rusk County and along the larger reaches of the Chippewa River. In general, the immediate project area currently does not sustain a significant recreation resource, and the contribution to the local economy from recreation and tourism in the vicinity of the project is minimal.

UTILITIES AND PIPELINES

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 service to areas south of Ladysmith and is planning to install a natural gas mainline along the STH 27 corridor south of Ladysmith.

Local telephone and electrical service is available at the project site, though upgraded electrical service will be needed if the mine is constructed.

An underground crude oil pipeline owned by Lakehead Pipe Line Company is located about 2,300 feet southwest of the mine site and crosses the Flambeau River about 3,550 feet downstream from the site.

HISTORICAL AND ARCHAEOLOGICAL SETTING

Four historical and archaeological studies have been undertaken in the project area. A historical survey was conducted in 1976 by the State Historical Society. Three archaeological surveys were conducted in the mid 1970s through 1988. The three archaeological surveys concluded there was no evidence of prehistoric occupation of any portion of the project area. In addition, there is no significant evidence of historic occupation at the site.

SOLID WASTE

There are 7 town dumps and 3 village dumps currently in use in Rusk County. Solid waste from the City of Ladysmith is taken from a transfer station in the city to the Lake Area Landfill in Sarona (Washburn Co.). All of the town and village dumps are small (under 50,000 yd^3 capacity) facilities and do not meet current design standards. These landfills may close if pending revisions to the Resource Recovery and Conservation Act are enacted by the U.S. Congress. These provisions would mandate the closing of all sanitary landfills not meeting current design standards by the early 1990s.

CHAPTER THREE
ENVIRONMENTAL IMPACTS

IMPACTS TO GEOLOGY

BEDROCK GEOLOGY

During the course of the mining operation, about 1.9 million tons of ore and 3.5 million tons of surrounding bedrock (waste rock) would be broken up and moved from the open pit. The waste rock would be returned to the pit at the completion of mining with the high sulfur rock placed at the bottom of the pit. The top of the backfilled rock would be at approximately the same elevation as the original bedrock. The backfilled bedrock would range in size from large boulders to powder and would contain various sized voids between the rock fragments. The permeability of the backfilled pit would be higher than pre-project conditions. Also, the bedrock immediately adjacent to the pit may have a higher degree of fracturing from blasting during the mine operations. However, the surrounding bedrock would remain unaltered and the net flow of groundwater through the pit would only be slightly increased.

MINERAL RESOURCES

Flambeau Mining Co.'s mineral deposit extends approximately 800 feet below the land surface. The current mining proposal is to remove ore only to the depth of about 225 feet. This upper zone of ore contains approximately 70% of the copper and 30% of the gold of the entire deposit. The high grade of this ore makes direct shipping of unconcentrated ore economical. The deeper, lower-grade mineralization, if it were ever mined, would likely need to be concentrated on-site before shipping. The facilities for ore concentration and tailings disposal are very expensive and are generally only economical with larger, longer-term projects. The proposed project would remove a substantial portion of the value of the total orebody and would likely make future development of concentrator facilities uneconomical. Thus, the proposal would significantly diminish the probability that the deeper, lower-grade portion of the deposit would ever be mined.

The project would also consume various quantities of nonmetallic minerals including about 160,000 cubic yards of crushed rock, 33,000 tons of lime, and minor amounts of sand, gravel, and clay. Most of these materials would be permanently disposed of in the pit at the end of the project. However, these materials are not scarce, and the impact on the availability of these mineral resources would not be significant.

TOPOGRAPHY

The project would have obvious temporary impacts to the area topography during operation. The seven acre topsoil stockpile would eventually be about 40 feet above the existing land surface. The 40-acre low sulfur waste rock stockpile would reach about 60 feet high and the 27-acre high sulfur waste rock pile would be about 70 feet high. Slopes on the sides of the waste rock stockpiles would be about 35 degrees. Slope gradients and southerly and westerly aspects may make it difficult to stabilize fines on any of the stockpiles. The stockpiles would be developed at various rates over the course of the mining project. The reclamation phase of the project would backfill the open pit with the stockpiled material and the land beneath the stockpiles would be returned to the approximate original contour.

The project would have obvious temporary impacts to subgrade topography as well. The open pit is expected to reach a maximum depth of 225 feet and cover approximately 32 acres. The majority of the pit would initially be backfilled to approximately six feet above the original land surface of the site. The western 800 feet of the pit would be backfilled to the approximate original topography. Over time, the backfilled material will settle, and the land surface will subside. Flambeau Mining Co. predicts that the backfill will settle about three feet resulting in final topography slightly above the original contours on the eastern part of the pit and slightly below the pre-mining topography on the western side of the pit.

The actual rate and amount of settling is difficult to predict accurately. Factors such as the size and gradation of backfilled rock, the degree of compaction of backfill upon placement, and chemical reactions within the backfill would all affect settling. However, if the land over the pit were to settle an amount equal to the entire volume of ore removed from the pit, the land surface would drop about six feet. The backfilled material will likely occupy more than its original volume due to increased surfaced area and void spaces. Other materials disposed in the pit, such as the incidental wastes associated with the reclamation phase, will provide additional fill volume. Thus, an average of three feet of settlement over the entire pit is a reasonable estimate.

Settlement would likely take place unevenly over the backfilled area. Localized areas of settlement of substantially more than three feet could occur. The long-term topography over the pit area would probably be somewhat uneven with abrupt variability, which could make post-mining land management activities difficult. Uneven topography could also intercept surface water drainage over the pit causing isolated pockets of lower, undrained land. If excessive ponding of water occurs, infiltration to the groundwater would increase. Increased infiltration over the pit would not significantly affect the amount of water flowing through the backfilled waste rock. The surface drainage pattern over the area would be recreated to the extent practicable.

The flood control dike would remain in place, permanently altering a small area of the site topography. Other ancillary facilities such as the access road, rail spur, parking lot, and plant site will be restored to the approximate original contours.

SOILS

The project would entail stripping topsoil from about 139 acres of the site, about 35% of which is prime farmland soils, and stockpiling it for about 7 to 8 years prior to use during site reclamation. These activities would alter the physical and chemical characteristics of the topsoil causing a change in soil productivity. Poorly controlled stripping and/or excessive compaction could result in more significant losses in productivity. Soil chemical properties can be modified by management techniques such as application of fertilizer and lime, but the physical properties are much more difficult to restore. Soil management must consider physical properties such as organic matter, infiltration, permeability, bulk density, rooting depth, available water, tilth and drainage in order to facilitate post-mining soil productivity.

Soil erosion poses a potential for significant short- and long-term impacts. Soils on the site can generally be classified as moderately erodible. While soil erosion and sedimentation can be minimized with proper control practices, some sedimentation is inevitable. The extensive earth moving and grading of the site will probably result in situations where erosion control devices are not in place or fully functional when a heavy rain occurs. Even with erosion control structures in place, heavy rainfall or runoff prior to the establishment of vegetation could cause substantial soil loss.

The primary impacts of soil erosion are reduced productivity and sedimentation of streams and wetlands. Due to the project's proximity to the Flambeau River, adverse impacts to the river could occur, particularly if the planned erosion control practices are not properly implemented. Excessive wind erosion can abrade, blowout and bury vegetation. In addition to reducing the ambient air quality, dust deposited on vegetation can reduce photosynthetic potentials and can stress and weaken plants. With proper control measures and practices, soil erosion would be minimized and the associated impacts would be short-term and minor.

IMPACTS TO GROUNDWATER

GROUNDWATER DRAWDOWN

As the mining pit is excavated below the watertable, groundwater will flow into the pit thus lowering the watertable in the area around the pit. Flambeau Mining Co. contracted with Thomas A. Prickett and Associates and Engineering Technologies Associates, Inc. to develop a groundwater model which was used to evaluate groundwater impacts of the mining operation. The model used was a modified version of the Prickett-Longquist Aquifer Simulation Model (PLASM). This modeling confirmed previous modeling conducted for the site and the results are consistent with the hydrogeological characteristics of the site area.

Modeling Technique

The groundwater modeling evaluation uses a computer to solve the mathematical equations which describe the flow of groundwater at thousands of points on a grid superimposed over the project area. Data describing the hydrogeological characteristics of the project area are incorporated into the model. These include: model boundary conditions such as Meadowbrook Creek or the Flambeau River; transmissivity and storage of the aquifer materials; groundwater recharge from percolating precipitation; and the influence of wetlands. The model is checked to see if the model simulation provides a reasonable match of the field conditions. Model input is varied until the best match to field conditions is achieved. A reasonable range of hydrogeological characteristics was modeled to bracket the potential response of the model to the impacts. The impacts were simulated by changing the model inputs to reflect the disturbed conditions during and after mining.

Pit Inflow

Model predictions show that the average annual pit inflow (seepage) increases over time as the pit is excavated (Figure 3-1). While the maximum instantaneous inflow rates would occur during the initial overburden removal, maximum annual pit inflow occurs at the end of mining when somewhere between 75-175 gallons per minute will be entering the pit. A value of around 125 gallons per minute is most probable. Of this, about 47 gallons per minute is induced flow from the Flambeau River, 14 gallons per minute is groundwater which previously discharged to the Flambeau River, and 66 gallons per minute is diverted from the surrounding aquifer.

Water Table Drawdown

Figure 3-2 shows the number of feet of groundwater drawdown in the project area at the end of mining using the most probable model simulation. The greatest drawdown effects are seen to the north where two feet of water table drawdown is expected to occur up to about 1/2 mile from the northeast end of the pit. Drawdown to the northwest and southeast is more limited with two feet of drawdown expected about one-quarter mile from the pit margin. Figure 3-3 shows the water table surface at the end of mining for the most probable case. This figure indicates groundwater flow is toward the pit from all directions. At distances greater than about 1/8 of a mile (670 feet) from the pit margin, the groundwater flow directions are similar to those prior to mining.

Figure 3-4 shows the maximum extent of drawdown, which occurs 2.3 years after the end of mining. This delayed drawdown occurs because, even as the water table in the immediate vicinity of the pit begins to rebound after mining, areas of depressed water table conditions away from the pit continue to drain groundwater away from the area beyond them. This additional drawdown after the end of mining extends the zone of a two-foot decline in the water table about 250 feet further to the north and 450 feet further to the east. Figure 3-5 shows the water table surface at the maximum extent of drawdown. At this point in time, the groundwater flow paths are becoming more like premining conditions.

The water table changes due to mining at two different locations are shown on Figure 3-6. The points, A and B, are shown on Figures 3-2 through 3-5. Point A is close to the pit and point B is located about 1/2 mile northeast of the pit. Point A experiences a continual decline of the water table during mining to a 65 foot maximum at the end of mining. The groundwater at this point rebounds rapidly after pit reclamation. The rate of rebound slows after time with about three feet of drawdown remaining 18 years after reclamation. Point B only has about 4.5 feet of drawdown with about one foot of drawdown remaining 18 years after reclamation.

Figure 3-7 shows the water table expected after the groundwater flow system has reached equilibrium after mining. Backfilling of the pit with more permeable materials than were originally in place results in a permanent lowering of the water table in the pit area. This long-term water table decline would range from about 1-4 feet in the pit area with the greatest declines centered above the southwest end of the pit.

IMPACTS TO GROUNDWATER QUALITY

Operational Impacts

Operational impacts to groundwater quality during mining include seepage from the low sulfur waste stockpile, potential seepage from the high sulfur waste stockpile, potential seepage from the ore crushing and loading areas, and seepage from the wastewater settling ponds.

Low Sulfur Waste Stockpile

The low sulfur waste consists of nonmineralized materials from the pit excavation. These include till, sandstone, saprolite and waste rock. The saprolite and waste rock would be sorted such that only waste with less than 1% sulfur would be placed in the low sulfur waste stockpile. The low overall sulfur content of the waste would prevent low pH (acidic) conditions from developing which would limit the production of dissolved metals and sulfate. The resultant nonacid condition also limits the solubility of most metals of environmental significance. The net result is that significant production and transport of leachable materials of environmental concern from the low sulfur stockpile are not expected. The exposure of fresh mineral surfaces and oxidation of the small amount of sulfide minerals present will probably produce a leachate with greater concentrations of constituents than the natural groundwater. However, precipitation, neutralization and sorption of the dissolved materials as the leachate travels through the underlying till soils will reduce metals to near background levels.

Slightly increased levels of total dissolved solids, hardness, sulfate, iron, and manganese might be expected as the leachate enters the groundwater under the unlined low sulfur waste area. The collection basin lysimeter under the northeastern part of the stockpile would aid in determining the quantity and nature of any leachate being generated. In the event that contaminants from the low sulfur waste facilities occurred in concentrations greater than anticipated the environmental consequences would be limited by the groundwater flow paths under the site. Contaminant movements into the groundwater during mine operation will flow primarily into the adjacent mine pit. This water would be treated prior to discharge to the Flambeau River. After mine closure, the discharge of contaminants at even the worst possible concentrations and quantities would not likely be measurable in the Flambeau River due to the dilution of any contaminated groundwater by the large river flow.

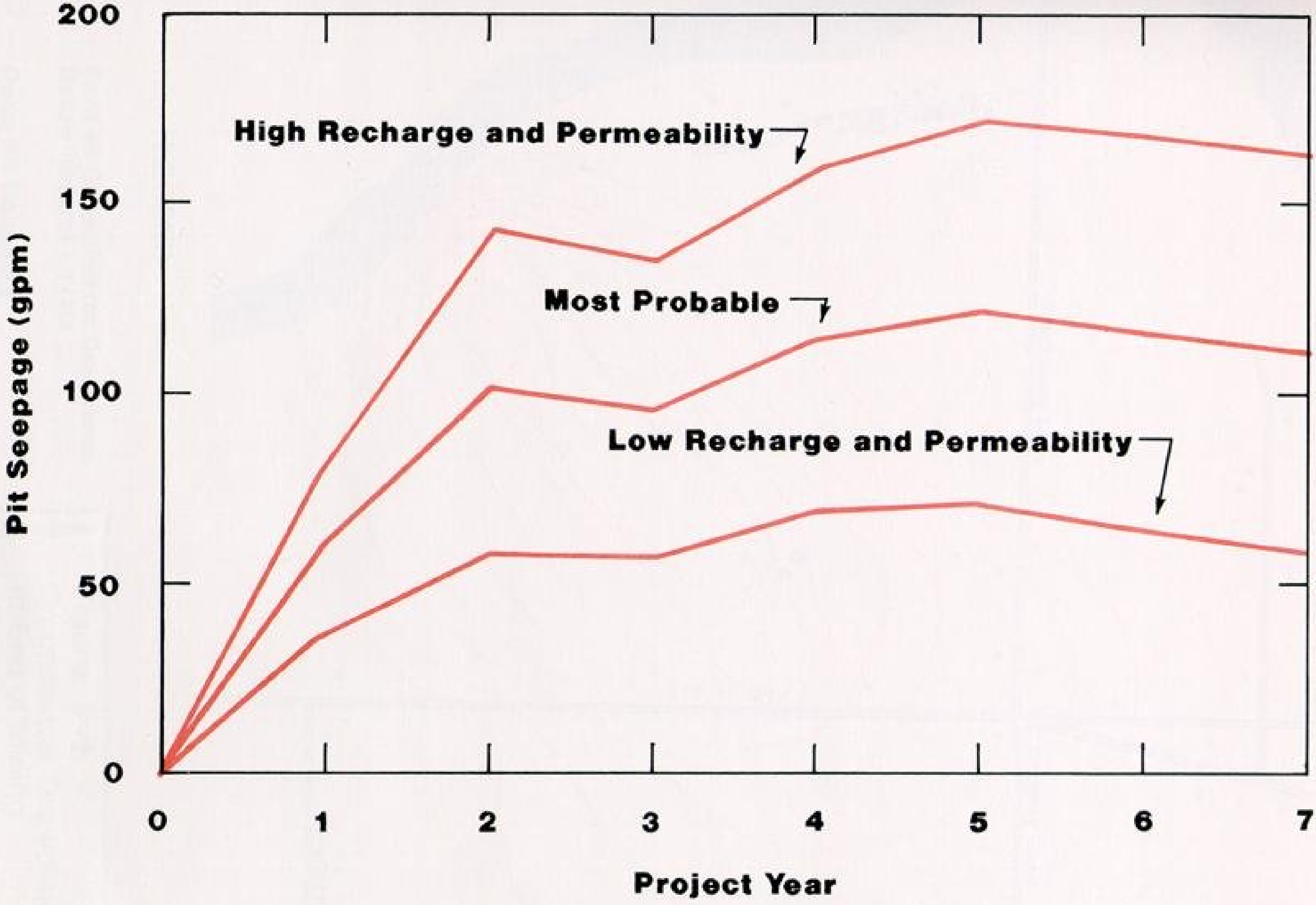
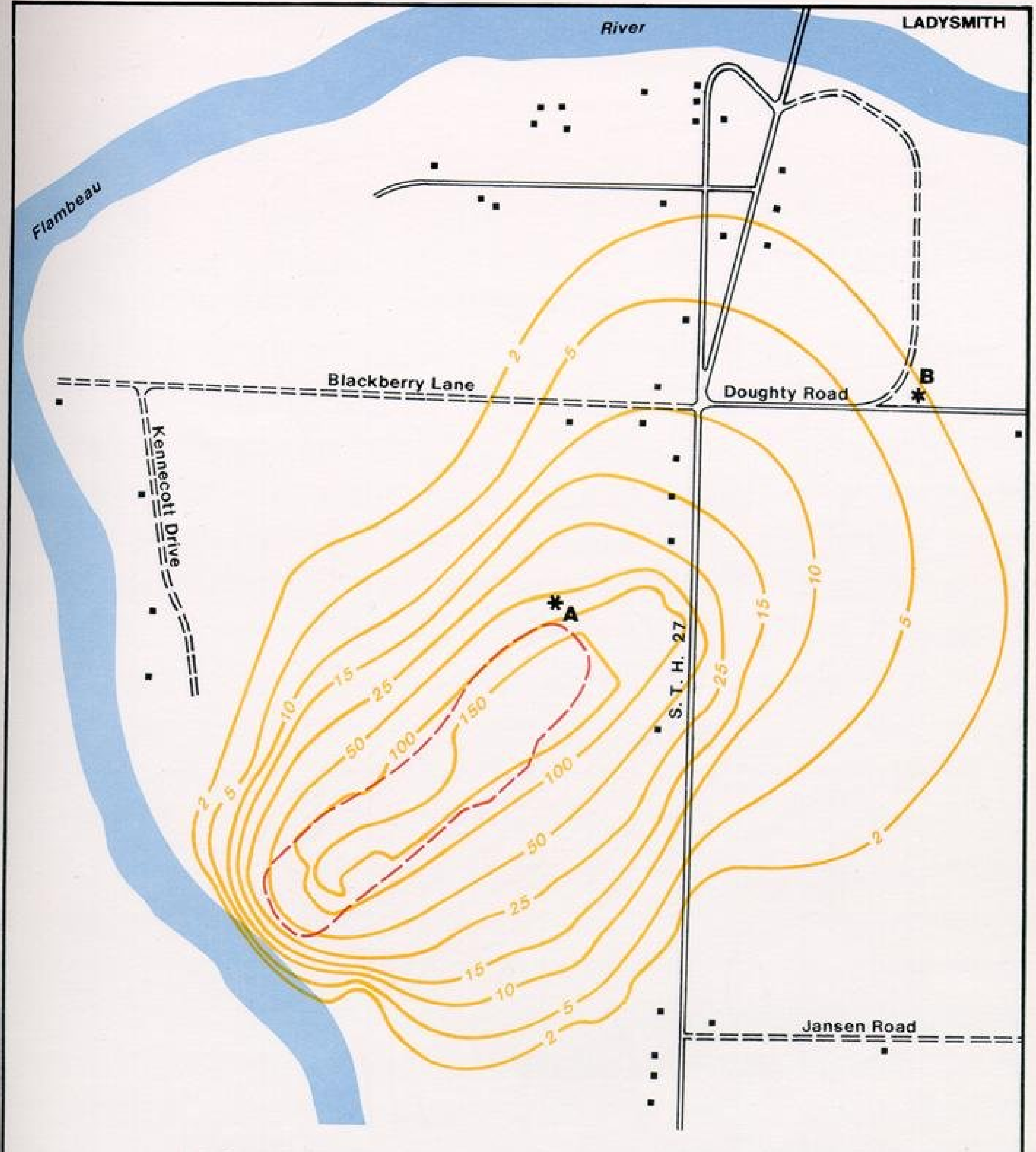


Figure 3-1 Potential Rates of Groundwater Flow into the Pit



LEGEND

10 — **Feet of Groundwater Drawdown Below Natural Levels**

Open Pit Boundary

* **Modeling Reference Points**

N

0 500 1000 2000 FEET

Figure 3-2
Groundwater Drawdown at End of Mining

LEGEND

— 1100 — Elevation of Groundwater Table in Feet M.S.L.

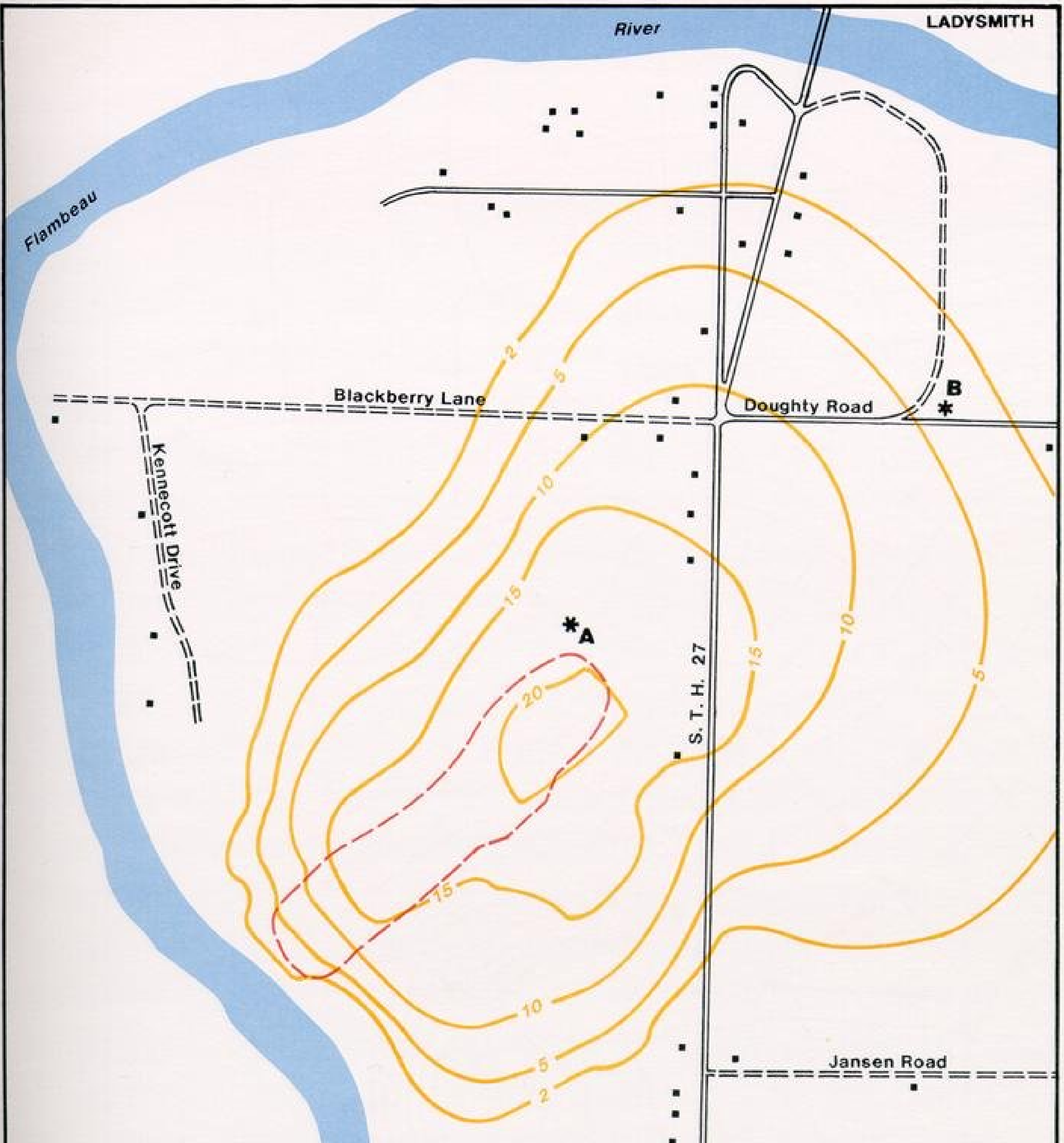
— — — Open Pit Boundary

* Modeling Reference Points

N

0 500 1000 2000 FEET

Figure 3–3
Predicted Water Table at End of Mining



LEGEND

Feet of Groundwater Drawdown Below Natural Levels

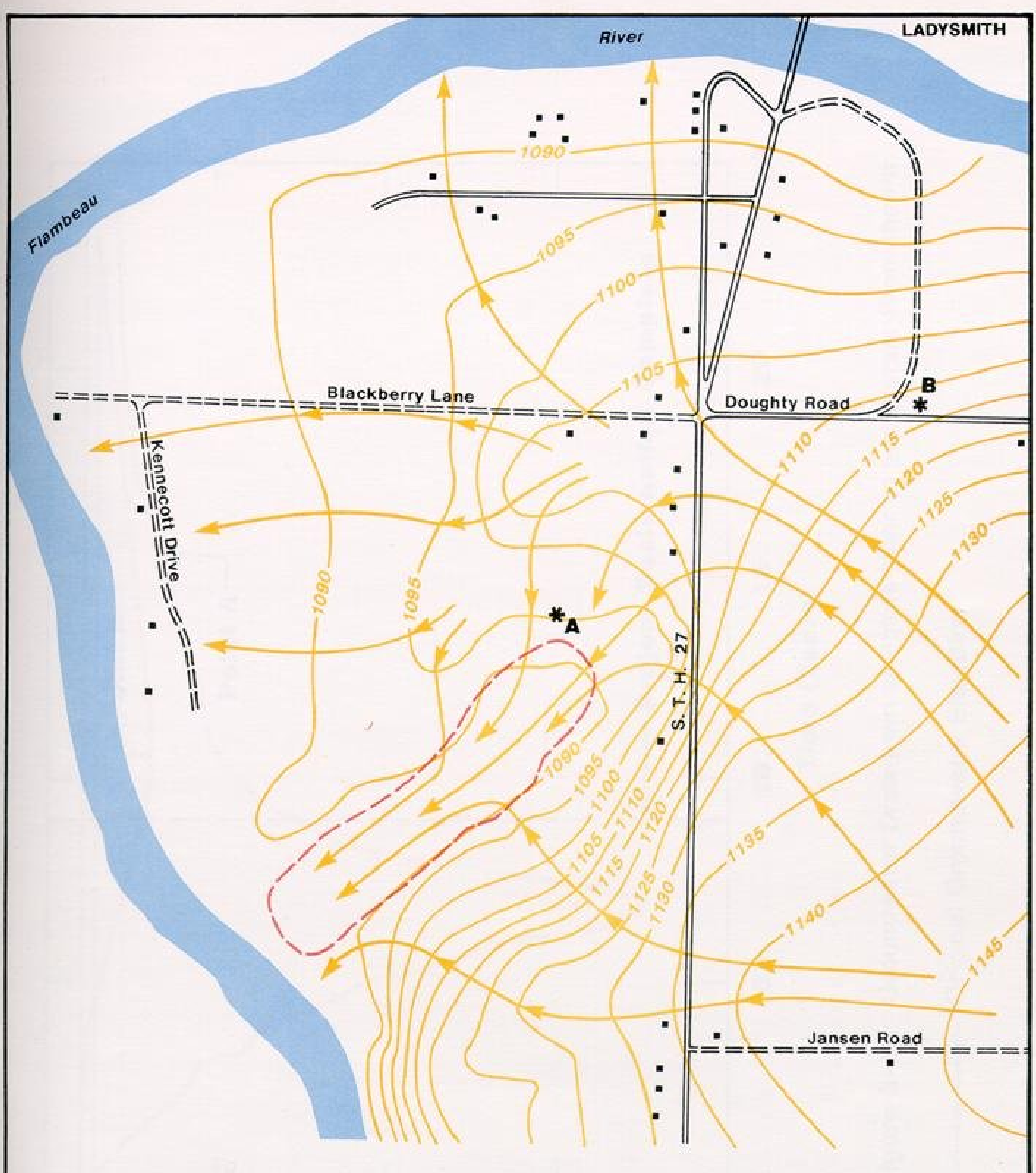
Open Pit Boundary

* Modeling Reference Points

Figure 3–4
Maximum Extent of Drawdown
2.3 Years After End of Mining

N

0 500 1000 2000 FEET



LEGEND

- 1100 — Elevation of Groundwater Table in Feet M.S.L.
- Open Pit Boundary
- Direction of Flow
- * Modeling Reference Points

Figure 3–5
Predicted Water Table 2.3 Years After End of Mining (Maximum Drawdown)

N

0 500 1000 2000 FEET

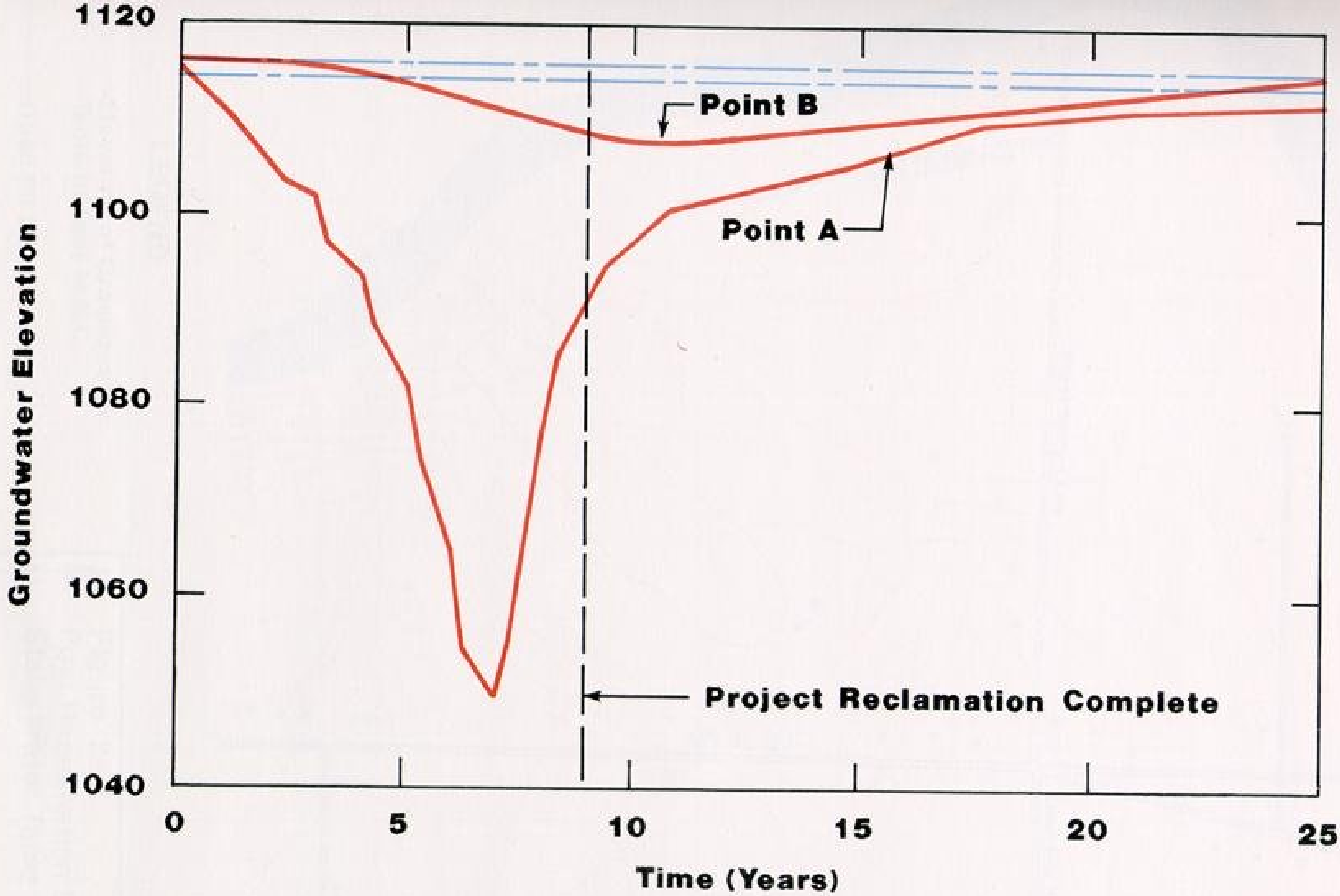


Figure 3–6 Groundwater Drawdown at Points Near to and Distant From the Pit

—— – – —— Original Groundwater Elevation

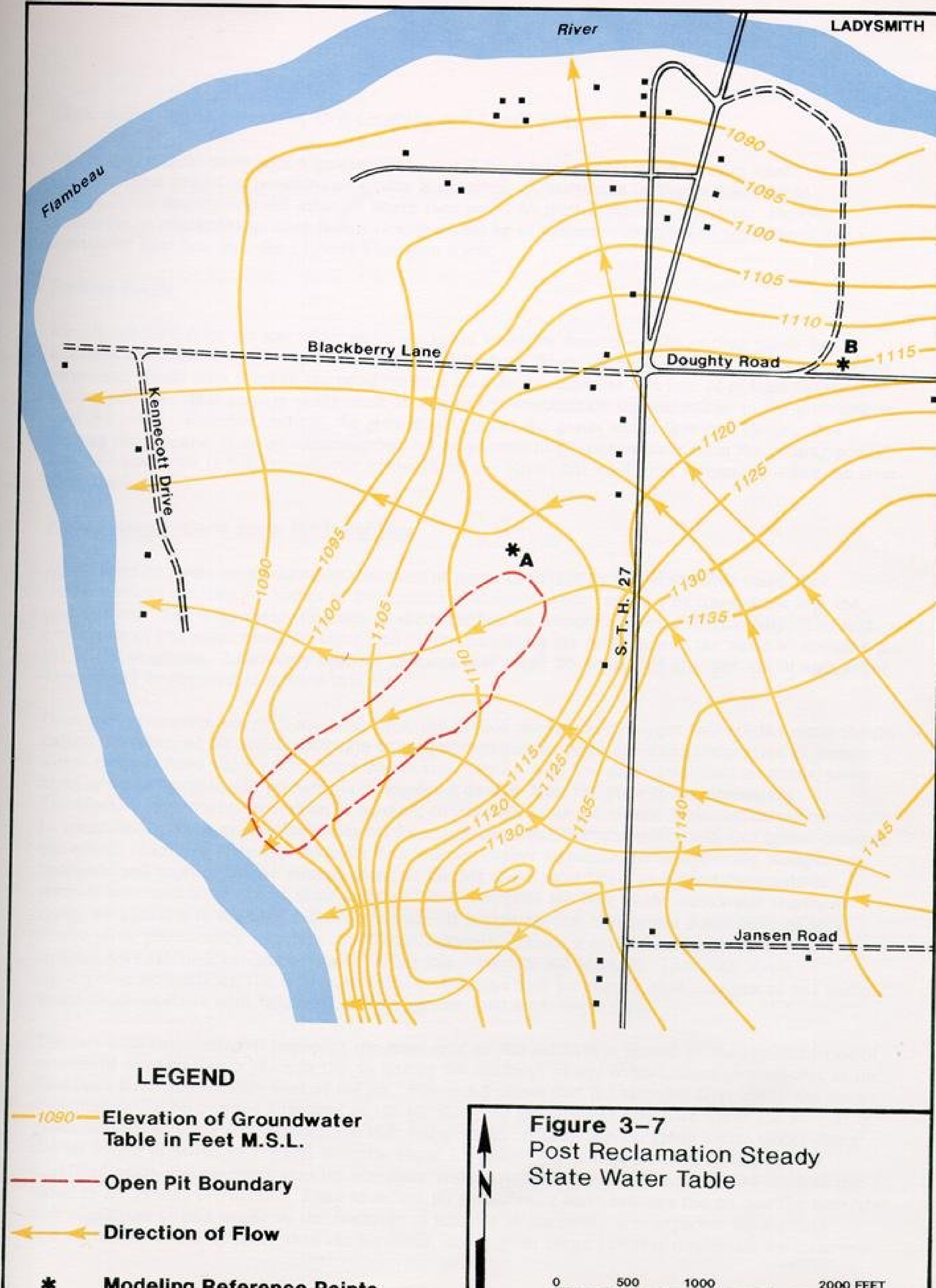


Figure 3–7
Post Reclamation Steady State Water Table

High Sulfur Waste Stockpile, Ore Crushing and Loading Areas

The lining of these areas with a geomembrane would limit leachate migration to rates where no environmental impact to groundwater quality is expected. A worst-case leakage would lead to contaminants flowing into the mine pit where they would be treated prior to discharge. Delayed movement of contaminants after facility closure would be of limited environmental significance due to dilution as they flow into the adjacent Flambeau River.

Settling Ponds

Runoff collected from the low sulfur waste stockpiles would be directed to the settling ponds for retention and treatment prior to discharge to the Flambeau River. Since the settling ponds are unlined, wastewater would seep through the pond bottoms into the groundwater at a rate of at least 5,000-6,000 gallons per day. This seepage could cause an increase in contaminant concentrations in the groundwater near the ponds. However, most of the groundwater under the ponds would flow into the pit, thus limiting the potential zone of contamination. A small amount of contaminants from the settling ponds may be transported in the groundwater to the Flambeau River, but would not measurably affect the river water quality.

Post-Closure Impacts From Pit Backfilling

Acidic leachate could be produced by oxidation of pyrite contained in the mineralized waste rock. Acidic leachate can dissolve metals of environmental concern which can then be transported into the environment. The fragmented condition of the backfilled waste would increase its reactivity. The acid production of the waste would be controlled during backfilling the pit by liming the waste to maintain a pH of 6.5 or greater. Laboratory analyses indicates that about 2.5 pounds of lime per ton of high sulfur waste would be required to achieve this pH.

Once the reclamation activities are completed, the limited circulation of oxygen through the waste should reduce the potential for sulfide oxidation to insignificant levels. Although some attenuation of metals within the backfilled waste would occur due to their contact with low sulfur backfilled materials, some areas of waste leachate will probably be transported directly from the pit without attenuation. Therefore, a conservative evaluation of leachate concentrations would assume their concentrations would be controlled by their most soluble mineral forms. A conservative evaluation would also ignore common ion effects. Leaching tests and solubility data indicate copper hydroxide, ferric hydroxide, manganese hydroxide and gypsum are the mineral forms at the pH of 6.5 most likely to control the resultant leachate concentrations. These same minerals would comprise the bulk of the wastewater treatment sludge backfilled with the high sulfur waste rock. It is possible that manganese concentrations may exceed those predicted by solubility equilibrium calculations since it could form a neutral species complex with the high concentrations of sulfate ion present in the leachate. Using the above conservative assumptions, the maximum leachate concentrations for copper, iron, manganese and sulfate would be about 0.014 mg/l, 0.32 mg/l, 0.725 mg/l and 1360 mg/l, respectively.

The potential environmental impact of the movement of this leachate is limited by the restricted rate of movement of groundwater through the pit and by the discharge of any contaminated groundwater to the Flambeau River immediately west of the pit. Figure 3-8 shows that the saprolite layer above the wastes backfilled in the pit and the alignment of the pit along the groundwater flow path limits the amount of groundwater which can flow through the high sulfur waste. A cross section groundwater model along the pit length prepared by Prickett indicates about 1.4 gallons per minute would flow through the backfilled waste and discharge into the Flambeau River. A 50% uncertainty factor would increase this value to 2.1 gallons per minute. Since there are no groundwater users between the pit and the river, the only significant impact would be the discharge of leachate to the river. It is expected the leachate concentrations would be lower than the maximum values given above and that they would decrease over time. However, the maximum values can be compared to the river flow adjacent to the pit to evaluate the maximum potential impacts to the river.

The Flambeau River's low flow discharge of about 500 cubic feet per second is equal to 224,000 gallons per minute. The maximum leachate flow of 2.1 gallons per minute discharging into the river would be diluted by a factor of about 107,000. Using the maximum leachate concentrations given previously, the incremental contaminant additions to the river would be 1.3 x 10^{-7} mg/l for copper, 3.0 x 10^{-6} mg/l for iron, 6.8 x 10^{-6} mg/l for manganese, and 1.3 x 10^{-2} for sulfate. These metal concentrations are not even measurable by today's instruments. A comparison of the incremental contaminant concentrations to the historical river background concentrations is shown in Table 3-1.

TABLE 3-1

Comparison of Contaminant Loading from Pit Leachate with Existing Water Quality

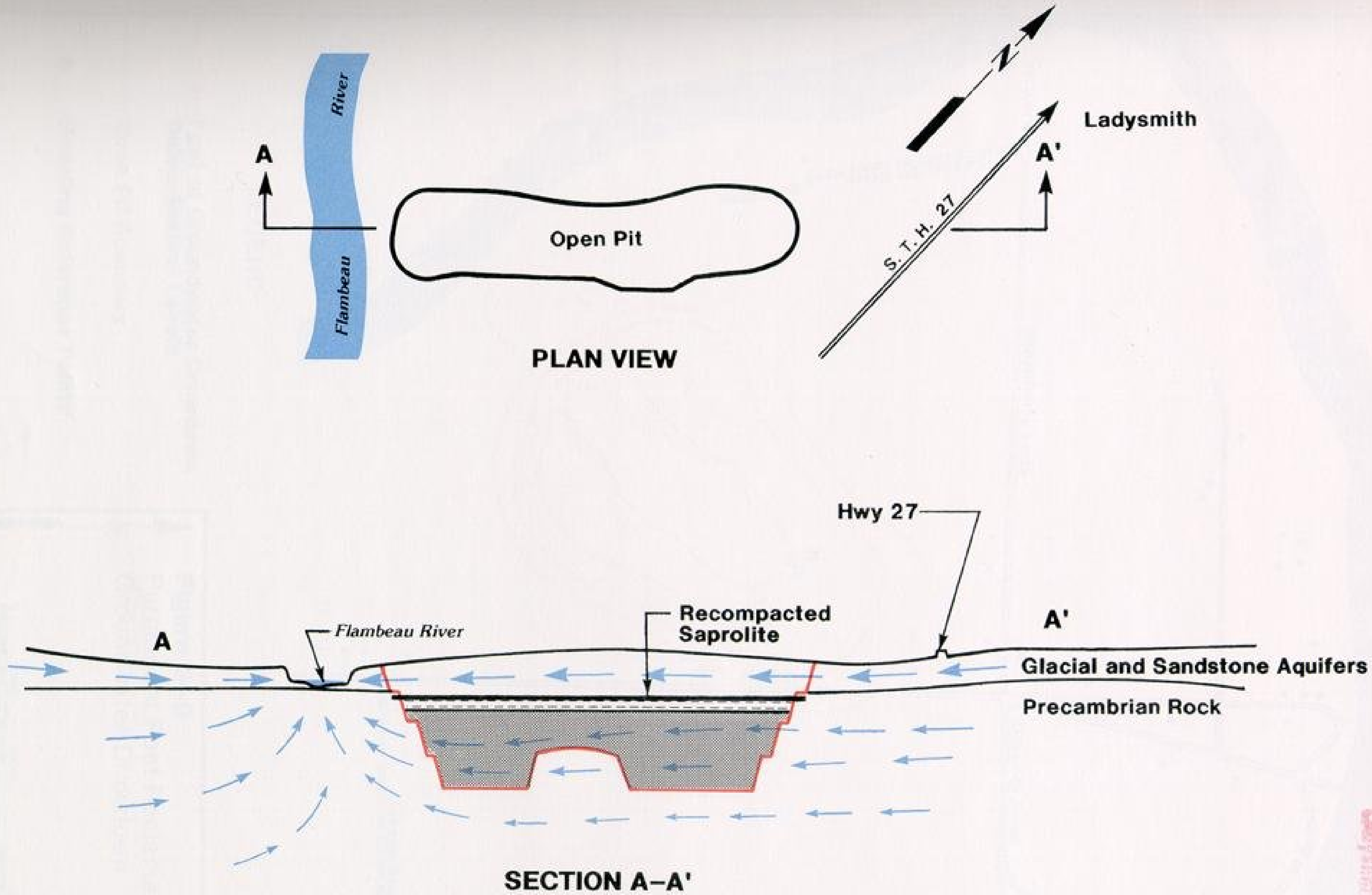
Contaminant	Incremental Contaminant Concentrations (mg/l)	Flambeau River Back-Ground Concentration (mg/l)
Copper	0.00000013	<0.115
Iron	0.000003	0.40
Manganese	0.0000068	<0.05
Sulfate	0.013	10

The results show that addition of the maximum concentrations of contaminants in groundwater flowing through the backfilled pit would not adversely affect water quality in the Flambeau River.

IMPACTS TO PRIVATE WELLS

The groundwater drawdown resulting from pit dewatering would cause levels in wells near the mine to drop. Figure 3-9 shows the maximum extent of the 2 foot drawdown contour and private wells in the mine vicinity. Water levels in the wells outside the 2 foot drawdown contour may decrease slightly, but probably not with adverse affects to the well performance. Water level declines of more than 2 feet could cause wells to become dry or to no longer comply with well regulations. The impacts to individual wells depends on the specific construction of each well and the amount of drawdown at the well. The model simulation of the maximum extent of drawdown (Figure 3-4) indicates that eight Flambeau Mining Co.-owned wells would experience maximum declines of 10-15 feet with one other well having between 0-2 feet of decline. Other private wells northeast of the pit in the STH 27 area would have less than 10 feet of drawdown. Of this group, one is predicted to have about 8 feet of drawdown, four would have between 2-5 feet of drawdown, and ten wells would experience 0-2 feet maximum drawdown. This last group of wells is adjacent to the Flambeau River and drawdown is expected to be insignificant due to the potential for the river to act as a constant source of groundwater recharge.

Groundwater contamination would pose a minor threat to private wells. The general groundwater flow pattern through the site is westerly, with all of the area groundwater discharging into the Flambeau River. The only private wells within the path of groundwater potentially contaminated by the mine site



NOTE: Groundwater Flow is Proportionate to the Size of the Arrows.

Figure 3–8 Groundwater Flow Through Pit After Backfilling

LEGEND

3.5 **Feet of Groundwater Drawdown Below Natural Levels**

Open Pit Boundary

* **Modeling Reference Points**

Figure 3–9
Permanent Post Reclamation Groundwater Drawdown

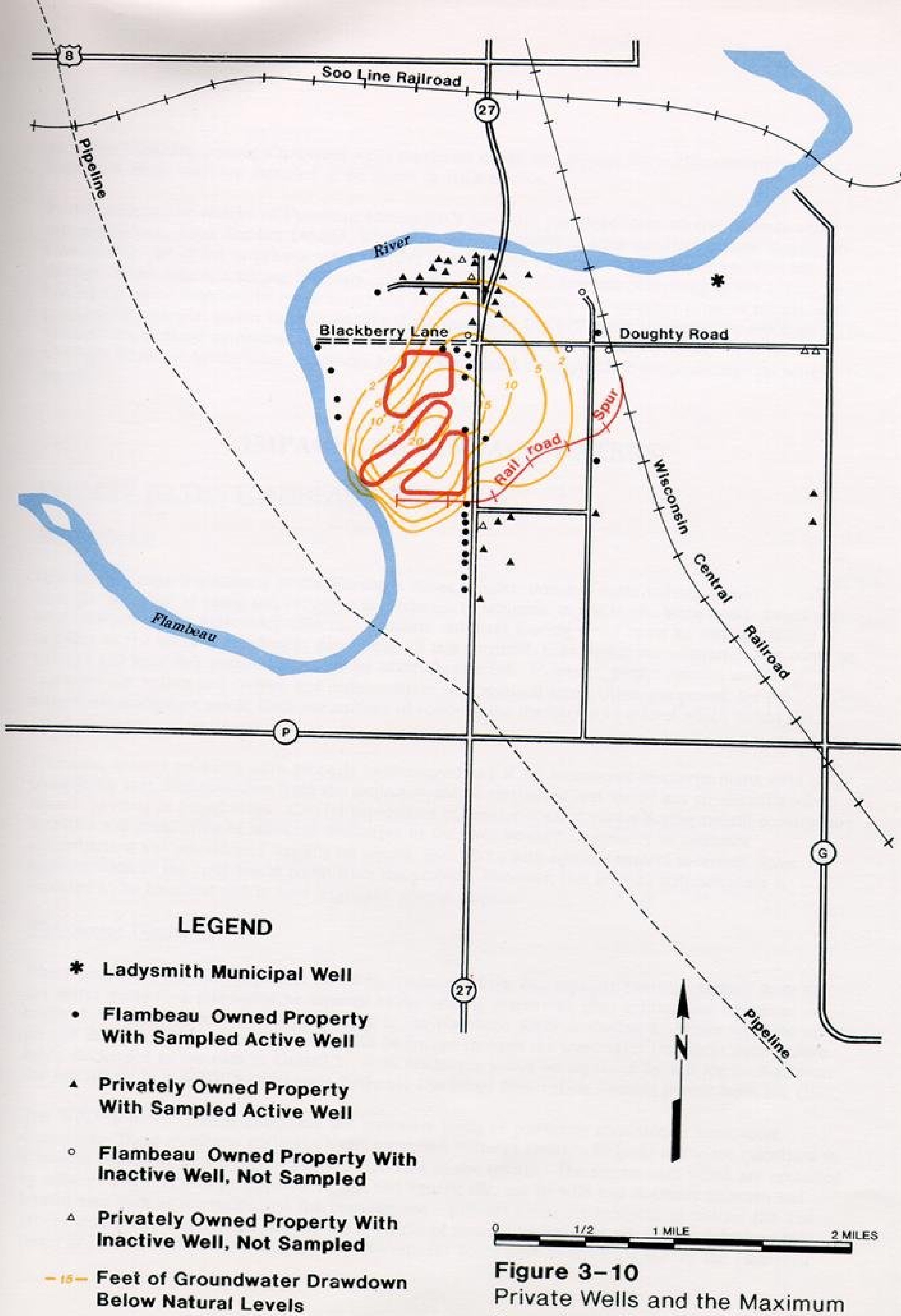


Figure 3–10
Private Wells and the Maximum Drawdown (2 Foot Contour)

are those Flambeau Mining Co.-owned wells northwest of the site (Figure 3-9). Groundwater quality impacts at these wells are expected to be minor or indiscernible.

Private wells in the vicinity of Flambeau Mining Co.'s mine are protected from adverse impacts under two regulations. First, Section 144.855, Wisconsin Statutes, prohibits mine dewatering from causing an unreasonable detriment to private water supplies and provides a mechanism for well owners to file damage claims against a mining company. Secondly, the Local Agreement pertaining to the Flambeau Mining Co. mine requires the applicant to test area wells for quality and quantity prior to mining, and provides for remedial action by the company if the quality of the well water is affected by the mine. The combination of these authorities should ensure that, if water quality or quantity in any wells are adversely impacted by the mine, Flambeau Mining Co. would be responsible for replacing that water supply.

IMPACTS TO SURFACE WATERS

IMPACTS TO THE FLAMBEAU RIVER

Sedimentation

Due to the project's proximity to the Flambeau River, construction and earth moving activities would have the potential to cause soil erosion and discharge of sediment to the river. Some solids would also be discharged in the wastewater effluent. Excessive sediment loading could cause an increase in the turbidity of the water and sediment deposition. If this occurred, habitats for macroinvertebrates could be covered and local fish populations could be adversely affected. However, proper erosion control measures can reduce soil erosion and sedimentation to a minimal level. Also, the permit for the wastewater discharges would limit the amount of solids in the discharges to a level which would not cause excessive sedimentation.

If erosion control measures were properly implemented and if the wastewater discharge limits were consistently met, sedimentation from the project would be minimized and would not significantly affect aquatic habitats or populations. Careful supervision of erosion-control efforts during critical construction activities and monitoring of sediment discharges to the river would be necessary to minimize sedimentation and any adverse impacts on aquatic life. Even with optimal control measures, some sedimentation in the river would result from the project. However, this level of sedimentation is expected to be localized and to have negligible adverse impacts.

Wastewater Discharge

Wastewater from the mining project would be discharged from two separate sources. Runoff from the low sulfur waste rock pile would be directed to the settling ponds and, after settling and treatment as required with a polymer and lime, discharged to the Flambeau River at Outfall 2. Water from the open pit and the high sulfur waste rock pile would be routed through the wastewater treatment plant before being discharged to the river at Outfall 1. Both discharges would be regulated by and required to meet the limitations in a WPDES (Wisconsin Pollutant Discharge Elimination System) permit from the DNR.

The WPDES permit system establishes the maximum levels of pollutants allowable in wastewater discharges. These maximum pollutant levels are called "effluent limits." Effluent limits are calculated in a manner which protects the most sensitive function of the stream. The stream uses which are protected by effluent limits include propagation of fish and aquatic life, use by wild and domestic animals, and human uses such as recreation and fish consumption. Effluent limits are designed to protect fish and other aquatic life, wildlife, and humans for a variety of toxic endpoints that are usually expressed in terms of acute or chronic toxicity. Thus, if the effluent limits were consistently met by the Flambeau mining discharge, adverse affects from any single substance would not be expected. Possible impacts from combinations of substances are addressed under **BIOASSAYS.**

Table 3-2 provides the preliminary effluent limits for the mine discharges along with the projected effluent quality. A daily maximum limit would apply to each substance and discharge individually and is expressed as a maximum concentration in micrograms/liter (ug/l). The weekly and monthly average limits would apply to the total discharge from both outfalls and are generally expressed as a mass limit (lbs/day). Mass limits define the maximum allowable amount (lbs) of a substance which may be discharged, and are applicable regardless of the volume of the effluent flow. Because of the high flow in the Flambeau River relative to the flow of the discharge, the wastewater would be significantly diluted shortly after entering the river (see footnote to Table 3-2). As a result, chronic limitations are not necessary for all substances since acute toxicity limitations are more stringent.

It is likely that the proposed wastewater treatment system if properly operated, would adequately treat the wastewater to meet effluent limits. Flambeau Mining Company's pilot test data indicate that the treatment technology is capable of achieving the limits for most of the listed parameters. The settling ponds may have difficulty in meeting the limit for total suspended solids unless the operation of the ponds is optimized. Two parameters, beryllium and aluminum, were not included in the pilot test program. However, beryllium was not detected in significant amounts in the waste characterization and is not expected in the effluent. Aluminum is readily removed by treatment, and Flambeau Mining Co.'s proposed treatment system should be able to achieve the aluminum limit. Mercury was not detected in the pilot plant testing and is not expected in detectable amounts in the effluent. The 2 ng/l effluent limit for mercury is two orders of magnitude below available levels of detection and compliance would be measured by no detection of mercury. Any exceedances of the effluent limits could result in adverse impacts to aquatic biota or consumers of the biota.

It should be noted that the actual river flow may periodically be below the $Q_{7,10}$ flow of 435 cfs used for calculating the effluent limits. Dairyland Power operates a dam upstream of the mine site in a peaking mode on a daily basis, resulting in substantial variability in stream flow. Background stream flows may be reduced to 280 cfs for short periods of time. Short-term reduction in stream flows, however, would not significantly affect the effluent limits or the effect of the effluent on stream biota. Effluent limits based on acute toxicity criteria do not rely on background stream flow for dilution. Calculations of limits based on chronic toxicity utilize low flows averaged over time. Thus, effluent limits based on the $Q_{7,10}$ flow would adequately protect stream biota even if stream flows occasionally fall below the $Q_{7,10}$ flow.

Table 3-3 shows the potential changes in water quality in the Flambeau River from the wastewater discharge. The discharge would not cause the concentration of any substances in the river to exceed the most stringent applicable water quality standard. Thus, none of the ecological functions of the river would be impaired by the effects of any single substance. Also, these projections assume that the concentration of each substance in the wastewater is at the effluent limit and, as such, is a conservative estimate of water quality impacts. The actual concentrations in the effluent would likely be less than the effluent limits for most substances.

TABLE 3-2

Effluent Limits and Projected Effluent Quality
For the Flambeau Mining Discharge
At 1/3 of Assimilative Capacity

Parameter	Preliminary[1] Effluent Limits: Monthly Average	Preliminary[1] Effluent Limits: Weekly Average (lbs/day)	Preliminary[1] Effluent Limits: Daily Maximum (ug/l)	Projected Effluent Quality[2] ug/l	Projected Effluent Quality[2] lbs/day	Pilot Plant Test Results (ug/l)
Arsenic			730	5		< 3
Beryllium	0.67 lbs/day			no data		no data
Cadmium	50* ug/l	0.046	95	< 5	< 0.016	< 0.3
Chromium (total)		6.4	5400	< 50	< 0.153	< 2
Chromium (+6)			28	no data		< 2
Copper	150* ug/l		50	< 20		< 10
Lead	300* ug/l	0.89	590	< 100	< 0.372	< 2
Mercury	0.002 ug/l		2.0*	< 0.3		< 0.5
Nickel		7.6	3100	< 40	0.110	< 30
Selenium			120	< 100		3
Silver			6.6	< 6		< 0.4
Zinc	750* ug/l		300	< 30		< 30
Aluminum			1500	< 1000		no data
TSS	20,000		30,000	20,000		
pH	- (6-9 range) -					

1 Monthly average limits are based on human cancer, human threshold, and wild and domestic animal criteria except those marked with an asterisk (*) which are EPA categorical limits.
Weekly average limits are based on chronic toxicity criteria.
Daily maximum limits are based on acute toxicity criteria or EPA categorical limits (*).
Monthly and weekly average limits are based on 1/3 of the available assimilative capacity of the river.

Reference flows used in calculating limits:

Flow	Basis	Criterion
35.89 cfs	1/3 of 1/4 of $Q_{7,10}$ (435 cfs)	Chronic toxicity (weekly ave.)
201.2 cfs	1/3 of .85 of $Q_{7,2}$ (710 cfs)	Human threshold, wild and domestic animal
618.3 cfs	1/3 of mean annual (1855 cfs)	Human cancer

Reference hardness values used in calculating limits:
Effluent (for daily maximum) = 155 ppm
River (for weekly average) = 52 ppm

2 From Revised WPDES application (Flanbeau Mining Company, 1989)

TABLE 3-3

Water Quality Impacts to the Flambeau River from the Wastewater Discharge[1]

Substance	Instream Concentration Existing	Instream Concentration With Discharge[2]	Most Stringent Water Quality Standard
Arsenic	<5.0	0.7	50.0
Beryllium	<1.0	0.2[3]	0.2
Cadmium	<1.0	0.01	0.23
Chromium (total)	<5.0	1.9	31.6
Chromium (+6)	<50.0	0.03	9.7
Copper	3.7	3.7	6.2
Lead	<5.0	0.27	4.39
Mercury	<0.5	0.0007	0.002
Nickel	0.4	2.7	38.0
Selenium	<5.0	0.11	7.07
Silver	<0.4	0.006	0.93
Thallium	<5.0	2.76	11.0
Zinc	5.1	5.4	28.5
Aluminum	62.5	63.8	87

[1] All values in ug/l (parts per billion)

[2] Based on a stream flow of 1/3 of the assimilative capacity of the river (618.3 cfs) and a total effluent flow of 0.57 cfs. Assumes each substance in the discharge is at the effluent limit (e.g. maximum concentration).

[3]Background data indicates beryllium concentrations in the discharge would be substantially less than the effluent limit.

The effluent limits described in Table 3-2 utilize 1/3 of the assimilative capacity of the river in the limit calculations. Flambeau Mining Company has indicated in its WPDES application that, based on the criteria in NR 207, Wis. Adm. Code, it should be entitled to the full assimilative capacity of the river. If the company is granted full assimilative capacity under NR 207, effluent limits would be as shown on Table 3-4. In either case, the limits would provide protection to stream biota and uses from adverse effects of individual substances.

TABLE 3-4

Effluent Limits For the Flambeau Mining Discharge at 100% of Assimilative Capacity

Parameter	Preliminary[1] Effluent Limits Monthly Average	Weekly Average (lbs/day)	Daily Maximum (ug/l)
Arsenic			730
Beryllium	2.0 lbs/day		
Cadmium	50* ug/l	0.14	95
Chromium (total)		19	5400
Chromium (+6)			28
Copper	150* ug/l		50
Lead	300* ug/l	2.6	590
Mercury	0.002 ug/l		2.0*
Nickel		22.	3100
Selenium			120
Silver			6.6
Zinc	750* ug/l		300
Aluminum			1500
TSS	20,000		30,000
pH		6-9	

1 Monthly average limits are based on human cancer, human threshold, and wild and domestic animal criteria except those marked with an asterisk (*) which are EPA categorical limits.
Weekly average limits are based on chronic toxicity criteria.
Daily maximum limits are based on acute toxicity criteria or EPA categorical limits (*).
Monthly and weekly average limits are based on 1/3 of the available assimilative capacity of the river.

Reference flows used in calculating limits:

Flow	Basis	Criterion
108.75 cfs	1/4 of $Q_{7,10}$ (435 cfs)	Chronic toxicity (weekly ave.)
603.5 cfs	.85 of $Q_{7,2}$ (710 cfs)	Human threshold, wild and domestic animal
1855 cfs	mean annual (1855 cfs)	Human cancer

Reference hardness values used in calculating limits:

Effluent (for daily maximum) =	155 ppm
River (for weekly average) =	52 ppm

Heavy Metals

Maximum concentrations of heavy metals in the Flambeau River from the discharge are shown in Table 3-4. These concentrations reflect a very conservative analysis in which the discharge is assumed to contain the maximum permissible concentrations and the river is assumed to be at low-flow conditions. Even under these conservative assumptions, concentrations of most metals in the river would show little to no increase from the wastewater discharge.

Heavy metals that are discharged would either remain in the water column or be removed from the water via biological uptake or settling to the bottom. The rate at which heavy metals would be removed from the water column would depend on a number of factors, including the amount of organic material and suspended solids in the water, hydraulic characteristics of the river, and the proportion of the total metal content which is in a dissolved state. Metals not removed would stay in the water column and be transported downstream.

Carcinogens

Several of the potential constituents in the proposed effluent are known or suspected human carcinogens. Beryllium is a known animal carcinogen. However, beryllium was detected in only one sample from the river water and one from the groundwater; beryllium was not tested for in the pilot test. There is sufficient evidence that chromium is a human carcinogen, although information does not exist on the mode or level of exposure which may produce carcinogenic effects in humans. Cadmium is a suspected human carcinogen and information gaps similar to those for chromium exist. Inorganic forms of arsenic are known to cause skin and lung cancer in humans. However, there is also evidence that arsenic in very low levels may be an essential nutrient for humans.

Effluent limits for beryllium were based on human carcinogenicity. Limits for the other carcinogens were based on fish and aquatic life protection (arsenic and chromium), or other non-carcinogenic effects to humans (cadmium) since these limits provide the most stringent protection.

Hydrogen Sulfide

Hydrogen sulfide is a compound which will probably be present in the effluent as a by-product of the sulfide precipitation step of the wastewater treatment system. Hydrogen sulfide can be extremely toxic to fish and aquatic life at low concentrations. However, the precise toxicity characteristics of hydrogen sulfide are not well defined. Furthermore, the laboratory detection limit for hydrogen sulfide is much higher than the level at which the compound is toxic. As a result, it will be very difficult to set a meaningful effluent limit for hydrogen sulfide in the Flambeau Mining Co. discharge. The discharge may contain levels of hydrogen sulfide which are toxic to fish and aquatic life even though hydrogen sulfide is not detectable in the effluent. Therefore, toxicity testing using bioassays would be necessary to determine if hydrogen sulfide is present in the discharge at toxic levels.

Bioaccumulation

Bioaccumulation refers to the tendency of aquatic organisms to accumulate chemicals in their bodies at concentrations many times higher than the surrounding water. This occurs from direct uptake of chemicals from the water and from accumulation of metals (in this case) through the food chain. Bioaccumulation can result in concentrations of some metals in fish and macroinvertebrate tissues that are harmful to the organisms and to humans and animals eating those organisms. The procedures used to calculate the effluent limits take into account the rates at which metals tend to bioaccumulate and, thus, are designed to prevent adverse effects to humans and animals from excessive levels of metals. The effluent limits combined with the high dilution of the effluent in the river should serve to minimize the potential for bioaccumulation of metals. However, bioaccumulation is site specific, and the precise effects of bioaccumulation from Flambeau Mining Co.'s discharge in the Flambeau River cannot be determined until the discharge actually occurs and monitoring is conducted.

Bioassays

The effluent limits described above are established to prevent toxic effects and bioaccumulation from each individual chemical. When chemicals are mixed together in a discharge, they may have a combined, or synergistic effect which causes the discharge to be toxic even though the individual chemicals are below toxic levels. Discharges may also be toxic because of the presence of unexpected chemicals. Toxicity testing using bioassays is the best way to determine if a discharge is actually toxic to fish and aquatic life.

A bioassay test involves placing sensitive aquatic organisms, such as minnows and water fleas, into the discharge water at full strength and at a diluted strength and observing the organisms over time for adverse reactions. Bioassays can also be performed before discharge actually begins by using laboratory generated wastewater. However, bioassay tests on laboratory generated wastewater are not completely reliable due to the difficulty of accurately synthesizing the wastewater.

Flambeau Mining Co. performed bioassay analyses on synthesized lime treatment and lime and sulfide treatment effluents. The Department did not verify these analyses, although the studies were conducted by a reputable independent firm. These analyses showed no acute or chronic effluent toxicity as defined in NR 106, Wis. Adm. Code, (Hunter/ESE, Inc., 1989).

Bioassays will be required after the discharge begins. Based on past experience with bioassays, it is possible that Flambeau Mining Co.'s discharge will fail the tests. This failure could occur because of chemical toxicity or because the effluent lacks chemicals essential to support aquatic life. If the bioassays are failed, Flambeau Mining Co. would be required to retest and to attempt to eliminate the cause of the bioassay failure. The discharge could have toxic effects during the time required to implement the testing and remediation efforts.

Impacts to Downstream Flowages

Flowages downstream from the mine site include the Thornapple Flowage (7 miles from the site) and the Holcombe Flowage (21 miles from the site). These flowages are susceptible to adverse impacts if water quality of the Flambeau River is degraded. Decreased water velocity in flowages tends to settle out suspended solids, resulting in increased sedimentation and potentially elevated contaminant levels in biota.

No adverse impacts to the Thornapple or Holcombe Flowages are expected from the Flambeau Project. The effluent limits which would regulate the wastewater discharge are designed to prevent adverse accumulations of contaminants in aquatic organisms. Other factors such as dilution and attenuation would decrease concentrations of any contaminants as they were transported downstream. If unexpected impacts occurred, the Thornapple Flowage would likely limit the downstream extent of impacts. Monitoring of water quality, sediments, and biota at downstream locations would provide the data necessary to determine the magnitude and extent of any mine-related impacts.

IMPACTS TO RIVER FLOWS

No significant impacts to the Flambeau River flows would occur at any stage of the project. While the pit would intercept groundwater which normally would flow into the river and draw some river water into the pit, the amounts would be very minor in comparison to the total river flow. The average groundwater/river water inflow to the pit of 125 gpm is about 0.01% of the average Flambeau River flow and about 0.07% of the $Q_{7,10}$ flow. Also, most of the project water will be returned to the river through either the wastewater discharge or infiltration into the groundwater. Only very minor amounts of water would be consumed by evaporation and incorporation into the ore leaving the site. No post-closure changes in river flows would occur.

Intermittent Stream A is fed by the discharge from Wetland 1. Since the mine would occupy part of the Stream A watershed and would disrupt the groundwater flow into Wetland 1, flows in Stream A would be reduced. Flambeau Mining Co., however, plans to maintain the water level in Wetland 1 with wastewater. To the extent that Wetland 1 water levels are maintained, flows in Stream A would also be maintained near or slightly below pre-project conditions. Stream B would be eliminated by the mine. The mine would divert water from a portion of the Stream C watershed, thus slightly reducing streamflows. However, the mine would occupy less than 10% of the Stream C watershed, and the resulting flow reductions would not be significant.

Meadowbrook Creek is far enough from the pit that the groundwater drawdown would not divert significant quantities of groundwater currently discharging into the creek. Therefore, Meadowbrook Creek flows would not be discernibly affected.

After the mine closes, the groundwater would return to approximately the original levels over the course of several decades. Groundwater levels would, however, be permanently slightly depressed over the backfilled pit. Groundwater discharges to the land surface in the area of Wetlands 1 and 2 may be reduced or eliminated. As a result, flows in Stream A would be reduced, possibly on a permanent basis.

Stream B would be re-created during site reclamation. The stream would enter the wetland created during reclamation and exit the site through a weir into its historic outlet. No significant changes in Stream B flows are expected.

IMPACTS TO WETLANDS

FACILITY CONSTRUCTION AND OPERATION

Construction of the mine site including the open pit, high sulfur waste rock pile, mine support facilities, and the railroad spur would directly impact about 8.4 acres of wetland (Figure 3-10). Table 3-5 identifies the wetlands which will be directly impacted and specifies the affected acreages. The groundwater drawdown may affect additional acreage. Since the wetland boundaries used for this analysis include some areas with only marginal wetland characteristics (e.g. possessing either soil <u>or</u> vegetation of wetlands) this analysis may slightly overstate the actual acreage involved in direct wetland impacts.

During pit construction a portion of Wetland 2 (2½ acres) would be excavated, including intermittent Stream B which drains part of the area over the pit. The remaining portion of Wetland 2 would be dewatered from the groundwater drawdown and would be used to store hydric soils for use during wetland reclamation. This wooded wetland is considered to be relatively common in northern Wisconsin, has a high biological value and supports vegetation and wildlife typical of a northern, wet-mesic forest. Wetland 2 also serves a moderately important hydrologic function by retaining groundwater discharge and surface runoff from a 65 acre watershed.

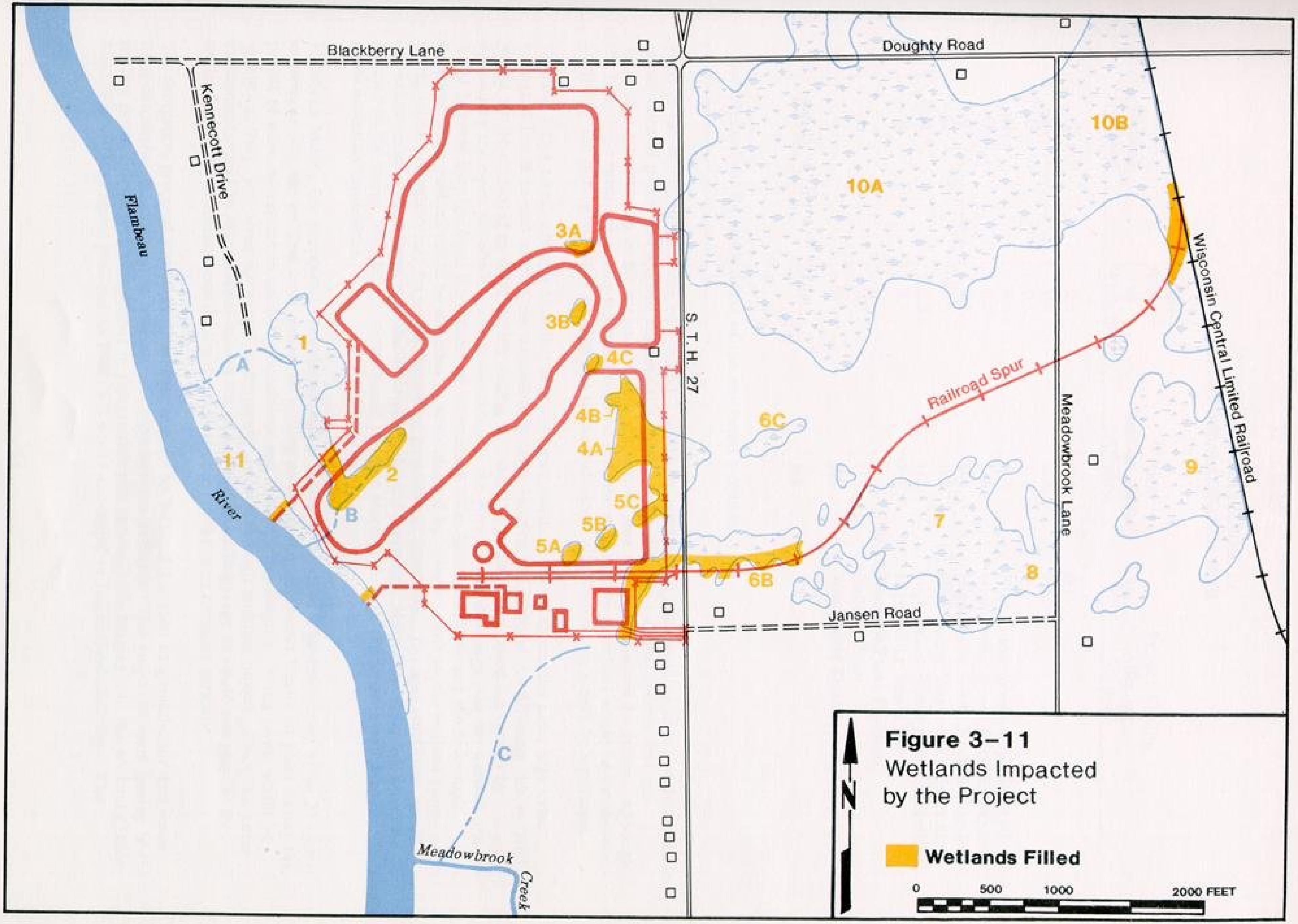


Figure 3–11
Wetlands Impacted
by the Project

TABLE 3-5

Wetlands Directly Impacted by Construction of Project Facilities

Wetland Number[1]	Total Acreage in Wetland	Wetland Acreage Directly Affected	Project Facility Affecting Wetland
2	2.5	2.5	Pit
3a	0.3	0.3	Pit
3b	0.1	0.1	Pit
4a	0.3	0.3	High Sulfur Waste Rock Stockpile
4b	0.1	0.1	High Sulfur Waste Rock Stockpile
4c	0.1	0.1	High Sulfur Waste Rock Stockpile
5a	0.2	0.2	High Sulfur Waste Rock Stockpile
5b	0.2	0.2	High Sulfur Waste Rock Stockpile
5c	8.7	4.1	High Sulfur Waste Rock Stockpile/Plant Facilities
6b	3.7	0.4	Railroad Spur
11	NA	0.1	Wastewater Ditches
TOTAL		8.4	

[1] See Figure 3-10 for the location of the numbered wetlands.

Most of the biological functions of Wetland 2 would be permanently lost, resulting in minor decreases in populations of plants and animals that use this habitat type. Plant and animal species that use Wetland 2 are common in the region and thus, impacts to area populations would be minor. Although the hydrologic functions of this wetland would be lost, the surrounding watershed would be extensively altered by the mining activities and the loss of the hydrologic values would no longer be significant.

Wetland 1 (5.4 acres) which is classified as a wet-mesic northern forest, shares the same high value biological functions and moderately valuable hydrologic functions of Wetland 2. Although this wetland would not be excavated or filled during mining activities the groundwater drawdown caused by dewatering the open pit would decrease or eliminate the groundwater discharge into the wetland and could increase seepage from the bottom of the wetland. The biological value and the hydrologic function of the wetland could be diminished, particularly if hydrologic inputs to the wetland from precipitation are subnormal during the period of groundwater drawdown. Drought conditions would exacerbate mine-related impacts to the wetland's biological functions. Hydrologic functions would be affected to the extent that the drawdown would increase seepage through the wetland and decrease its water retention capabilities.

Flambeau Mining Co. proposes to supplement water inflow to Wetland 1 by discharging up to 20 gpm of wastewater into the wetland from either the settling ponds or the wastewater treatment plant during the period of mine operations to replace groundwater and surface water sources. Water levels would be monitored daily, and water discharged as frequently as daily through multiple outlets. Since the water supplement would be discontinued toward the end of the backfilling stage, it would not provide for wetland water level maintenance during the post-mining groundwater rebound period.

The mitigation proposal should avoid adverse impacts to Wetland 1 caused by groundwater drawdown from dewatering the open pit as long as mitigation water is available. The projected water quality of the settling ponds discharge is comparable to the groundwater currently discharging into the wetland (Table 3-6). The effluent limits provided in Table 3-2 would also apply to the wetland discharge. The discharge would have slightly higher concentration of several metals (selenium, copper, iron, manganese, and magnesium), but would still be below levels toxic to aquatic life. The increases in some metals discharged may result in slightly higher metal levels in the wetland environment, but would not cause impacts detrimental to the wetland's biota.

TABLE 3-6

Water Quality of the Wetland 1 Groundwater Seep and the Mitigation Discharge[1]

Parameter	Groundwater Seep Chemistry[2]	Mitigation Discharge Water Chemistry[3]	Drinking Water Standards
Primary Standards Parameter			
Arsenic	< 5	5	50
Cadmium	1.1	< 5	10
Chromium	< 5	< 50	50
Lead	< 5	< 100	50
Mercury	< 0.5	< 0.3	2
Selenium	< 5	< 100	10
Silver	< 5	< 6	50
Secondary Standards Parameter			
Copper	5	< 20	1,000
Iron	100	300	300
Manganese	50	100	50
Zinc	50	30	5,000
pH	6.24		
Other Parameters			
COD	< 5,000	< 20,000	
Hardness	52,000	155,000	
Magnesium	4,400	10,000	
Temperature	7.0° C		
Aluminum	38	< 1,000	

1 Values in µg/l.
2 From a single sample by Flambeau Mining Co. on 11/5/87.
3 From Revised WPDES Permit Application, Discharge 002 (Kennecott, 1989).

Wetlands 3b and 4a are small ponds dug in the late 1960s. Wetlands 3a, 4b, 4c, 5a, and 5b are small pothole type wetlands which have been recently farmed. These wetlands do not possess significant biological or hydrological values and removing them would not cause significant adverse impacts.

Wetland 5c (8.7 acres), a shrub-wet meadow wetland in the headwaters of Stream C, performs low- to moderate-value biological and hydrological functions. The western portion of the wetland has been disturbed by adjacent agricultural activities and is of less value than the eastern portion. About 4.1 acres of the western part of Wetland 5c would be buried by the high sulfur stockpile and the support facilities. The biological and hydrological functions of the western part of the wetland would be permanently lost.

Proximity impacts from the stockpile and support facilities along with the groundwater drawdown may affect the remaining portion of Wetland 5c during the mining activities. This wetland is at or near the water table, but the relationship of groundwater to the wetland is not well defined. The surface elevation of Wetland 5c is between 1,138 to 1,142 feet mean sea level. Several feet of fine grain organic soil probably covers the wetland bottoms. The water table is at approximately 1,136 to 1,139 feet mean sea level in the wetland area. The close proximity of the water table to the surface and the fine grain wetland soils make it likely there is a direct saturated hydraulic link between the wetland and the groundwater system, though it is difficult to know whether the groundwater table supports the wetland position or whether the wetland base just happens to coincide with the groundwater table. It is possible that the maximum mining drawdown of 2-15 feet in the wetland area may increase the existing downward gradient at the wetland and reduce water levels within the wetland. This impact would be limited as the water table falls below the bottom of the fine grain wetland sediments. At that point, the wetland would become perched above the groundwater table and the water movement out of the bottom of the wetland would become a constant value dependant on sediment conductivity and the height of any ponded water within the wetland. The groundwater model predicted flow from Wetland 5 ranged from 0.7 to 1.9 gallons per minute. Model simulation of mining impact at Wetland 5c indicated flows may drop to 0.3 gallons per minute. The mine-induced drawdown could cause the water levels in the remaining portions of Wetland 5c to drop, especially if climatic conditions were unusually dry.

Wetland 6b is a 3.7 acre recently disturbed sedge meadow-like wetland in the headwaters of Stream C. About 0.4 acres of this wetland would be filled for the railroad spur. Wetland 6b provides moderately valuable biological and hydrological functions. A portion of these functions would be lost during the mine operation.

Wetland 6c (1.3 acres) may experience 3-4 feet of water table decline. Since there are no groundwater monitoring wells in the area of Wetland 6c it is difficult to evaluate the potential impact. It appears the bottom of the wetland sediments may intersect the water table, thus supporting saturated conditions to some degree. It is most likely the presence of the fine grain soils in the area occupied by Wetland 6c along with its location in a low drainage area has produced the existing wetland conditions and that water table declines caused by mining will not have a significant impact on the wetland. Wetland 6c is a low value wetland which currently does not support gydrophytic vegetation.

The outermost extent of the groundwater drawdown may reach parts of Wetland 7. Groundwater levels under the northwestern portion of this 17.8 acre sphagnum bog may drop several feet for a relatively short period of time at the point of maximum groundwater drawdown. Due to the short duration and minor nature of the drawdown, no adverse impacts to Wetland 7 are expected.

Wetlands 8 and 9 are outside of the area of mining induced groundwater drawdowns and would not be significantly affected.

Maximum groundwater drawdown under Wetland 10a is predicted to be from 25 feet in the west to less than 2 feet in the east. Soil investigations and estimated groundwater elevations indicate the wetland soils are perched above the groundwater table, and no increased drainage of this wetland is expected to accompany the groundwater drawdown.

A small area of hydric soils adjacent to Wetland 10b would be impacted by construction of the rail road spur. This area does not currently support hydrophytic vegetation.

Wetland 11 is a long, narrow floodplain wetland adjacent to the Flambeau River. The two open-channel wastewater discharge outfalls would be constructed through this wetland and affect about 0.1 acres. No significant adverse impacts to any functions of Wetland 11 would occur from either the outfall construction or the groundwater drawdown.

LONG-TERM WETLAND IMPACTS

Flambeau Mining Co. proposes to create a 7.5-acre wetland at the west end of the pit along with a 1-acre test wetland at the northeast corner of the site. Creation of these wetlands, if successful, could restore most or all of the long-term wetland losses from the project. If reestablishing the wetlands is unsuccessful, the areas would provide only minor wetland functions, and the wetland losses described for the construction and operation would be sustained, long-term impacts.

Both wetlands would initially be constructed as perched wetlands, relying on precipitation and runoff to maintain the wetland hydrology. As a result, the basins will be susceptible to varying water levels caused by heavy rainfalls or drought. It is possible that the trees and shrubs planted in the forested portion of the 7.5 acre wetland would not survive seasonably high water levels caused by potential impedances of the wetland outflow.

As the groundwater elevations rebound within the backfilled pit, the groundwater under the 7.5 acre wetland would gradually rise. The steady-state groundwater elevation at the eastern edge of the wetland would be approximately the same as the intended water level in the wetland. The groundwater flow into the wetland would help stabilize water levels during dry periods. Some settling would occur under the wetland constructed on the backfilled pit. While only a few feet of settling is expected, it is possible that over ten feet of settling could occur. Settling would tend to increase the depth of the water in the wetland, causing an increase in the amount of open water and a decrease in the amount of emergent wetland vegetation. Settling may also reduce the effectiveness of the wetland liner, resulting in increased seepage from the wetland until the underlying groundwater levels fully recover.

The weir at the outlet of the 7.5 acre wetland would allow manipulation of the water level to maximize the ecological value of the wetland. However, the weir would also require a minor level of maintenance over time to keep it functioning properly. The rectangular shape of the 1-acre wetland is unnatural, and would be less aesthetically pleasing than a design which graded smoothly into natural contours.

Revegetation success would depend on adequate site preparation and appropriate planting techniques. Success would be highest if planting was done during May and June.

If the wetlands are successfully established, they would provide moderate to high quality wildlife habitat. The open water, littoral habitat, and forest would provide habitat diversity and edges between vegetative types. If the restoration efforts are less successful, the biological value of these wetlands would be diminished. The hydrological functions of the restored wetlands would be similar to those of the original wetlands and would not be significantly affected by a lack of revegetation success.

A key element to restoring Wetland 1 would be the restoration of adequate water inflow to the wetland. Flambeau Mining Co.'s reclamation plan relies on the groundwater seep, which currently supplies Wetland 1, reappearing as the groundwater levels rebound. However, the groundwater modeling indicates that the groundwater table over the reclaimed pit will not completely rebound to its pre-mining elevation. Long-term groundwater elevations in the vicinity of the Wetland 1 seep may be several feet lower after the project and may take several decades to rebound to the approximate pre-mining levels.

In addition to permanently lowered groundwater levels, the hydrological environment upgradient of Wetland 1 would also be extensively altered. The soils over the pit would be mixed, eliminating the natural zones of differing permeabilities and replacing them with homogenized soil of uniform permeability. The soils in the low sulfur waste rock stockpile area would be compacted, and the topography slightly altered, which will probably change the ability of that area to recharge the groundwater. Soils under the settling ponds, which are immediately upgradient of the seep, would be excavated to depths of up to 15 feet. As a result, it is possible that the groundwater seep may not reappear even if groundwater elevations rebound to the approximate pre-mining elevations and water levels in Wetland 1 would be permanently lowered. Wetland 1 would not receive groundwater discharge for several to many years after the site reclamation was completed.

Other wetlands directly impacted by the project (Wetlands 3, 4, 5 and 6) would not be restored during reclamation.

IMPACTS TO TERRESTRIAL RESOURCES

At least 135 acres of the plant and animal communities within the 181 acre mine site would be eliminated by the project construction. An additional three acres would be affected by the rail spur east of the mine site. Table 3-7 shows the acres and habitats affected by the various project facilities. About 33% of the affected habitat is classified as old field, 28% woods, and 7% wetlands. The remainder of the affected area is agricultural land.

Elimination of the vegetative communities noted above would cause a proportional reduction in the animal populations using those habitats. While these habitat reductions would cause wildlife populations to decline on a very localized basis, the impact to regional populations would be negligible. For example, the project would result in a decline of about five to seven white-tailed deer, while the 1987 Rusk County harvest was almost 4,500 deer. Similarly small population declines would be expected for mammals, birds, amphibians, and reptiles inhabiting the site.

Project noise and disturbance would also affect wildlife in areas adjacent to the mine site. Some species can readily adapt to noise and disturbance, while other species might leave the area. Individuals of the same species demonstrate very different tolerances to noise. However, the project noise and disturbance would diminish rapidly with distance from the site limiting the amount of wildlife habitat potentially affected. Actual impacts to wildlife populations from noise and disturbance would be minor.

With successful reclamation of the mine site, establishment of vegetative communities similar or superior to those originally on the site would also establish new wildlife habitat available for occupation. Reestablishment of the natural biota would occur gradually over a period of time as the reclamation plantings mature and natural succession progresses. If the wetland reclamation efforts were not effective, wetland dependent populations could be permanently reduced.

Additional discussion of potential long-term impacts to terrestrial biota is provided under **RECLAMATION IMPACTS.**

TABLE 3-7

Direct Project Impacts to Plant Communities (Acres)

	A	F	OF	R	W1	W3	W4	W5	W6	Total Acres
High sulfur waste rock 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		.1	6.9							7.0
Settling ponds		1.4	4.4							5.8
Low sulfur waste rock stockpile	17.9	12.2	9.4							39.5
Visitor parking			.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
Railroad spur east of fence	.9	1.5	.1			.1	.4		.2	3.2

Key:
- A = Agriculture
- F = Upland mixed forest
- 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

IMPACTS TO AQUATIC RESOURCES

The Flambeau River harbors the only aquatic biological community which could be affected by the project. The other surface waters in the mine site vicinity (Streams A, B, and C) are intermittent, and do not provide any significant support for biological communities. Impacts to the aquatic life in the Flambeau River could occur from the wastewater discharge and from surface water runoff from the mine site.

The quality of the wastewater discharge is regulated by establishing effluent limits. These effluent limits are based on the best data available on short- and long-term toxicity to aquatic organisms of individual wastewater constituents. There is a relatively high degree of confidence that these effluent limits adequately protect aquatic life from the effects of each individual wastewater constituent. However, pollutants which individually are below toxic concentrations can interact synergistically to form a toxic wastewater. There is no method to predict with certainly the potential for synergistic toxicity of Flambeau Mining Co.'s effluents.

If the effluent is toxic, Flambeau Mining Co. would be required to undergo a process to identify and eliminate the reasons for the toxicity. If Flambeau Mining Co. was allowed to continue discharging wastewater during this process, the wastewater discharge could cause toxic effects to fish and other aquatic life in the Flambeau River in the vicinity of the wastewater discharge. These effects would be limited to a relatively small portion of the river because of the high dilution (more than 700 to 1) provided by the background river flow.

Surface water runoff from the mine site could transport substantial quantities of soil into the river. Excessive sediment discharges into the river could increase water turbidity and cover habitat on the river bed, adversely affecting aquatic biota. Sedimentation impacts would be localized and probably short term in nature. Sedimentation from the site could be minimized with proper erosion control practices on the mine site. With adequate erosion control, impacts to aquatic life from sedimentation would be minor.

IMPACTS TO THREATENED AND ENDANGERED SPECIES

No state-listed threatened or endangered species of mammals, birds, reptiles, amphibians, or fish are known to reside on or adjacent to the mine site. A threatened species of pond weed (Potamogeton vaginatus) was identified by the company in Wetland 4, which would be filled by the project. However, this species is not expected to inhabit this type of ecological environment and Department staff have concluded it was a misidentified specimen.

The active bald eagle nest located 1 mile southwest of the site is not expected to be affected by the project. It is possible that the blasting noise could reach the nest, particularly under specific meteorological conditions. If this occurred, the reaction of the nesting eagles would be unpredictable. If the individuals were particularly sensitive to disturbance, blasting noise could cause them to temporarily or permanently abandon the nest site. However, given the distance to the mine site and the low frequency of blasting, no adverse impacts are anticipated.

While the mine site provides habitats which could be used by other threatened or endangered species, these habitats are not locally rare or unique. Therefore, no significant impacts to important threatened or endangered species habitats would occur.

AIR QUALITY IMPACTS

The mining project would involve several potential sources of air pollution including:

- Suspended particulates (dust) generated by mining activities and wind entrainment.
- Lime dust released as the silo at the wastewater treatment plant is filled.
- Exhaust gases from natural gas-fired space heaters located in the mine buildings.
- Exhaust from the diesel-powered vehicles operating on the mine site.
- Fugitive diesel fuel vapors released from the storage tank.

Dust emissions, termed Total Suspended Particulates (TSP), would be the principal pollutant. Sources of TSP would include drilling and blasting in the pit; loading, transporting, and unloading waste rock or overburden; ore crushing; ore transportation and loading into railcars; and wind erosion from the stockpiles. Dust emission would be limited by watering the roads, stockpiles, crusher, and/or conveyor as needed. Dust suppression would be about 90% effective on roadways, 75% effective on the crusher, and 50% effective on the conveyor. Maximum TSP emissions, with controls, would be about 53 tons per year (Table 3-8). This is well below the 250 tons per year which would be required to classify the project as a major air pollution source under state and federal regulations. TSP emissions would be highest during the construction and reclamation phases.

TABLE 3-8

Estimated Air Emissions (Tons per Year).[1]

	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
Reclamation						
Year 1	53	42	7	117	3	13
2	40	42	7	117	3	13

[1] TSP - Total Suspended Particulates
CO - Carbon Monoxide
HC - Hydrocarbons
NO_x - Nitrogen Oxides
SO_x - Sulfur Oxides

Without watering and/or other dust control measures, TSP emission could be excessive, particularly in the areas of STH 27 and the Flambeau River. However, with proper applications of dust-control practices, the project would not add significantly to existing ambient concentrations of TSP and would not cause an exceedance of ambient air quality standards. These standards are designed to protect sensitive individuals and therefore provide adequate protection for the health care facilities north of the mine site. No significant emissions of toxic materials would be expected with the dust.

Dust would also be emitted from the rail cars as the ore was transported from the site. These emissions are expected to be minor, since the crushed ore would tend to be moist and to contain only a limited fraction of fine particles which would rapidly settle to the bottom of the rail car. Due to the low emissions expected from rail shipments, no adverse environmental or health effects are anticipated.

Other pollutants which would be emitted from the project are carbon monoxide, hydrocarbons, nitrogen oxides, aldehydes, and sulfur oxides. These pollutants come primarily from vehicular operations and heating exhausts. These sources would be exempt from regulation. Table 3-7 shows potential emission of these pollutants over the course of the project. Emissions at the indicated levels would not cause violations of air quality standards and would have little or no noticeable effect on the area's air quality.

The lime silo at the wastewater treatment plant would also be a source of dust. The 46 ton silo would be filled four times per week. Emissions from the filling would be controlled by passing the exhaust through a fabric filter baghouse. This filtering would collect about 99.9% of the powdered lime and would result in a release of 0.14 pounds of lime dust per filling. No impacts to air quality would occur at this level of emissions.

Other minor sources of air emissions included fumes from the diesel storage tank, fumes from the laboratory hood vents, and burning of wood wastes during construction activities. None of these sources is expected to significantly affect ambient air quality.

NOISE AND VIBRATION IMPACTS

NOISE

Noise impacts are generally expressed as an increase in decibels over the existing noise levels. There is no completely satisfactory method for predicting the impacts of increased noise levels to individuals or communities. The perceived loudness of a sound varies with the tone or frequency of the sound. Lower frequency sounds do not seem as loud as higher frequency sounds of the same intensity. Varying sound intensities, such as a bulldozer operating, are more easily heard than constant sounds. Different or unusual sounds, such as machinery noise in a rural environment, can be discerned even though the noise source is of lower intensity than the background sounds. As a result, human responses to an increase in noise from the mine cannot be precisely predicted by evaluating changes in decibel levels.

A variety of scaling techniques can be used to approximate the impacts of noise increases to individuals and communities. Table 3-9 presents guidelines developed by the International Organization for Standards to assess community responses to noise increases.

TABLE 3-9

Generalized Community Responses to Noise Increases

Difference, dB*	Category	Description
0	None	No observed reaction
5	Little	Sporadic complaints
10	Medium	Widespread complaints
15	Strong	Threats of community action
20	Very Strong	Vigorous community action

*dB = decibels

The Department of Transportation criteria indicates that an increase of about 6 dBA (decibels, A-scale) is some impact, and an increase of 15 dBA is a significant impact. The Environmental Protection Agency has identified a day-night sound level (L_{dn}) of 65 dBA as its short-term goal and L_{dn} of 55 dBA as its long-term goal. The L_{dn} of 55 dBA is considered necessary for the protection of public health and welfare. Table 3-10 provides U.S. Department of Housing and Urban Development guidelines for acceptable noise levels for various land uses.

The major noise sources from the mine would be equipment operation at the surface stockpiles, equipment operation on the pit, the crusher operation, and rail spur operations. Noise impacts from blasting are addressed under **BLASTING.**

Noise impacts from each of these project components were analyzed separately. To simplify computations, noise levels from each component were not added together, nor were project noise levels added to background noise. As a result, actual noise levels may be a few decibels higher than indicated below. Also, meteorological conditions can have a significant impact on noise propagation, causing short-term increases of 10 to 20 decibels in specific locations. Finally, the noise analysis is presented in terms of increased noise levels. Project noises will be discernible beyond the area where the project causes an actual increase in average noise levels.

Pit and Stockpile Noise

During the construction, operations, and reclamation phase of the project, equipment at the stockpiles and the open pit would be the major sources of noise. Flambeau Mining Co. predicts the following peak noise levels from these facilities:

Stockpiles (At each location)

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

Open Pit

L at source: 100 decibels

at 100 feet: 70 decibels
at 200 feet: 64 decibels
at 300 feet: 60 decibels

L = Sound power level at the source

At these levels, peak noise at STH 27 east of the high sulfur waste rock stockpile would be about 72 dB. East of the low sulfur waste rock pile, peak noise levels at STH 27 would be about 68 dB. Peak noise levels west of the pit on the Flambeau River would be about 64 dB at the river's edge and 56 dB on the river surface. The Flambeau Mining Co.-owned homes immediately north and east of the low sulfur waste rock stockpile would be exposed to noise levels of 66-72 dB. Figure 3-11 shows the approximate boundary of the 65 dB peak noise level resulting from equipment operations on the stockpiles and the pit.

TABLE 3-10

Land Use/Noise Compatibility Matrix

Land Use	Decibel 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.U.	N.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.

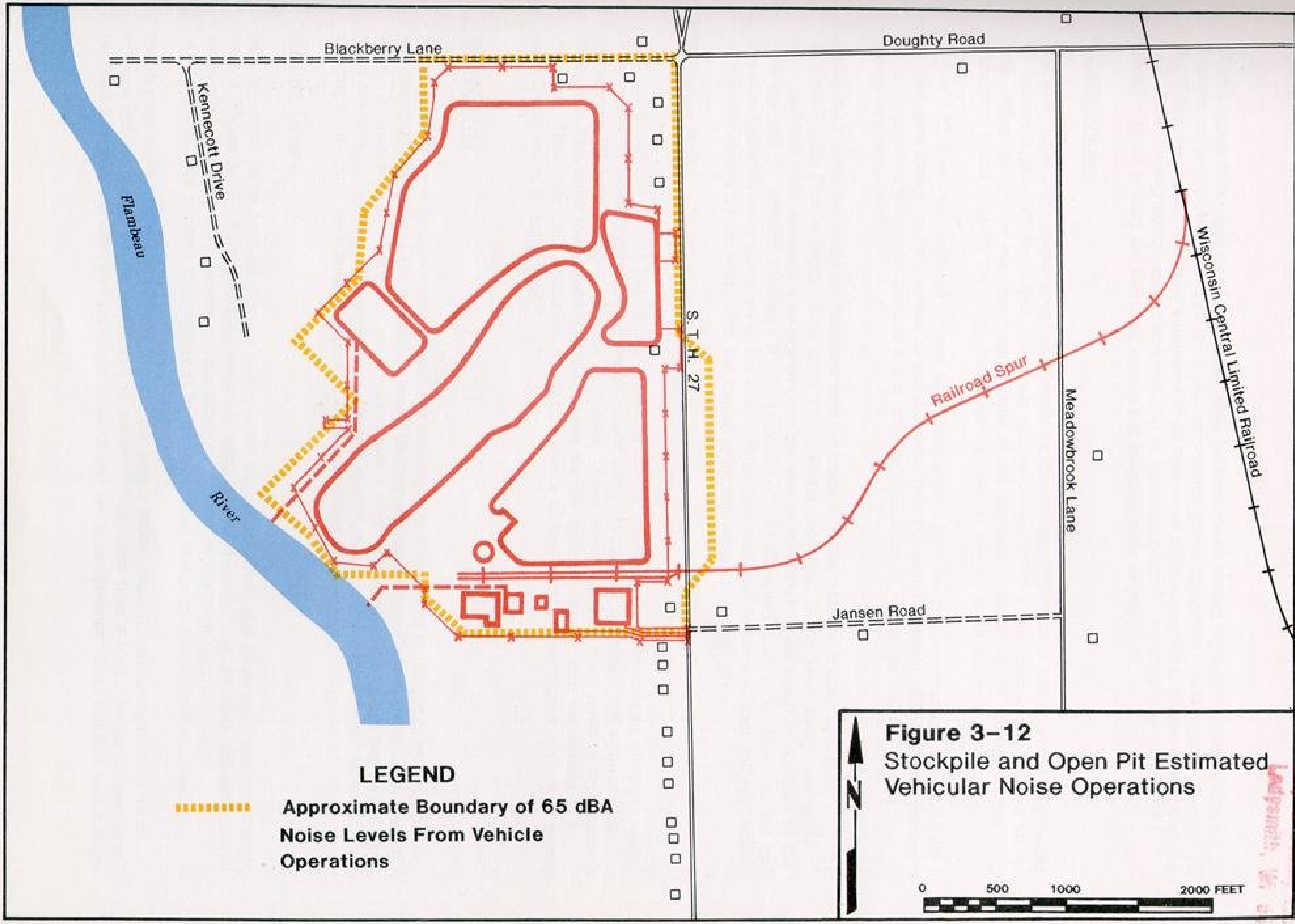


Figure 3–12
Stockpile and Open Pit Estimated Vehicular Noise Operations

Noise impacts from equipment operations would be more severe during nighttime activities. During the 4-month pre-production phase and the 2-year reclamation phase, equipment would operate 24-hours per day, 7-days per week. Vehicular equipment could operate at night during other phases of the project as well. Due to lower background noise levels and an increased potential for disturbing people, EPA assigns a 10 dB penalty for nighttime noise when assessing noise impacts.

Crusher Noise

A second major noise source at the mine would be the crusher. The crusher would be run only during the operation phase of the project, and would operate about 50-70% of the time during daylight hours only. When the crusher was operating, it would be the dominate noise source on the site. Noise generation would resemble that from similar size crushers at the gravel pit north of the mine.

Figure 3-12 shows the projected summer noise level impact from the crusher operation. The 6-15 dB increase area extends slightly further to the northwest than the winter scenario. The different pattern of noise propagation during the summer is due to noise attenuation by vegetation and to different background noise levels.

Figure 3-13 shows the maximum increases in noise levels expected from the crusher operation. Maximum noise level increases would occur during winter conditions due to lower background noise levels and less noise attenuation by vegetation. Increases of more that 15 dB would be confined to the mine site and the adjacent Flambeau River. Increases of 6-15 dB would occur in all directions and up to about 4,800 feet away northwest of the mine. Noise level increases to the northeast and east would be partially limited by the waste rock and topsoil stockpiles when they are in place.

Railspur Noise

Rail operations call for one train of approximately 26 cars traversing the railspur eight times per week. Rail operations would comprise a new noise source along the railspur and would add additional noise to the existing Wisconsin Central mainline operations. Trains would generate noise levels of approximately 80-90 dB. This noise level would only exist during the few minutes that the train was passing by a receptor. Thus while train operations would be a source of loud noise, no significant increase in average noise levels would be anticipated.

BLASTING

Blasting would be utilized to break up both ore and waste rock beginning in the pre-production phase and continuing throughout the operation phase. Blasting would occur on the average of three times per week. In areas exclusively of either waste rock or ore, a single, larger blast each week may suffice. In areas consisting of waste rock interfingered with ore, smaller, more frequent blasts would be used. Blasting would cause both noise impacts and seismic vibration in areas surrounding the mine site.

Blasting Noise

Blasting would create both air pressure waves, or air blasts, and noise. Air blasts and noise are directly related (Figure 3-14). Both normally decrease in intensity with distance from the blast. However, cloud cover, wind, and temperature inversions can affect the amount of this decrease and, in some circumstances, even increase the intensity of the pressure wave at a point distant from the blast.

Blasting the waste rock would probably involve the largest blasts. Near the mine, slight delay times between igniting charges would be effective in minimizing the noise from a blast. As the distance from the blast increases, the effects of delays are reduced, and the sound/pressure waves combine into a single event, thus increasing the noise level. Assuming that 60 holes are fired per blast with five holes per delay and 100 pounds explosive per hole, and that the effect of delays disappears at 1,500 feet, the estimated noise levels are as follows:

Distance from Blast (ft)	Estimated Noise Level (dB)
500	124
1,000	119
1,500	122
2,000	120
5,000	114
10,000	109

The maximum allowable noise level at occupied buildings under state law is 129-133 dB. Under normal conditions, blast-related noise would not exceed these levels. Noise levels could, however, be amplified by atmospheric conditions to the point that regulatory limits are exceeded. The direction and distance from the blast site of any exceedances would be strongly influenced by the wind strength and direction and by the presence of temperature inversions or low cloud cover. Southerly winds in excess of 20 miles per hour could cause blasting noise to approach or exceed regulatory limits in the city of Ladysmith. Winds in other directions could similarly extend the impacts of blasting noise. State regulations require an operator to periodically monitor blasting noise to ensure compliance with the maximum allowable noise levels.

Some impacts would also occur from blasting noise at levels below the regulatory maximums. About 115 dB is considered to be the noise level at which residents may start to complain (Figure 3-14). Under normal conditions, this level of blasting noise would extend to almost 5,000 feet. The hospital, convent, and university campus north of the mine site are approximately 4,200 to 4,300 feet away and could be subjected to complaint-causing noise levels from blasting.

Private residences within a 5,000 foot radius of the mine could also experience complaint-level noise. Noise levels at the closer residences, such as those near the STH 27 junctions with Blackberry Lane and Jansen Road, would be slightly higher (120-122 dB), but would normally still be well below the levels likely to cause property damage. Peak noise levels at these locations are currently about 114 dB. The project would cause regular (3 times per week) instantaneous noise events slightly louder than the current peak noise level.

Blasting noise would also be discernible beyond 5,000 feet from the blast site. Under normal conditions, noise levels at 10,000 feet from the blast site would be about 109 dB. This zone of noise impacts would extend to downtown Ladysmith. The infrequent and relatively low noise level from the blasting would have only a minor effect on the downtown's noise environment.

All of the blasting noise impacts discussed above would be strongly influenced by the prevailing atmospheric conditions. Noise levels could be substantially higher at down-wind locations particularly during temperature inversions and/or low cloud cover. If blasting were conducted under these conditions and/or if the size of the charge were increased, the zone of complaint-causing noise levels would increase. Careful monitoring of noise levels from initial blasting would enable the operator to determine the actual noise propagation patterns and to design subsequent blasting to minimize adverse impacts.

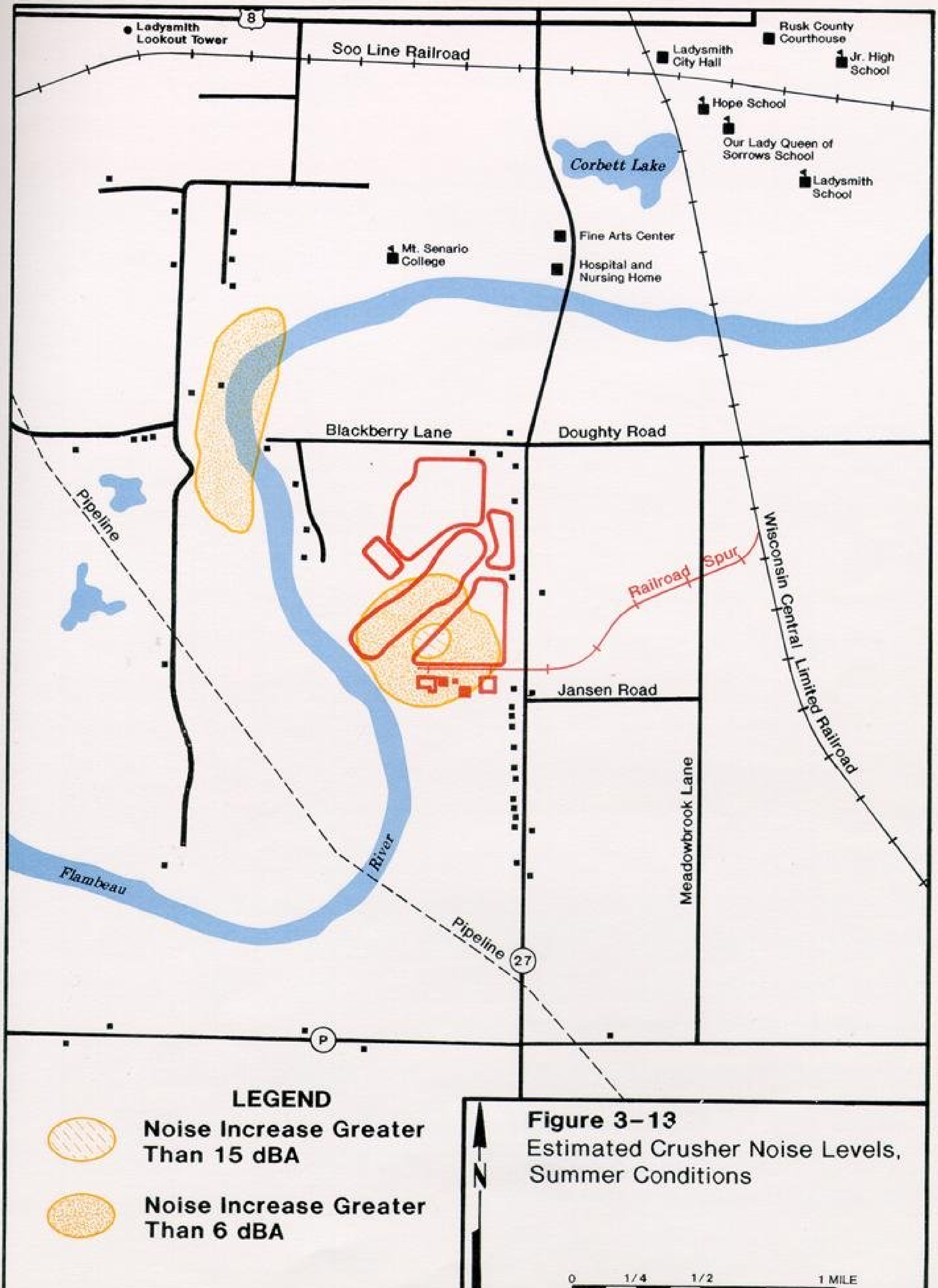


Figure 3–13
Estimated Crusher Noise Levels, Summer Conditions

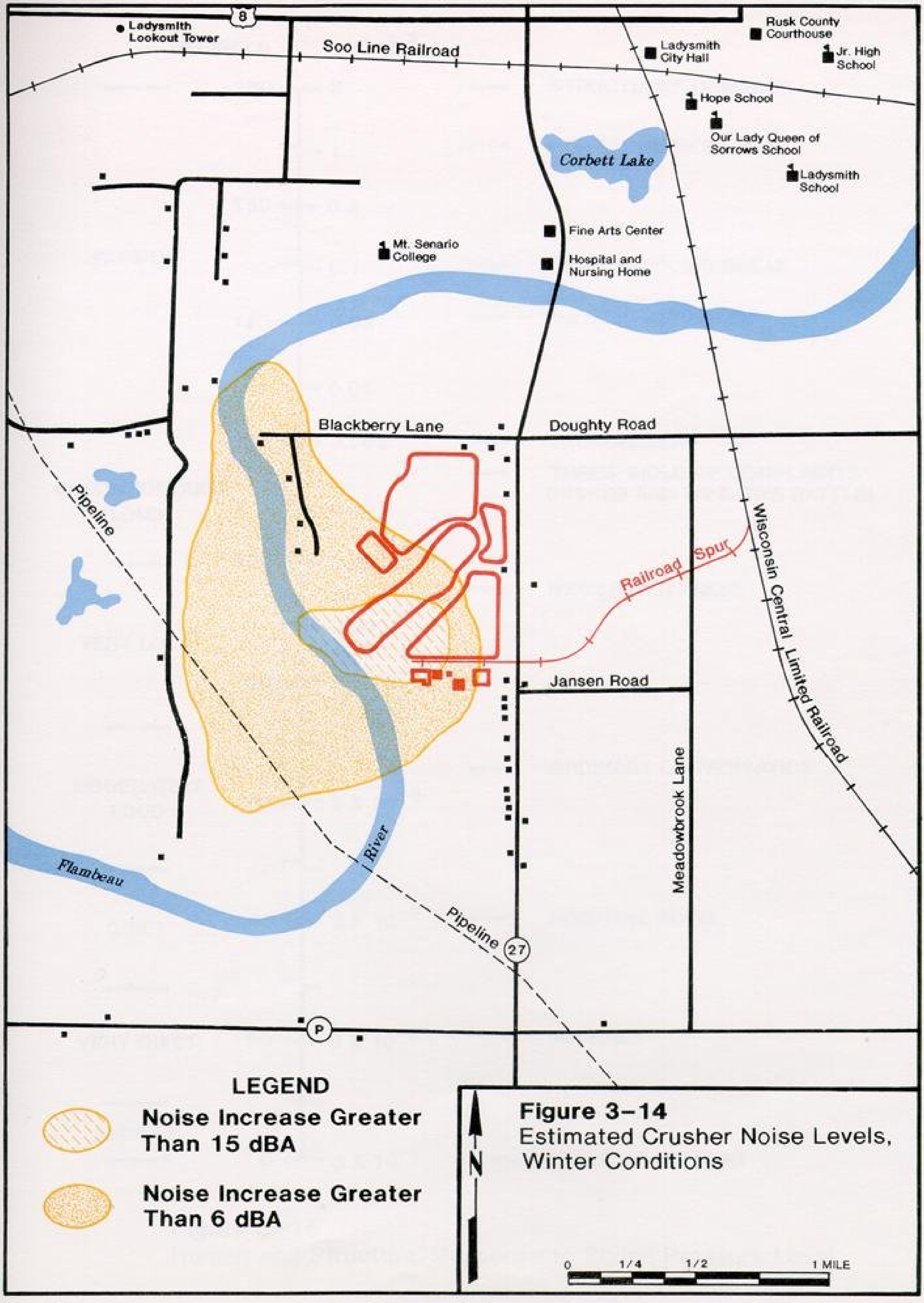


Figure 3–14
Estimated Crusher Noise Levels, Winter Conditions

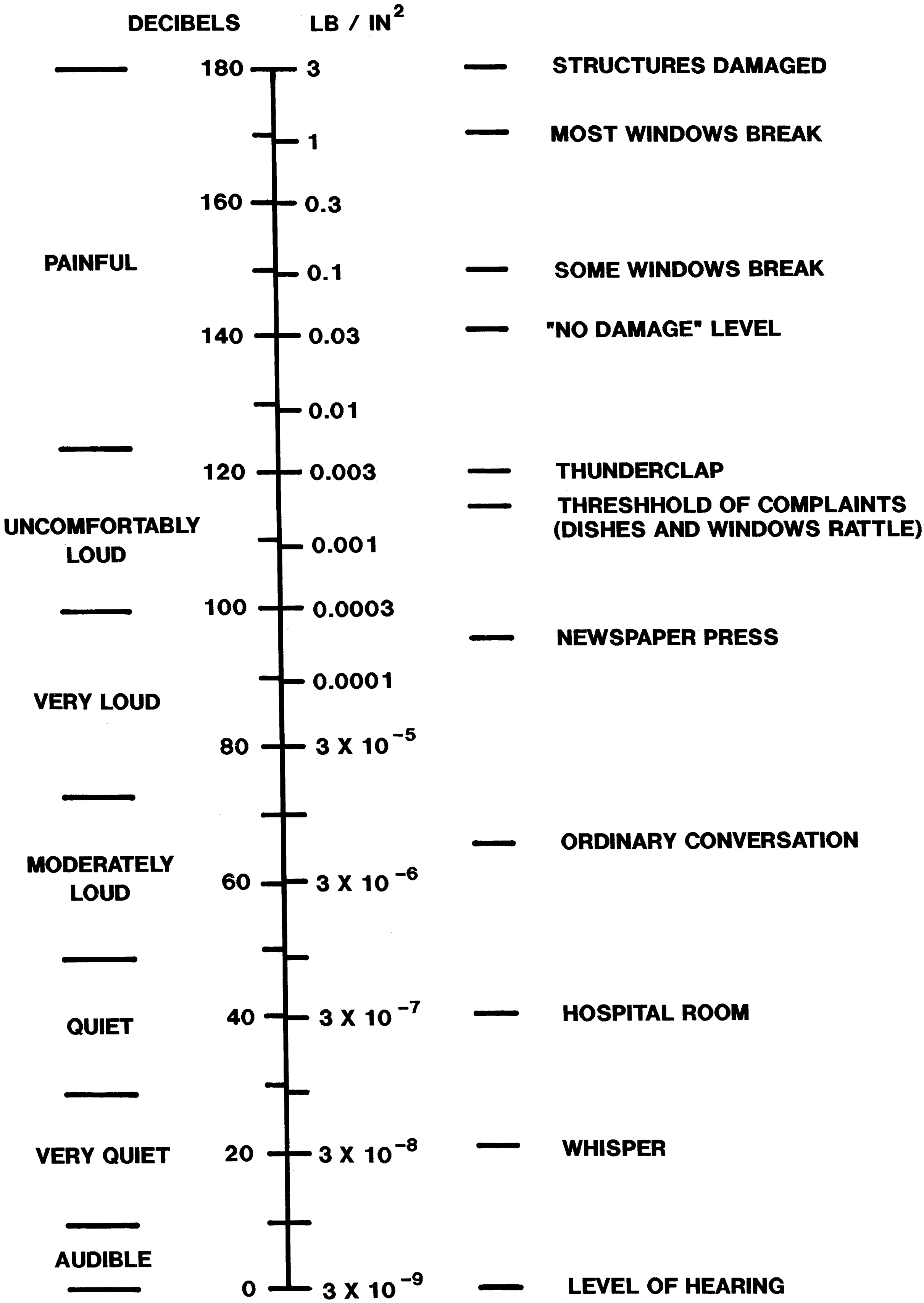


Figure 3–15
Human and Structural Response to Sound Pressure Level

Vibrations

Seismic vibrations would be generated by blasting in the pit. The strength of vibrations generated by blasting would be primarily related to the weight of explosive (charge) per delay rather than the total weight of explosive per blast. Flambeau Mining Co. estimates that a maximum of 500 pounds of explosive per delay would be employed, with up to 6,000 pounds of explosives per firing. Surface effects from blasting would also be affected by the orientation of the blast and the frequency of blast vibrations.

Vibrations of the land surface were evaluated by estimating the peak particle velocity (PPV) which would result from blasting. Assuming 500 pounds of explosive were used per delay, blasting would produce vibrations of about 1.5 inches/second at the Flambeau River west of the pit and about 0.15 inches/second at STH 27 east of the pit. Vibration levels at homes approximately 1,000 feet from the pit such as those at STH 27 and Blackberry Lane would be about 0.08 inches/second while levels at homes 2,500 feet from the pit would be about 0.02 inches/second.

For comparison purposes, vibrations at the 0.01 to 0.1 inches/second range are roughly equivalent to the vibrations one would feel in a house located about one city block from a fast freight railroad. A typical residence will vibrate locally (in one room) under the impact of heavy walking at levels up to 0.2 inches per second. Table 3-11 summarizes U.S. Bureau of Mines data on human responses and possible damage from various levels of vibration.

TABLE 3-11

Human Responses to Seismic Vibrations

Peak Particle Velocity (inches per second)	Human Response	Comments
0.01	Below human detection	-
0.1	Barely detectable	-
0.2	Detectable	People should be advised of blasting
0.4	Definitely detectable	-
0.6	Disturbing	Rigidly mounted mercury switches may trip out
1	Unpleasant	-
2	Very unpleasant	Safe blasting criterion for residential structures
3		Minor cracking of plaster
4	Intolerable	Minor falling of plaster, heavy cracking of plaster

It should be noted that Flambeau Mining Co. has not proposed to limit the explosive charge weight to the 500 pounds per delay which was used for the above estimates. In actuality, the company would conduct test blasting during the early phases of the project to identify the optimal set of blasting variables. The optimal weight of charge per delay may be higher than 500 pounds. State regulations allow peak particle velocities of up to 2.0 inches/second at the nearest structure at blast vibrations 40 Hz or greater. Blasting which would approach this level of vibration would require over 30,000 pounds of explosive per delay. It's unlikely that such a high charge weight would be used. Charge weights substantially more than 500 pounds per delay could increase seismic vibrations to the point that detectable or disturbing levels of vibration could extend several thousand feet from the blast site. The Department of Industry, Labor and Human Relations regulates blasting to avoid injury, damage or unreasonable annoyance to individuals off of the blasting site, and requires seismograph records for each blast.

Effects on Pit Inflows

Blasting could increase fracturing of rock in the immediate vicinity of the pit wall. Normal blasting practice would be to use smaller changes near the pit wall to shape and protect the final pit walls. Blasting impacts to bedrock permeability would be insignificant over most of the pit wall although permeabilities of the river pillar could be somewhat increased by blasting. Grouting during operations could be used to reduce inflows through the river pillar. No increase in long-term groundwater flow through the pit would be expected from blasting.

Effects on Pipelines

Vibrations from blasting are not expected to adversely effect pipelines in the vicinity of the mine. Guidelines for blasting near pipelines allow vibrations up to 4 inches/second. The crude oil pipeline west of the mine is about 2,280 feet away at its closest point. Peak particle velocities at this location would be 0.02-0.03 inches/second. Velocities at the natural gas line serving the mine would be about 0.15 inches/second. In addition, Department of Industry, Labor and Human Relations blasting regulations provide specific requirements for protecting pipelines from damage.

AESTHETIC IMPACTS

The major aesthetic impacts of the project would be the clearing, grubbing, and earth moving of construction activities and the visibility of the stockpiles.

The initial clearing and grubbing of the site would remove trees and other vegetation from much of the project site. This would create a more open view into the site and would temporarily replace vegetative land with exposed earth. Construction of the 100-foot long flood control dike would remove trees along the river's edge and provide a view into the mine site from the Flambeau River. Construction of the 400-foot long slurry wall would also remove vegetation along the river edge and would either lessen or eliminate the vegetative screening of the mine site from the river. Construction activities, in general, would be visible from STH 27 east of the site.

The waste rock and topsoil stockpiles would be the most visible of the project facilities. Since the stockpiles would be increasing and then decreasing in size over the course of the project, the visibility of the piles would vary accordingly. At all heights, the stockpiles would be obvious from points along STH 27 and Blackberry Lane. At peak heights, the project stockpiles would be visible from higher elevations at Mount Scenario College and St. Mary's Complex. Project visibility from STH 27 at the Flambeau River and at the intersection of Blackberry Lane would be impeded by vegetation.

The rail spur and rail operations would be visible from the STH 27 and Meadowbrook Road crossings. The electrical power line would, for the most part, be constructed on existing poles or on new poles replacing the existing ones and would have no long-term aesthetic impact.

Nighttime operations would cause additional aesthetic impacts. Twenty-four hour per day operations are scheduled during the pre-production and reclamation phases, and could occur during the remainder of the project. Nighttime noise tends to be more disturbing, and stray light from the operations would make the mine site much more visible.

Flambeau Mining Co. proposes to mitigate aesthetic impacts by transplanting existing trees from the active mine areas to the 150-foot wide strip between the project facilities and STH 27. A sufficient number of successfully transplanted trees could be effective in screening much of the mine operation from the highway.

Reclamation and revegetation of the site at the end of the project operations would eliminate most of the aesthetic impacts of the project. Over time, the trees planted during the project reclamation would mature, and the site would blend with the surrounding landscape.

In general, the noise, dust, and visual intrusions from the project would adversely affect the aesthetics of the area. In particular, the Flambeau River and STH 27 would be areas sensitive to aesthetic impacts. However, due to the potential for vegetative screening and the short-term nature of the project, the overall aesthetic impacts would be minor.

HISTORICAL AND ARCHAEOLOGICAL IMPACTS

No sites of important historical or archaeological features are known to exist on the project area. Therefore, no impacts to known archaeological or historical resources would occur. The presence of a qualified archaeologist during construction activities would be necessary to ensure that any unknown sites exposed by project activities would not be inadvertently damaged.

RECLAMATION IMPACTS

Reclamation is defined as the process by which a mining site is returned to its original state or to a state which provides long-term environmental stability. It involves designing, contouring and shaping the land surface, replacing surface water drainage patterns, mitigating wetland losses, and revegetating to stabilize the site and support the designated post-mining land uses.

LAND USE AND REVEGETATION

Flambeau Mining Company's reclamation plan proposes to establish a mixture of grassland, savannah copses, and wetlands over the site (Figure 1-11). The proposed final land use is passive recreation and wildlife habitat.

In concept, the proposed revegetation would be well-suited to support the proposed final uses. The proposed grasslands and open-water wetland are habitat types which would increase wildlife habitat diversity in the vicinity. The scattered savannah copses of trees and shrubs would provide additional plant community diversity and wildlife habitat. The interspersion of grassland and copses would facilitate hiking and nature study, and would create an aesthetically pleasing landscape. The plant species proposed (Appendix A) are indigenous to the general area and would blend with the surrounding plant communities.

Successful revegetation would depend on proper soil handling, fertilization, and planting and maintenance procedures. Vegetative measurements such as percent cover, biomass, species diversity and survivorship would be employed to determine the success of revegetation. Reclamation would not be considered complete until specific vegetative standards were achieved.

Vegetation of the restored wetlands would depend largely on water levels. Excessive water depth in the wetland as a result of differential settling of the backfill could preclude establishing wetland vegetation in much of the area. Elevated water levels could kill woody species planted at the wetland periphery. It is also possible that undesirable plant species such as purple loosestrife could invade and dominate the site. Vegetative performance standards, if achieved after the site was settled, would assure the wetland is adequately revegetated.

With achievement of the vegetative standards discussed above, revegetation of the site as proposed would provide improved wildlife habitat and recreational opportunities.

GRADING AND SURFACE WATER DRAINAGE

Final grading of the mine site would restore most of the site to approximate original contours. Land over the pit would be shaped 6 feet above the original elevation and allowed to settle. As previously described, the western 800 feet of the pit would be graded to create a wetland. No additional grading would be done after the site is initially reclaimed. Therefore, any uneven settling of the backfilled materials in the pit would cause the land over the pit surface to be rough, possibly precluding some future land uses of the area. Similarly, the wetland area may settle unevenly, resulting in varying elevations throughout the area.

Final contouring would also recreate intermittent stream B in its approximate original location. Surface water runoff from the stream B watershed would drain into the created wetland on the west end of the pit. The wetland would discharge through a weir in the flood control dike at approximately the original location of Stream B's outlet to the Flambeau River.

The abandoned gravel pit north of the mine is no longer part of the mining plan and would not be utilized or regraded and contoured.

RECLAMATION WASTE DISPOSAL

Waste materials produced during the removal of mining facilities and the demolition of structures would be disposed of in the open pit or in a one-time disposal facility located within the settling ponds. Materials which had contacted high sulfur wastes would be disposed with the waste rock. These materials would include the HDPE liner and drainage blanket materials from the high sulfur stock pile and crushing facilities. The base from the ore haul road would also be placed in the pit. Other materials, including concrete, bituminous surface, riprap, culverts, septic tanks and building demolition waste would be placed in the disposal facility. Since these materials normally do not release significant quantities of contaminants, no adverse impacts to groundwater from the disposal facility are anticipated. Use of the disposal facility rather than the pit for demolition wastes would facilitate monitoring of the backfilled pit and promote more even setting of the land surface.

MONITORING IMPACTS

The proposed monitoring plan should detect any significant releases of pollutants to most environmental components. The groundwater monitoring network in combination with the in-pit monitoring wells, would provide the information necessary to determine the quality and effect of leachate leaving the backfilled pit. The lysimeter under the low sulfur stockpile would indicate unexpected leaching of contaminants. The surface water monitoring program would detect changes in water quality and bioaccumulation of metals in aquatic organisms. Water level monitoring in wetlands would indicate drawdown-related impacts. Vegetative monitoring after reclamation would be used to determine if reclamation was successful.

No monitoring of air quality is proposed. As a result, excessive emissions of dust from the site may not be detected.

SOCIOECONOMIC IMPACTS

The following socioeconomic impact section includes analyses of the study area population, its economic base, tax structure, employment, some public services and housing. These impacts would occur if the mine were developed as proposed. The analyses assume approximately a one year project construction period, six years of operations and two years for closure and reclamation. It is also assumed that Flambeau Mining Co. would begin the project with little or no delay if permits were granted and that the mine would be operated continuously without major interruption. Fiscal and economic impacts stated in dollar amounts all are in 1989 dollars unless otherwise stated.

The analyses do not focus on ethnic impacts, housing development, sociocultural changes or public service impacts such as municipal sewer and water. These socioeconomic impacts are believed to be minor or negligible due to the relatively short project duration, the existing conditions in the study area, the relatively low level of hiring and the small population impacts expected.

EMPLOYMENT AND EMPLOYMENT SOURCES

Construction

The three phases of the proposed mine, construction, operations and reclamation, would involve somewhat different types of activities, and involve varying numbers of employees by Flambeau Mining Co. and its contractors as indicated in the Project Description Chapter. During facility construction, there would be separate contractors, subcontractors and their employees coming to the project site for construction. For example, these include contractors for clearing and grubbing, earthwork and excavation, liner and underground piping construction, buildings and plant construction and other activities. Typically contractors bring equipment and most of the needed employees with them to a new job. However, local contractors would involve local workers. Therefore, the proportion of local hiring depends on how many local contractors are selected. Because there is only a moderate number of local contractors in Rusk County and the 10 mile area adjacent to the county borders, and because some expertise needed for facility development is not available locally, the Department estimates that 30-40% of the contractor labor force during construction would be from within the study area. Larger contractors from Minneapolis/St. Paul, Eau Claire, Chippewa Falls, Wausau or Stevens Point could provide competitive bids for the project and provide construction workers from outside the local area.

Construction of the facility would result in hiring about 70 employees for the first three months. Approximately 65 of these would be contractors and their employees, while 5 would be Flambeau Mining Co. employees. During this period, therefore, 60-70% of the contractor employees (39-46) and 3-4 Flambeau Mining Co. employees are expected to be from outside the local study area.

During the final five months of construction, the preproduction stage, hiring by contractors would increase to a maximum of 100 employees, and Flambeau Mining Co. hiring would increase to a maximum of 60 employees. Assuming that 60-70% of the contractor employees and 20% of the mine employees would be from outside the study during this period, a maximum of 80-90 employees would be from outside the local study area for a short period during construction. Flambeau Mining Co. is not required to hire 75% locally during the construction period according to the provisions of the local agreement.

In summary, during the proposed eight month construction period, a maximum of 50 employees are expected to come from outside the local study area during the first three months. During the final five months the number of employees from outside the local study area is expected to increase to a maximum of 90.

Operations

During the operations phase, Flambeau Mining Co. proposes to employ an average of 53 employees. According to the local hiring requirement in the local agreement, Flambeau Mining Co. would hire 75% or 40 employees from the local study area by the time ore shipments begin. In order for a worker to qualify as a study area resident, he or she must have lived in the study area for at least one year prior to being hired.

Reclamation

Employment is expected to increase slightly during the two year reclamation and closure phase following mining. An average of 61 employees would be hired, and an estimated 10-20% of these would be from outside the local study area. At the end of the reclamation and closure period all permanent employment would end. Table 3-12 shows the estimated number of workers who would be hired from outside the local study area during the mining phases.

Secondary Employment

Flambeau Mining Co. and contractor hiring during the eight years of operation and reclamation/closure would have an additional, secondary impact on employment due to increased demands for good and services in the local area. An employment multiplier of 1.5 - 1.7 for Rusk County would mean that for every ten jobs created in basic activities, an additional 5 - 7 employment opportunities would be created in nonbasic or support activities. Based on this multiplier, hiring an average of 53 employees from the local study area during operation should result in an increase of an additional 26 - 37 employment opportunities in the study area. There also would be an increase in secondary employment impacts during the reclamation/closure period, although less pronounced due to the cessation of many mining-related activities.

POPULATION IMPACTS

Population impacts to the study area would result from employees or potential employees moving to the area from outside its boundaries. However, during the construction period, most contractor employees from outside the study area would be expected to commute to the area on a daily or weekly basis. Contractor employees from within the study area would probably commute daily. Therefore, the temporary presence of construction employees in this study area should not affect the area's permanent population.

During the construction period, a few mine employees would move to the area after starting employment. While a maximum of 20 mine employees are expected from outside the local study area, only about 13 are estimated to move into the area. If family size averages three people, the increased population would be about 39 people during the end of construction and through operations. The mine employees who move to the area during construction are expected to stay through operations and some through reclamation/closure as well.

An increase of about 39 people to Rusk County would increase the population by 0.3%, an insignificant amount. If ten of the workers and their families, 30 people, moved to Ladysmith, the city population would increase by 0.8%. It is assumed that one-half or more of the immigrant families would leave the area after operations were completed and the remaining families would leave after reclamation/closure. The impacts of such population changes should be negligible to the local area.

TABLE 3-12

Contractor and Mine Hiring and Estimated Number of Hires from Outside Local Study Area

Construction Period	Mine Hiring	Estimated No. from Outside Study Area	Contractor Hiring	Estimated No. from Outside Study Area
Construction Phase (3 months)	5	3-4	65	39-46[1]
Preproduction Phase (5 months)	60 max.	20[2]	100	60-70[1]
Operations Period (6 years)	53 ave.	13[3] ave.	0	0
Reclamation/Closure (2 years)	61 ave.	6-12[4]	0	0

[1] 60-70% estimated hired from outside local study area
[2] 33% estimated hired from outside local study area
[3] 25% as specified in local agreement
[4] 10-20% estimated hired from outside local study area

SCHOOL ENROLLMENT IMPACTS

The largest potential impacts to local school enrollment would result from families moving to the study area during the operations period, when it is expected that about 13 families would move into the area. If each family averages 1 - 1.5 children, there would be a maximum of 20 additional children in the area. If all the children were assumed to be of school age, and all attended the Ladysmith School District, the existing school district attendance of 1,250 would increase by 1.6 percent. Because significant reserve capacity in the school system exists, this maximum impact scenario should result in only minimal impacts to the school district. Children of mine employees would probably leave the school system when mine employment ended.

There is a mechanism for a school board to recover, from the state, costs due to increased enrollment resulting from a metalliferous mine. Section 70.395(2), Wisconsin Statutes, allows school boards to apply to the Mining Investment and Local Impact Fund Board to recover such nonshared costs. Therefore, any minor impacts on the school district from the project should be eligible for offsetting payments from the Board.

EMERGENCY, POLICE, AND FIRE SERVICE IMPACTS

Development of the proposed mine would result in a very small increase in population in the area. As a result of the small population increase, no new housing or roads and little anticipated further direct or indirect development is anticipated. Traffic levels also should not be significantly increased during the project. Therefore, the expected impact of the proposed project on emergency ambulance service and police and fire protection should be minimal.

SOLID WASTE IMPACTS

The proposed project would be a minor source of additional solid waste in Rusk County. Total solid waste production at the mine site (about 135 tons/year) and indirect production from the increased population and economic activity (about 50 tons/year) would result in a minor increase in the solid waste generated in Rusk County. The probable destination for this solid waste is the Lake Area Landfill in Sarona (Washburn County). This landfill has sufficient capacity to absorb this additional waste stream with only a very minor impact on site life.

The waste oils, metals and tires would most probably be shipped out of county to a waste recycler. See the risk assessment section on transport accidents and spills for additional discussion.

TRANSPORTATION IMPACTS

Transportation impacts in the local study area would result from five main activities: 1) contractor and mine employees driving to and from the project area during construction, operations and reclamation/closure periods; 2) truck traffic delivering and removing equipment, supplies, railroad ballast, crushed rock, and other construction materials; 3) visitor traffic to observe the mining operations; 4) rail traffic for transporting the crushed ore from the mine and 5) temporary delays in traffic during blasting. Each of these traffic sources is discussed below.

Maximum employment at the proposed mine would occur in the final phase of construction during the preproduction period, when 160 employees would be driving to the mine site. This would increase traffic on STH 27 north of the site by about 255 vehicles per day (vpd) and 115 vehicles per hour (vph) in the afternoon peak hour. The latter would increase peak hour traffic to about 345 vph. The capacity of STH 27 is 790 vph for Level of Service B. Thus, the highway is expected to continue to operate at Level of Service B with no significant impact.

Design and construction of the main entrance and the secondary entrance for sightseers would be according to state design standards. The traffic at the principal entrance would be 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 would be adequate traffic control. Sight distance is a minimum of 1,800 feet at the principal entrance and 1,000 feet at the secondary entrance. The gradient is nearly level, so no adverse safety impact is expected. Some traffic disruption would occur during construction of the mine entrance.

During the operational phase, the employment forecast is for a maximum level of 57 persons. This would increase traffic on STH 27 north of the site by 85 vpd and 41 vph in the afternoon peak hour. The latter would increase peak hour traffic to 307 vph. The highway would be considered to have Level of Service A during the operational period. Operation of the site entrances should continue to be safe with the expected traffic volumes.

Traffic on STH 27 may be stopped occasionally during blast events for safety purposes. These stoppages may occur infrequently during the preproduction and early operation phases.

During reclamation, a maximum employment level of 63 persons is forecasted. This would increase traffic on STH 27 north of the site by 106 vpd and 48 vph in the afternoon peak hour. The latter would increase peak hour traffic to 314 vph. No safety or capacity problems should arise from this additional traffic.

During the various phases of the mine, there should be no significant transportation impacts to Blackberry Lane, Doughty Road, Gokey Road, Jansen Road, Meadowbrook Lane, or Tiews Road.

The proposed railroad spur would disrupt traffic on STH 27 and Meadowbrook Road for a few days when the surface crossing would be constructed. The STH 27 crossing would 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 would be interrupted an average of twice every other day. At 15 mph, the train would take about 60 seconds to clear the intersection, so no significant impact should result.

Trains hauling ore from the proposed mine most likely would proceed northward into the City of Ladysmith. Depending on the final destination of the one, the trains would travel either eastward or northwest from the city. If they traveled northwest, the trains would cross STH 27 again north of Ladysmith and interrupt traffic flow.

Main line operations on the Wisconsin Central would be influenced by the extra trains but could easily handle the extra capacity. No railroad operations would be required during the reclamation phase.

A large amount of crushed rock, ballast, and other construction materials would be brought to the site by trucks. Approximately 116,000 cubic yards of materials would be hauled to the site over a four month period. Assuming a 10 cubic yard average load truck, 10 hour days and 6 day/weeks; this yields 110 truck loads/day or 11 trucks/hour. In addition, trucks delivering other building supplies and equipment may contribute an additional 8-84 trucks/day. This results in potential project truck traffic of about 120 to 195 trucks/day. This could roughly double existing truck traffic on STH 27. The short term nature of the increased traffic is not anticipated to be significant.

The source or sources of most of the crushed rock needed during construction is unknown. Conversations with Flambeau Mining Co. staff and their consultants indicate a substantial amount of the gravel and crushed rock may come from open pit strippings or the active pit north of Blackberry Lane. If this is correct, the amount of truck traffic could be reduced by more than 50%. In either case, significant damage to STH 27 from hauling crushed rock would not be expected.

There could be additional traffic in the mine area during reclamation from salvage operations and if additional fill needs to be hauled to the mine site and if local roads were used. However, it is not known if additional fill would be needed or its source. The local agreement mentions this possibility and indicates the company would be responsible for any road damage.

After mine reclamation, employees would no longer be commuting to the mine site and visitors would not drive to see the mine. Therefore, traffic would return to pre-project levels after project completion.

Overall, the impact of project car and truck traffic should not be significant according to conversations with the Wisconsin Department of Transportation staff. The period of greatest concern is the construction and preproduction overlap period when peak hour traffic may increase by about 30-40%. Even at these higher rates, the anticipated traffic levels are well below those which should cause serious traffic congestion for this class of highway. Driver error or inclement weather, particularly at peak traffic hours, do offer increased potential for accidents. Proposed improvements to STH 27 for 1990, including a stoplight at USH 8 and 4 lanes from USH 8 to the Wisconsin Central Line rail crossings, should accommodate peak hour traffic.

HOUSING IMPACTS

As the number of construction employees increases to its expected maximum, project-related temporary and permanent housing impacts would increase also. During peak construction hiring, a maximum of 90 is expected to be hired from outside the local study area. Because most of these employees would be working temporarily in the area, they would be expected to commute, either on a daily or weekly basis rather than move into the local study area.

Some of these construction employees would commute daily and require no local, temporary housing. Assuming 70% (a worst-case estimate) of the workers commuted on a weekly basis, there would be 63 employees staying in the area during the week. These 63 employees would require temporary housing in the local study area. Temporary housing is available in the area's local hotels, motels, cabins, or rental homes, rooms, or apartments. Available hotels, motels, and cabins in the Ladysmith, Bruce, and Holcombe area near the mine site provide at least 277 beds. However, probably not all of these rooms would be in an acceptable price range.

In addition, the timing of the construction worker influx is important, for if it would overlap with the summer recreation season or hunting seasons, there would be greater competition for available temporary lodging. The expected peak of construction workers is mid-October 1990 through March 1991, which would avoid most of the recreation and tourism season, but includes the hunting season. If this were the actual peak construction period, the local motels, hotels, cabins, and other temporary lodging should be able to accommodate the increased demand.

In contrast, if the peak construction occurred during the summer recreation and tourist season, there would be much greater competition for temporary housing. The local accommodations would probably be unable to handle the demand, and the workers would have to travel further to Cornell, Rice Lake, or other outlying areas, occupy vacant housing, or use recreational vehicles, or temporarily, mobile homes.

The possible summer accommodation shortage could be reduced if buildings owned by Flambeau Mining Co. were available. However, none of the houses owned by Flambeau Mining Co. are expected to be available for use by employees during mining.

While there would be competition for housing during the final portion of construction, competition for seasonal housing should not result in significant amounts of new home construction or establishment of mobile home parks. The peak construction period is relatively short, and the low number of weekly commuters would not support additional new housing.

During construction and into operations, an estimated 13 mine employees and their families are expected to move to the local study area. Most of them should move to the Ladysmith area relatively close to the proposed mine. Immigration of 13 families should have a minimal impact to the existing housing stock in the area. There would be an ample number of homes for rent or for sale in the area.

It is expected that some of the mine employees who moved to the area would continue to live in the area and be employed at the mine through the reclamation phase. Therefore, housing impacts should be minimal following the end of ore shipment, when reclamation begins. When reclamation is complete, the remaining immigrant mine employees probably would move from the local study area. Their leaving should have a negligible impact on housing because of the small number of houses which would be involved.

FISCAL (PUBLIC FINANCE) IMPACTS

Net Proceeds Tax

The net proceeds tax is a graduated state tax on mine profits. A tax is due on mine profits, which are determined by subtracting certain mining costs from gross mining proceeds.

The State of Wisconsin would receive revenue derived from net proceeds tax payments to the state. The estimates of net proceeds tax revenues developed by the Wisconsin Department of Revenue are based on the following assumptions. First, the mine is assumed to operate continuously with no slowdowns or interruptions. Second, the mine is assumed to extract, on the average, 307,000 tons of ore annually for six years (1.84 million tons total) beginning in 1992 and ending 1997. Third, published reports on ore grade of 10.5% copper, 0.01 troy ounces of gold per ton and 2.10 troy ounces of silver per ton are assumed to be actual. Fourth, maximum ore transportation costs ($45 per ton, 1989 dollars) were estimated based on comparable freight charges assuming all the ore would be transported to Utah for processing at Kennecott's milling and refining facilities. Minimum transportation costs ($20 per ton, 1989 dollars) were estimated based on half of the ore being shipped to White Pine, Michigan and half to Noranda in Quebec. Fifth, copper prices were varied ±20% and ±40% from copper's average 1988 price of $1.15 per pound. Similarly, the prices of gold and silver were varied in the model runs based on 1988 year-end prices of $410 per troy ounce and $6.00 per troy ounce for the middle-price scenario. Sixth, it was assumed that previous costs for developing a mining proposal and permitting activities in the 1970's were not deductible for Wisconsin net proceeds tax purposes. Seventh, estimated expenditures were inflated by 4.5% to just over 5% per year to account for inflation.

The costs of mining such as labor during construction, operation and reclamation, supplies and permitting costs were based on Flambeau Mining Co.'s estimates in the environmental impact report and mining permit application and from other published sources. Mining costs were inflated over the duration of the project.

Estimates of overhead, milling and smelting costs were not provided by Flambeau Mining Co. Therefore, estimated costs used in the model were based on industry standards. No royalty payments were anticipated in the model assumptions.

The model results must be reviewed with caution. The model is a tool which is useful to predict future net proceed tax payments based on specific input data. However, the input data are only estimates based on the best available understanding of a range of possible scenarios. It is also obvious that metal prices will vary from day to day as could project costs and milling/refining sites. Therefore, the following analysis should be viewed as illustrative of a possible range of future scenarios, and the actual net proceeds taxes paid by Flambeau Mining Co. could vary considerably from the following model predictions.

Potential Revenue

Potential revenue for each mineral equals the amount of ore to be mined over the life of the mine (1,842,000 tons) multiplied by the ore grade multiplied by the metal price, and adjusted by a factor reflecting metal content not recoverable in processing. Information submitted by Flambeau Mining Co. did not indicate how much metal content is expected to be lost in milling/smelting; information on Exxon's Crandon project indicated that about 10% of the copper and 50% of the gold and silver is not recoverable, and these figures were used in the model.

Potential revenues are shown on Tables 3-13 and 3-14. Adjusting for unrecoverable metal, the total potential revenue for the life of the mine ranges from $269 million in the low metal-price scenario to $627.6 million in the high metal-price scenario.

Total Expenditures

Smelting fees are affected by metals prices; the other expenditures are affected by inflation but not metals prices. Because of the high proportion of non-price sensitive costs, total estimated expenditures do not show as wide a range as estimated revenues.

Under the high transportation cost case, total expenditures for the life of the mine range from $251.6 million in the low metal-price scenario to $335.3 million in the high metal-price scenario. Under the low transportation cost case, total expenditures range from $188.8 million in the low metal-price scenario to $272.5 million in the high metal-price scenario.

Federal and State Taxes

Taxes are projected to vary with metals prices. Federal income taxes are calculated at the statutory rate of 34% of taxable income (which, due to special tax provisions, is not equal to net cash flow before taxes). State income taxes are calculated at the statutory rate of 7.9% of taxable income (which is also affected by special tax provisions). The net proceeds tax is calculated by applying the net proceeds brackets (as adjusted for inflation) to "net proceeds" in each year.

Under the high transportation cost case, federal income taxes range from $0.4 million in the low metal-price scenario to $66.9 million in the high metal-price scenario. State income taxes range from $1.9 million in the low-price scenario to $22.3 million in the high-price scenario.

Under the low transportation cost case, federal income taxes range from $16.2 million in the low-price scenario to $81.4 million in the high-price scenario. State income taxes range from $6.7 million to $26.7 million.

Tables 3-15 and 3-16 show estimated net proceeds tax payments to the state based on high and low ore transportation costs, respectively. Transportation costs are an important variable in determining net proceeds tax because the ore would be shipped before concentrating, thus transportation costs are high. Assuming the low transportation cost scenario were available and chosen by Flambeau Mining Co., net proceeds tax collections could vary from $1.6-24.4 million over the life of the project depending on metals prices. Considering the middle metals price scenario, which is slightly higher than current metals prices, approximately $11.3 million would be collected in net proceeds tax. Under the high transportation cost scenario, net proceeds taxes would range from $0.6 and $18.2 million, and would total $6.6 million under the middle metals-price case. Dollar amounts are in then current amounts, which means they have been adjusted for inflation.

In order to determine whether the estimated net proceeds tax payments would be sufficient to pay the first dollar payments and additional payments to Rusk County, the following analysis shown on Table 3-17 was conducted. The first column shows the amount needed to make the annual $100,000 first dollar (indexed) payments to the three municipalities over the expected mine life. The amount varies from $0.445 million to $0.568 million due to indexing for inflation. The second column shows the additional annual $250,000 (indexed) payment which Rusk County could receive if sufficient net proceeds taxes were available. Column three indicates the sum of columns 1 and 2. Column 4 indicates the amount which would be transferred to the investment and local impact fund, according to statute, for distribution to municipalities. In calculating the amounts available to transfer, the low transportation cost and middle metals price scenarios were assumed in the column headed by "Low Cost." High transportation cost and middle metals price scenarios were assumed in the column headed by "High Cost." The amounts in both columns are equal to 60% of the net proceeds tax collected or the total first dollar amounts, whichever is greater.

Comparison of column 4 with column 1 indicates that under this scenario there would be more than sufficient funds in the investment and local impact fund to pay municipalities the first dollar payments. However, in comparing columns 4 and 3, there would be sufficient funds to pay both the first dollar and additional county payments in the first five years of mining. In the final year of mining, Rusk County might not receive the full $250,000 (indexed) payments because of insufficient available money in the investment and local impact fund. This assumes that no revenues from other sources would be available to the investment and local impact fund. As discussed previously, should there be insufficient money in the investment and local impact fund, Flambeau Mining Co. would guarantee first dollar payments to municipalities for five years and the additional payments to Rusk County for six years.

Based on the same middle metals price scenario and low transportation costs, by the end of the six year operations period, the Mining Investment and Local Impacts Fund would have accumulated about $1 million more in transfers than disbursements. Therefore, the fund would have about $1 million for discretionary use.

Under the high transportation cost and middle metals price scenarios (Table 3-17) significantly smaller net proceeds taxes would be paid by the company because of smaller profits. As a result, the amounts transferred to the Mining Investment and Local Impact Fund would total only about $3.838 million compared to the $6.605 million under the low transportation cost scenario. If this scenario occurred, the Mining Investment and Local Impact fund would not have discretionary funds.

Under the high transportation cost and middle metals price scenario, about $0.8 million would be deposited in the Badger Fund. Under the low transportation cost and same metals price scenario, about $4.4 million would be deposited in the Badger Fund.

TABLE 3-13

Results of the Mining Tax Model for the High Transport Cost Case

Item	High	Medium High	Middle	Medium Low	Low
	------------------ Metals Price Scenarios ------------------				
Ore Mined (thousands of tons):					
Each year of mining	307	307	307	307	307
Total ore mined	1842	1842	1842	1842	1842
Ore Grade:					
Copper	10.5%	10.5%	10.5%	10.5%	10.5%
Gold (troy oz/ton)	0.10	0.10	0.10	0.10	0.10
Silver (troy oz/ton)	2.10	2.10	2.10	2.10	2.10
Metals Prices:					
Copper/lb.	$1.604	$1.375	$1.146	$0.917	$0.688
Gold/troy oz.	$ 574	$ 492	$ 410	$ 328	$ 246
Silver/troy oz.	$ 8.40	$ 7.20	$ 6.00	$ 4.80	$ 3.60
Potential Revenue ($ millions):					
Copper	$620.6	$532.0	$443.3	$354.6	$266.0
Gold	105.7	90.6	75.5	60.4	45.3
Silver	32.5	27.9	23.2	18.6	13.9
Unrecoverable metal	(131.2)	(112.4)	(93.7)	(75.0)	(56.2)
Total Potential Revenue	$627.6	$538.1	$448.3	$358.6	$269.0
Estimated expenditures ($ millions):					
Mining of ore	$ 20.1	$ 20.1	$ 20.1	$ 20.1	$ 20.1
Overhead costs	4.5	4.5	4.5	4.5	4.5
Ore transportation	113.1	113.1	113.1	113.1	113.1
Milling of ore	19.8	19.8	19.8	19.8	19.8
Smelting fees	146.5	125.6	104.7	83.7	62.8
Royalties	0	0	0	0	0
Site reclamation	9.5	9.5	9.5	9.5	9.5
Depletion/Depreciation	21.8	21.8	21.8	21.8	21.8
Total expenditures	$335.3	$314.4	$293.5	$272.5	$251.6
Net cash flow ($ millions):					
Before taxes	$292.3	$223.7	$154.8	$86.1	$17.4
Federal income tax	66.9	50.9	34.5	17.7	0.4
State income tax	22.3	17.3	12.3	7.2	1.9
Net proceeds tax(*)	18.2	11.9	6.6	2.8	0.6
After taxes	$185.0	$143.6	$101.5	$58.5	$14.6

(*) Includes construction period payment; where applicable, the net proceeds tax of subsequent years was credited by the construction period payment.

TABLE 3-14

Results of the Mining Tax Model for the Low Transport Cost Case

Item	------------------ Metals Price Scenarios ------------------				
	High	Medium High	Middle	Medium Low	Low
Ore Mined (thousands of tons):					
Each year of mining	307	307	307	307	307
Total ore mined	1842	1842	1842	1842	1842
Ore Grade:					
Copper	10.5%	10.5%	10.5%	10.5%	10.5%
Gold (troy oz/ton)	0.10	0.10	0.10	0.10	0.10
Silver (troy oz/ton)	2.10	2.10	2.10	2.10	2.10
Metals Prices:					
Copper/lb.	$1.604	$1.375	$1.146	$0.917	$0.688
Gold/troy oz.	$ 574	$ 492	$ 410	$ 328	$ 246
Silver/troy oz.	$ 8.40	$ 7.20	$ 6.00	$ 4.80	$ 3.60
Potential Revenue ($ millions):					
Copper	$620.6	$532.0	$443.3	$354.6	$266.0
Gold	105.7	90.6	75.5	60.4	45.3
Silver	32.5	27.9	23.3	18.6	13.9
Unrecoverable metal	(131.2)	(112.4)	(93.7)	(75.0)	(56.2)
Total Potential Revenue	$627.6	$538.1	$448.3	$358.6	$269.0
Estimated expenditures ($ millions):					
Mining of ore	$ 20.1	$ 20.1	$ 20.1	$ 20.1	$ 20.1
Overhead costs	4.5	4.5	4.5	4.5	4.5
Ore transportation	50.3	50.3	50.3	50.3	50.3
Milling of ore	19.8	19.8	19.8	19.8	19.8
Smelting fees	146.5	125.6	104.7	83.7	62.8
Royalties	0	0	0	0	0
Site reclamation	9.5	9.5	9.5	9.5	9.5
Depletion/Depreciation	21.8	21.8	21.8	21.8	21.8
Total expenditures	$272.5	$251.6	$230.7	$209.7	$188.8
Net cash flow ($ millions):					
Before taxes	$355.1	$286.5	$217.6	$148.9	$80.2
Federal income tax	81.4	65.5	49.5	33.1	16.2
State income tax	26.7	21.8	16.9	11.9	6.7
Net proceeds tax(*)	24.4	17.6	11.3	6.2	2.5
After taxes	$227.7	$181.6	$140.0	$ 97.8	$54.8

(*) Includes construction period payment; where applicable, the net proceeds tax of subsequent years was credited by the construction period payment.

TABLE 3-15

Construction Period Payments and Estimated Net Proceeds Tax Payments
High Transportation Cost Case (Dollars in millions)

Year	High	Medium High	Middle	Medium Low	Low
1991	$ 0.300	$ 0.300	$ 0.300	$ 0.300	$ 0.300
1992	3.330	2.197	1.155	0.383	0
1993	3.203	2.117	1.188	0.511	0
1994	3.108	2.039	1.147	0.495	0.091
1995	2.932	1.887	1.051	0.441	0.096
1996	2.705	1.694	0.909	0.356	0.067
1997	2.580	1.622	0.863	0.320	0.061
Total	$18.158	$11.856	$ 6.614	$ 2.806	$ 0.614

Note: Where applicable, the net proceeds tax in 1992-1997 was credited by the construction period payment paid in 1991.

TABLE 3-16

Construction Period Payments and Estimated Net Proceeds Tax Payments
Low Transportation Cost Case (Dollars in millions)

Year	High	Medium High	Middle	Medium Low	Low
1991	$ 0.300	$ 0.300	$ 0.300	$ 0.300	$ 0.300
1992	4.296	3.095	1.986	0.999	0.276
1993	4.188	3.028	1.955	1.065	0.426
1994	4.125	2.982	1.922	1.058	0.433
1995	3.976	2.857	1.817	.0999	0.404
1996	3.785	2.686	1.680	0.895	0.346
1997	3.695	2.615	1.649	0.882	0.339
Total	$24.366	$17.563	$11.310	$ 6.197	$ 1.608

Note: Where applicable, the net proceeds tax in 1992-1997 was credited by the construction period payment paid in 1991.

TABLE 3-17

Indexed Amounts Needed for Payments to Municipalities and Fund Availability[1]

Year	Amount Needed for First Dollar Payments	Maximum Amount to County	Total	Low Cost; Transfer to MILIF[2]	High Cost; Transfer to MILIF[3]
1992	.445	.371	.816	1.192	.693
1993	.467	.389	.856	1.173	.713
1994	.490	.409	.899	1.153	.688
1995	.515	.429	.944	1.090	.631
1996	.541	.450	.991	1.008	.545
1997	.568	.473	1.041	0.989	.568
			5.547	6.605	3.838

1 Amounts expressed in millions of dollars and indexed at 5% annually.
2 Amount transferred to the investment and local impact fund is 60% of the net proceeds tax or first dollar payments, whichever is greater, according to statute. The remainder is transferred to the Badger Fund. Estimates are based on net proceeds tax analysis assuming middle metals price scenarios and low transportation costs.
3 Amount transferred assumes middle metals price and high transportation cost scenarios.

Revenues to Local Municipalities

In the local agreement, Flambeau Mining Co. agreed to make one-time construction payments of $100,000 to the Town of Grant, Ladysmith, and Rusk County. Construction payments are required under s. 70.395, Wis. Stats., and would be made regardless of the local agreement. In addition, two other types of annual payments, provided for under s. 70.395, Wisconsin Statutes, would be guaranteed by Flambeau Mining Co. during the operations period. These would be annual "first dollar" payments of $100,000 to all three municipalities and additional payment guarantees to Rusk County.

The first-dollar ($100,000) payments would be made each year during ore removal, and would be indexed according to an inflation indicator as would the construction payments. The gross national product deflator, the measure used to index these payments, has increased 22% between 1982 and 1988. Therefore, the payments will be referred to as $122,000 payments even though they would be larger than that when paid between 1991 and 1997. A maximum of $1.5 million ($1.83 million indexed to 1988) would be guaranteed by Flambeau Mining Co. The $122,000 annual indexed payments also would be adjusted by multiplying $122,000 times the number of tons of ore mined that year divided by 300,000 tons of ore, the expected annual average amount to be mined. The first-dollar payments by the company would be reduced by the amounts, if any, paid to the municipalities by the State of Wisconsin from net proceeds tax collections. It's likely that all of the first-dollar payments would be paid by the state. Under any scenario, whether a net proceeds tax is paid by Flambeau Mining Co. or not, the municipalities would receive annual first-dollar revenues assuming ore is mined and that the total amount guaranteed by Flambeau Mining Co. had not been reached.

In addition to the first-dollar payments, annual payments to Rusk County would be guaranteed up to a maximum of $250,000 ($305,000 indexed to 1988) for each full year of operations. The amount that Rusk County would receive from the state under s. 70.395, Wisconsin Statutes, would be subtracted from the amount Flambeau Mining Co. would pay. In addition, the County's guaranteed payment would be adjusted by multiplying the payment amount by the number of tons of ore mined that year divided by

300,000 tons of ore. The payments also would be adjusted by inflation and adjusted according to the price of copper according to the following table (note that the Comex price of copper was about $1.00/pound in January, 1990):

Copper Price Cents per Pound	Multiply payment by this percentage
less than 65	0
65 but less than 70	20
70 but less than 75	40
75 but less than 80	60
80 but less than 85	60
85 or greater	100

Table 3-17 shows the maximum amounts of payments the company would guarantee to the three municipalities.

The maximum guaranteed operations payments or first-dollar payments shown on Table 3-17 for Ladysmith, the Town of Grant, and Rusk County are $610,000 each, or $122,000 annually during the five years of mining which the local agreement covers. However, mining is planned for six years, and it is possible that first-dollar payments would be made to the three municipalities during the sixth year of mining. The amount of the first-dollar payments in the sixth year depends on the amount of net proceeds tax paid to the state by Flambeau Mining Co. that year. Therefore, the first-dollar payments in the sixth year of mining could be any amount up to $122,000.

TABLE 3-18

Summary of Guaranteed Payments to Municipalities[1]

	Ladysmith	Town of Grant	Rusk County
Construction Payments[2]	$122,000	$122,000	$122,000
Maximum Operations Payments[3]	$610,000	$610,000	$610,000
Maximum Additional Payments[4]	none	none	$1,500,000
Totals	$732,000	$732,000	$2,562,000

1 All payments would be indexed for inflation. Figures shown above are indexed to 1988.
2 One annual payment 30 days after construction begins.
3 Annual payments adjusted based on annual amount of ore removed divided by 300,000 tons. Total payments not to exceed $1.83 million (indexed).
4 Based on an annual maximum of $305,000 for each of six years of operation. These payments also would be adjusted based on 300,000 tons/year ore removal.

In summary, the payments to municipalities are of three types: a one-time construction payment, annual first-dollar payments, and additional payments to Rusk County. State law requires the construction payments by a mining applicant. State law also mandates the first-dollar and additional county payments from the mining impact fund. However, if the mining impact fund contains no money, payments either would not be made or would be made with state-borrowed funds. Flambeau Mining Co. has guaranteed all of these payments in the local agreement.

According to state law, the first-dollar and additional payments to Rusk County must be used for mining-related purposes. However, if the company paid the municipalities directly, the funds could be used for any purpose.

Property Tax Impacts

Development and operations of the proposed mine would change the assessed value within the taxing jurisdictions in two ways. First, the orebody is assessed at $1.125 million (1988) and has contributed value to the Town of Grant, the school district, county, and VTAE district since 1974. If mining begins, the orebody will no longer be assessed and that property value will be lost. Secondly, development of buildings, roads, and other structures on the mine site would increase the assessed value in the municipalities. The overall change in assessed value would be an increase of about $375,000. This is based on Flambeau Mining Co.'s estimate of $1,500,000 increase in value due to development reduced by the loss of the orebody value.

The following property tax impact analysis was based on adding a value of $375,000 to the Town of Grant, the Ladysmith School District, and the Indianhead Vocational School District in Rusk County. Although Ladysmith has annexed 15% of the orebody, the value of the orebody will no longer be assessed when mining begins. Therefore, no additional assessed value was calculated for the City of Ladysmith.

The property tax analysis was prepared using a computer model developed by the Department of Revenue. The model was designed to measure how changes in different property tax determinations influence property taxes. In this case, the change analyzed is an increase in tax base. At least 37 items of base property tax data for each township and their associated school districts are collected and entered in the program to calculate the tax impacts. With this data, the program calculates the effect an increase in tax base would have on local property taxes.

Table 3-19 shows the tax effects of a $375,000 addition to the tax base. The cumulative impact of increasing the Town of Grant tax base would be to increase taxes $6.559 on a $75,000 property.

TABLE 3-19

Summary of Tax Impact on $75,000 Property

	Tax Bill Before	Tax Bill After	Change
Township Portion:	$36.675	$40.125	+$3.450
County Portion:	$509.175	$508.500	-($0.675)
Local School Portion:	$1,503.000	$1,501.800	-($1.200)
VTAE District Portion:	$124.350	$124.350	$0.000
State Portion:	$15.000	$15.000	$0.000
GROSS TAX TOTAL:	$2,188.224	$2,189.763	+$1.539
General Levy Credit:	$76.401	$74.694	-($1.707)
School Levy Credit:	$148.252	$144.939	-($3.313)
NET TAX TOTAL:	$1,963.571	$1,970.130	+$6.559

The reason local taxes typically do not decrease when value is added to the tax roll is that shared revenue payments and other aids paid by the state decrease as tax base increases. If tax levies and aids collected by local governments remained unchanged when land went on the tax roll, each individual property owner would see their taxes decrease in response to the new taxes collected. However, as tax bases increase, aids paid by the state decrease, usually in a one-to-one proportion to the increase in tax base. These state policies for financial aid to local government are designed to minimize the impacts to local taxpayers from abrupt changes in tax base. The actual result when a tax base increases is that property taxes typically do not significantly change.

At the end of mining, when the mine development would be removed, the Town's tax base would decrease. When that occurred, there would likely be a small tax reduction to Town of Grant property owners due to increased state aid payments.

Property Taxes Paid by Flambeau Mining Co.

As a result of mine development, the net assessed value of the property would increase by about $375,000, and Flambeau Mining Co. would annually pay about $9,818 in increased property taxes on that amount during mining. However, when the mine site was reclaimed, the increased value would be removed. Therefore, Flambeau Mining Co. would pay an increased property tax only during the six years of mining.

Income Taxes

Income tax receipts by the State of Wisconsin would accrue from wages paid by Flambeau Mining Co. during the project. Flambeau Mining Co. estimated that total wage costs during construction, operations, and reclamation would be about $13.9 million including fringe benefits. Fringe benefits typically comprise about 30% of wage costs. Therefore, if the estimated $9.7 million wages received by Flambeau Mining Co. employees and contractors were taxed at an average of 5.3%, the total income tax received by the state would be approximately $516,000 over the project duration.

Sales Tax

According to surveys conducted by the U.S. Department of Commerce, about 18% of disposable income is spent on items on which a sales tax is charged. Disposable income is about 65% of total wage income. Therefore, of the $9.7 million wages received by Flambeau Mining Co. employees and contractors, $1.13 million would be spent on items for which a sales tax is charged. Assuming 90% of this would be spent in Wisconsin, the total sales tax revenues (5% sales tax) over the life of the project from wage sources would be about $51,000 to the State of Wisconsin. The 0.5% sales tax collected by Rusk County, using the same assumptions and assuming 75% would be spent in Rusk County, would amount to about $4,300.

Over the project duration, Flambeau Mining Co. has estimated it would spend about $8.5 million in supplies. It is unknown exactly how much of this would be spent on taxable purchases. However, if 30% of parts and consumables were taxable purchases in Wisconsin, and all the diesel fuel, gasoline, natural gas and electric power were taxed, the state sales tax revenues generated from purchases would be $240,000 during the project. If 50% of the supplies were taxable in Rusk County, the County would receive about $12,000 in additional sales tax revenue.

Corporate Income Tax

The State of Wisconsin would receive income tax revenue estimated at $12.3-16.9 million based on income from project mining under the middle metals price scenarios. This estimate was made by the Department of Revenue as part of their net proceeds tax calculations, and the assumptions are stated in that section.

An important assumption used in estimating corporate taxes was that the mine would be operated on a "stand-alone" basis. That is, Flambeau Mining Co. would conduct mining in Wisconsin through a business separately incorporated from the parent company. If this were true, corporate tax due the state would be based only on Wisconsin operations.

However, if Flambeau Mining Co. chose to operate the project under its own corporate umbrella, the mine's state income tax liability could vary from the amount due on a "stand-alone" basis. This is because the mine's income or loss would be calculated together with the parent company's, and losses or gains elsewhere would be combined with losses or gains in Wisconsin. While the choice in accounting is up to Flambeau Mining Co. for corporate tax purposes, this is not the case with net proceeds tax, which is calculated only on Wisconsin mining activities.

ECONOMIC IMPACTS

Wages and Salary Impacts

During the construction, operations, and reclamation/closure phases of the proposed mine, total expenditures for labor are estimated by Flambeau Mining Co. at $13.9 million. Of this total, about $9.7 million would be wages and salary (excluding fringe benefits), and about $6.3 million would be disposable income. Not all of the disposable income would be spent locally within Rusk County. If 65% were spent locally, about $4.1 million would be spent locally during the project by employees and contractors.

Business Impacts

A total of $8.5 million worth of supplies would be purchased during the three phases of the proposed mine. Supplies include parts and consumables, diesel, gasoline, natural gas, and electric power identified by Flambeau Mining Co. It is likely that a significant amount of the supplies could be purchased within Rusk County. The purchase of supplies and services would increase local business activity as would local spending of wages and salaries. In addition, the presence of construction crews during mine construction would stimulate temporary housing, restaurant, and leisure-time businesses in the Ladysmith area. Additional business impacts would result from dollars being respent in the local area. Business impacts would end with the cessation of mining following project reclamation.

Property Value Impacts

In the local agreement, Flambeau Mining Co. has agreed to a process which would reimburse property owners for loss in property value due to proximity to the mine. The property value guarantee applies when the mining operations begins and ends 20 years after mining operation ceases, and is applicable to land owners using a well. Two areas near the mine site are covered: 1) the area south of Doughty Road, north of CTH P between Flambeau Mining Co.'s land on the west and CTH G on the east; 2) the land between Flambeau Mining Co.'s ownership and the Flambeau River west of the railroad (See Figure 1-16). Approximately 30 residences are included within the two areas.

The process established in the local agreement requires the company to perform baseline appraisals of the properties. Owners that do not allow baseline appraisals are not eligible later to receive compensation due to property value loss. The local impact committee is identified as responsible for determining compensation based on land appraisals.

While it is not possible to determine whether the eligible land owners would utilize the established process or the effectiveness of the land value guarantee process, the process has been developed and approved by the Town of Grant Town Board and should provide a local guarantee of land values. Therefore, it is not expected that land owners (with wells) close to the proposed mine would suffer adverse property value changes.

Some dwellings and property close to the mine could increase in value due to the mine site development and operation. For example, some nearby houses could have greater value as rental units. Vacant land with strategic location might be more desirable for retail development or for temporary use during construction. It is possible that land could be developed for a restaurant, service station, or tavern along STH 27, for example. Thus mine development could increase some property values. In order to increase in value with mining, properties must have the right combination of existing and potential use, location, zoning, and other features.

IMPACTS TO RECREATION AND TOURISM

In order to analyze the impacts to local levels of recreation and tourism from the proposed mine, it is necessary to conceptualize the project in terms of how it would affect the local area. The local area would be only very slightly changed from its current condition if the mine were developed. For example, several hundred feet along the Flambeau River would be physically modified due to clearing vegetation for construction of the flood control berm and slurry wall. The mine pit itself would not be visible from the river, although the rock storage piles probably would be visible during part of the project. Treated wastewater and mine seepage into the river should not make any visible or noticeable changes to river quantity or quality. However, there could be dust impacts and noise from the mine activities. Also, the mine site would be fenced to prevent hiking and hunting.

Therefore, based on these anticipated changes, there could be minimal reductions in the existing levels of fishing, canoeing and hunting in the immediate area. However, there are sufficient alternative sites in the local region for hunting, canoeing and fishing. In addition, the region is not at its maximum outdoor recreation carrying capacity. Therefore, development of the proposed project would probably result in some of those traditionally using the area for recreation to find nearby alternative sites, most likely within Rusk County. The expected reduction in local recreation should be very small and, therefore, the economic impacts of reduced recreation locally should be negligible. There are no businesses locally which cater specifically to tourist and recreation sectors which would be significantly impacted by the project. Local recreational activities are expected to return to preproject levels after reclamation.

During operation of the proposed project, the company would provide a small parking lot and mine viewing area adjacent to STH 27. Tourists could view the pit area and observe the various mining activities in operation. Because this would be Wisconsin's first metallic mine opened in the last 20 years, the site should attract moderate numbers of visitors. The economic impact of the increased level of local tourism should be small. If the proposed mine were developed, there probably would be an overall small net increase in tourism and recreation to the local area which would have small but probably positive economic impacts to the area.

SUMMARY OF FISCAL AND ECONOMIC IMPACTS

Before the Department can grant a mining permit, it must make a finding that the mine would not result in a net, substantial adverse economic impact in the area reasonably expected to be most impacted. Fiscal and economic impacts in the above analyses will contribute to that finding.

Based on the previous analyses and on the stated assumptions, the overall or "net" fiscal and economic impacts of the project are not expected to be substantially adverse. That is, the sum of all the identified costs would be at least compensated by the corresponding revenues and other benefits. This summary is based on the assumption of project construction, operations, and closure as proposed by Flambeau Mining Co. It is unlikely that individual sectors and governmental entities would be impacted with greater costs than revenues during any phase of the project.

The significant positive and negative effects of the project which would impact the local study area include: 1) labor costs (employee benefits) and expenditures (local and statewide purchases) during construction, 2) direct and indirect (project-induced) labor costs during operations and closure, 3) materials and supplies purchased during operations and reclamation/closure, 4) statewide effects such as corporate, personal income and sales taxes, which indirectly benefit the local area, 5) costs to municipalities and school districts to provide necessary services, 6) Mining Impact Board or Flambeau Mining Co. payments to municipalities, 7) net proceeds taxes paid to the state, 8) Rusk County sale tax revenues, and 9) increased local economic effects from increased business activity.

If a mining project were terminated early, there could be significant fiscal and economic impacts. However, the proposed mining project has a relatively short period of six years planned for operations, preceded by a one-year construction period. Therefore, it is extremely unlikely for the project to close shortly after the start of mining. Once the mine begins operation, it almost certainly would continue operation through completion. Therefore, all evidence suggests that the project would not result in net, substantial, adverse economic impacts.

RISK ASSESSMENT AND MANAGEMENT

Like any other large construction project, the proposed Flambeau Mining Co. mine has certain human health and environmental risks associated with it. Some risks are associated with the normal hazards of operating machinery and equipment or other activities. Other risks come from the characteristics of materials used in processes or operations (e.g., toxicity, flammability and explosivity). Yet another category of risks stem from accidents or other unexpected events. This discussion focuses on the latter two categories of risks. Risk management covers the measures applied to minimize risks or the effects of hazardous incidents.

The probability of occurrence of the potential hazards identified in this risk assessment is low. Although accidents could occur during the life of the project, the potential can be minimized through appropriate design features, operating procedures, and employee training programs. Should an accident occur, contingency measures and remediation plans can minimize the potential adverse effects to human health and the environment. Most impacts would be minimal and/or of short duration. No potential hazard is believed to be irreversible.

RISKS ASSOCIATED WITH OPERATING SYSTEMS

Chemical Use and Storage

Three chemical substances would be used in the wastewater treatment plant: sodium sulfide, sulfuric acid, and quicklime (calcium oxide).

Approximately 19,000 pounds of sodium sulfide would be used annually. It would be delivered by truck in bags on pallets, and would be stored inside the maintenance building in an enclosed storage area. A few bags would be kept on a pallet in the wastewater treatment plant for use in the sulfide precipitation process.

Approximately 38,000 pounds of sulfuric acid would be used annually. It would be delivered to the plant in bulk by tanker truck, and stored in a 1,200-gallon holding tank in the plant enclosed in a spill containment barrier.

Approximately 3,400 tons of quicklime would be used annually. It would be delivered to the plant in bulk by truck, and stored in a 46-ton silo next to the treatment plant. The silo would be covered and sealed, and would have a dust collection system to prevent particulate quicklime from escaping into the ambient air.

Sodium sulfide is flammable and can pose a fire and explosion risk if improperly handled. It is a strong irritant to skin and tissue, and liberates toxic hydrogen sulfide on contact with acids. Sodium sulfide is harmful to aquatic life in very low concentrations. Sulfuric acid is strongly corrosive, very reactive and dissolves most metals. It is a strong irritant to skin and tissue and is toxic to aquatic life in very low concentrations. Quicklime (slaked lime) is a strong irritant to skin and tissue and is harmful to aquatic life in very low concentrations.

The chemical storage and delivery systems would be designed to prevent leaks and spills. As required by state and federal law, contingency plans would be provided for the use of each chemical. These plans would be developed prior to operation and would be used as training guides for the operators in the wastewater treatment plant.

A spill during transport of hazardous materials is a low probability event. Information for truck transport (Chemical and Engineering News, September, 1984) indicates that the probability of spills in 1983 was 2.7 in 100,000 per truck shipment. Most spills that did occur did not have major adverse effects. Low truck speeds, and low traffic densities within the project boundary would further reduce the probability of truck accidents.

Chemical spills or releases on the mine site would be contained and cleaned up. Absorbent material would be available near the sulfuric acid storage tank to collect any acid spilled during filling. If sodium sulfide was spilled at the mixing tanks, it would be swept up and put into the tank. If quicklime was spilled while the silo is being filled, it would be immediately swept up and used in the wastewater treatment plant.

In general, spills probably would be minor, discrete, short-term, reversible events, and the consequences would not be severe. Since small on-site accidental spills would be localized, no threat to public health and safety or the environment is expected. The probability of a major on-site spill is low and actions would be taken to mitigate any impacts. Major spills would be reported to the appropriate personnel for prompt action to contain and remediate the spill.

Wastewater Treatment System Failure

The wastewater treatment plant is designed to treat stormwater and groundwater inflow contaminated with metals and sulfuric acid produced by the ore and waste materials. Since the wastewater contains contaminants that could cause toxic effects to humans or the environment, it is important to evaluate whether events that could result in exposure to those effects is likely.

The wastewater treatment system would be shut down periodically for equipment maintenance, or for unplanned events which could interrupt operations. Preventive maintenance for the wastewater treatment plant would be designed to minimize unplanned equipment failures. Sufficient redundancy (spares, both installed and available standbys) should prevent long shutdowns of the treatment plant facilities. Temporary shutdown of the water treatment facilities could occur without degrading the environment because water fed to the facility could be held in the open pit for treatment until operations are restored.

There is little probability of failure of the surface water discharge pipeline. It would not be exposed to corrosive materials or extremes in internal or external pressures which could result in pipe failure. The water discharge pipeline would probably be constructed of six-inch diameter high density polyethylene (HDPE) pipe and buried below the frostline.

Should a wastewater treatment plant malfunction result in inadequate treatment of wastewater, the wastewater would be diverted to the runoff pond. After the treatment system was repaired, the water would be retreated prior to discharge or reuse. If the capacity of the ponds was exceeded, an overflow system would direct the flow to the open pit for storage until treatment operations was restored.

Wastewater Collection System Failure

The wastewater collection systems consists of the bermed and lined high sulfur waste rock stockpile, the lined surge pond, the lined runoff pond and the piping connecting these facilities with the wastewater treatment plant. Potential environmental contamination could occur if the collection system failed during operation and discharged contaminated water.

Potential failures of the wastewater collection system include:

- Failure of the pond embankments
- Leaks in the pipelines
- Leaks in the liners
- Blockage of the drainage system

Storm water runoff would flow to the wastewater treatment plant through high density polyethylene (HDPE) pipes buried five feet below ground and below the frost line. If constructed to specification, the pipelines offer little risk to the environment from leaks.

An HDPE liner would have extremely low permeability and has been successfully used in other industrial applications. If the liner was constructed to specification, the potential for significant leaks developing would be low. The most likely leaks would be from small rips or along a seam. They should have minimal impact on the environment since they would be relatively small, and because under normal operating procedures, wastewater would not be allowed to accumulate in the stockpile surge pond or runoff pond for extended periods (i.e., water would accumulate during rain events and then be treated expeditiously). In addition, wastewater leaking through the liner would flow toward the open pit where it would be collected and pumped to the wastewater treatment facility.

A potential risk could exist if the collection system at the base of the stockpile fails and results in an accumulation of wastewater within the stockpile berms.

Settling Pond Embankment Failure

A system of small, interconnected ponds would collect and store stormwater and infiltrated groundwater during preproduction mining only. Failure of a pond embankment is unlikely and would result in a relatively minor, short-term effect. The ponds might overtop or be damaged if a storm in excess of the design standards (25-year, 24-hour storm) occurred. An extended period of high precipitation which kept the pond full could weaken the pond embankment making wall failure more probable.

Air Emissions

Ore handling and crushing, vehicle operations, fuel transfer and storage, and chemical use, transfer and storage constitute air emission sources from facility operations. Air emissions can adversely affect human and environmental health and welfare if concentrations of pollutants exceed safe levels.

All significant air emission sources would have pollution controls. A complete discussion of air pollutant emissions is presented in the Air Quality section.

Transfer and storage of fuels would occur primarily at the 15,000-gallon bulk fuel storage tank located at the southern boundary of the plant. A vapor balance system would be used during storage tank loading to minimize hydrocarbon emissions. A dust collection baghouse would be mounted on the lime storage silo to collect any dust generated during the loading of the lime storage silo.

The sulfide treatment of plant process wastewater requires a pH of between 5 and 6. The system is designed with a three-tier failure protection mechanism to maintain the desired pH level. However, in the unlikely event that pH drops substantially, hydrogen sulfide (H_2S) could be produced. Assuming a worst case scenario where all the reactants in the tank undergo complete conversion, 0.35 pounds of H_2S could be formed. This is highly unlikely because the pH of the solution would rise as the reaction proceeded to a steady state equilibrium to a point where no additional hydrogen sulfide would be formed. The mixing tanks are covered and vented through the building ventilation; any H_2S generated would be released and immediately diluted by the ambient air to safe levels.

Monitors in the mixing tank area would alert operations personnel if hydrogen sulfide is being generated. These monitors would alert personnel before H_2S reached toxic levels within the plant. Even if the maximum amount (0.35 lbs.) of H_2S were discharged to the atmosphere, it would not cause any public health hazard. DNR does not require analysis of H_2S emissions unless emissions of 1.66 pounds per hour are projected.

All other air emissions are unlikely to cause conditions that would threaten human and environmental health and welfare. With respect to H_2S, if the gas is detected in the mixing tank area an alarm would sound and personnel would evacuate the treatment plant building immediately. There should be no risk to health or environment due to H_2S generation outside the wastewater treatment plant building.

Fuel Storage and Distribution

Diesel fuel and gasoline would be used during all phases of the project. During the construction and reclamation phases, diesel fuel would be required for earth moving equipment and would be dispensed from the tanker truck used for delivery. Other vehicles and equipment would use gasoline. The risk associated with storage of fuel and fueling of vehicles and equipment, regardless of project phase, comes from accidental fuel spills. Fuel spills could occur from leaking pipes and hoses or careless handling. This could occur during transfer of bulk fuel to the storage tanks or fueling of equipment. This assessment focuses on small quantity spills from handling rather than the rupture of the storage tanks. Handling of fuel presents the greatest opportunity for human error to occur in the fuel storage and handling system.

During construction and reclamation, fuel would be dispensed from tanker trucks within a temporary berm. Soil absorption would retard the migration of spilled fuel off-site. The only short-term effects would be highly localized contamination of soil and volatile emissions of the fuel vapor. There would be no long-term or irreversible effects if the contaminated soil was removed following a spill.

During mine operation, diesel fuel and gasoline would be stored in an above ground 15,000-gallon diesel fuel storage tank and a 1,000-gallon gasoline storage tank, respectively. Diesel fuel would be dispensed from the storage tank to a tanker truck which would fuel equipment in the field during the beginning and end of shifts and during break times. Small spills would be cleaned up with absorptive materials. The only short-term effect of a fuel spill would be the emission of fuel vapor. The long-term effects of a spill should be minimal if the fuel is promptly cleaned up and contaminated soil is removed. If this occurs, there should be no long term contamination of ground or surface waters, or air pollution which would affect human or environmental health and welfare.

Contingency measures are required under federal regulations. These measures would be developed before the start of construction and would be incorporated into personnel training. The fuel storage tanks will be inspected daily for signs of leakage.

Storage and Transportation and Use of Explosives

Blasting will be required for mine development and for operation. An accidental detonation could affect the environment and public health and safety. This could result from impact, shock, fire, or an electrical discharge. Experience from the mining industry indicates that accidental detonation of surface stored explosives is an extremely rare event. Explosive storage would be maintained on the surface in a secure area, southwest of the low sulfur waste rock stockpile. In this location, explosives would be stored in three separate magazines. Two magazines would contain a total of 15 tons of explosives, and a third magazine will hold the caps, primers, and detonating cord. Explosive materials would be transferred by truck to the open pit mine.

The magazine would be designed to comply with applicable codes, standards, and regulations. These regulations assure that debris generated by the detonation and the associated shock wave would present a minimal hazard to on-site personnel and the surrounding buildings and structures.

The risk of an accidental detonation is also of concern in the open pit during transportation of explosives. Clearly marked transportation vehicles and stringent on-the-job safety training would help reduce the risk. Design features, which are required for the surface storage of explosives by federal and state regulations, would be included in the final design of the facility. Standard procedures for handling and storage as set forth by the Institute of Makers of Explosives (IME) would be followed throughout the duration of the project.

Blasting

The initial surface excavation would be ripped rather than blasted. Blasting would first occur on the first full bench, located 40-60 feet below the original surface topography. The steep dip of the ore and the proposed mining technique would tend to direct any fly rock in a northwesterly direction and away from STH 27. However, as an extra safety precaution, under certain circumstances, traffic may be halted on the highway during blasting. Precautions would also be taken on the Flambeau River when blasting in the extreme west end of the pit.

Ground vibration, air impact and noise impact would be minimized by the use of millisecond delays between holes so that the holes are exploded in sequence, rather than simultaneously. Due to the small size of the operation, the relatively small blasts, and distance away from the nearest neighbors, the risk to human health and the environment should be low.

CONTINGENCY MEASURES

Flambeau Mining Co. has developed a contingency plan as required by NR 182, Wis. Adm. Code. The plan would be applied if an accidental or emergency discharge or other condition occurs which would violate license conditions or other applicable standards was detected by the monitoring program. Responses to accidental or emergency discharges were discussed in the preceding section. Should a significant increase in a monitoring parameter occur, the following measures would be implemented:

1. Review all sampling, sample handling, and analytical procedures to assure proper procedures were used.

2. Determine extent and the significance of the elevated parameters.

3. Resample to verify the analytical results.

4. If results are confirmed, determine the significance of the problem and its potential impact on the environment.

5. Determine if immediate action is required or if continued monitoring is sufficient.

6. Determine, if possible, the source.

If the evaluation shows that a problem exists, Flambeau Mining Co. would determine the extent of the problem. For example, if groundwater contamination is detected, additional monitoring wells could be installed to determine the vertical and horizontal extent of the contamination. A contaminant transport model might be employed to determine the impact of the elevated parameters, and to help define corrective measures. The information gathered during this investigation would be submitted to the DNR.

The results of the investigation would determine the remedial action needed to correct the problem. In the case of groundwater contamination, remedial actions could consist of:

- Conducting additional groundwater monitoring of all aquifer systems located downgradient from the problem area, including more frequent monitoring of key indicator parameters. This might also include the use of specialized groundwater monitoring wells.

- Repairing the source of the problem.

- Constructing slurry cutoff walls.

- Installing pumping wells to remove contaminated groundwater.

If surface water contamination were detected, remedial actions could include:

- Additional monitoring of the Flambeau River, its sediments and/or its aquatic life. This would include monitoring on a more frequent basis, but with a limited number of key indicator parameters. It might also include the use of specialized monitoring equipment or techniques.

- Repair of the source of the problem

- Construction of additional erosion control features.

Other contingency measures would include providing supplemental water to impacted wetlands, increasing the size of the wetland restoration, and providing alternate water supplies to private well owners. The company would also be required to prepare a spill prevention, control and countermeasures plan, as required by federal law, to address potential impacts to surface waters from oil discharges.

RISKS ASSOCIATED WITH CATASTROPHIC EVENTS

Fires

The potential for accidental fires to occur always exists. The presence of flammable materials, operating machinery and electricity all contribute to conditions that could result in a fire. Naturally-caused fires resulting from lightning strikes are also a possibility. Fires are hazardous occurrences by themselves; they can also bring about other hazardous conditions due to chemical reactions or failures of equipment.

Although combustible materials would be used on the mine site, fires which occur on-site should be brief and localized. Fire protection for all temporary construction buildings would be provided by a water truck stationed on site. A water line connected to a pump with a 10,000-gallon above ground storage tank would supply hose stations at the water treatment building and maintenance shop. Hand-operated fire extinguishers would be provided by the various contractors. In addition, the Ladysmith Volunteer Fire Department and the Department of Natural Resources would be contacted as needed.

The occurrence of accidental fires within the project boundary must be considered during all three phases of the project. Based upon data on surface fires at underground mines (Bureau of Mines; *An Annotated Bibliography of Metal and Nonmetal Mine Fire Reports*, December 5, 1980) the probability would be less than one accidental surface fire during the life of the project, and its duration would be less than four hours. Therefore, on-site fires represent a low probability risk.

The potential for an on-site fire causing an off-site fire (e.g., forest fire) would be minimal because the large cleared area and roads around the mine site would serve as fire breaks. During the construction phase, controlled burning may be used to eliminate waste wood from clearing and grubbing activities. Measures would be specified on the WDNR burning permit to minimize the potential for forest fires.

The potential for fires starting along the power line and rail corridor would be low. Undesirable vegetation in these corridors would be controlled through cutting or the use of EPA-approved herbicides. During project operation the railroad spur would receive limited use (approximately three or four round trips per week). These conditions would minimize the potential for fires along the corridors.

Pit Wall Failure

Failure of a pit wall during mining could result in human injury and lost production. This event would produce a rock slide into the pit which could bury equipment and injure or kill personnel. Slope engineering studies, however, show that favorable rock structure coupled with acceptable rock and overburden material strength, allow for relatively steep slopes for the shallow Flambeau pit.

A potential risk to the stability of the pit walls exists from an inflow of groundwater to the open pit mine, particularly at the southwest end of the pit. To minimize water inflow from the river, a slurry wall would be constructed between the pit and the river from the surface to the bedrock contact. In addition, horizontal benches would be maintained for safety considerations. These 27-foot wide benches would be left at 60-foot vertical intervals on the pit walls below the bedrock contact. The benches would have safety berms to control rockfall.

Crushed Ore Spill

To present a potential risk to the environment, crushed ore would have to be spilled from the rail cars and left in place for an extended period to allow precipitation to leach metals and acids into surface and groundwater. Spills on the mine site or along the rail spur would be retrieved promptly; thus the risk would be minimal.

Spills of crushed ore off-site could occur by derailment of a railcar; however, the probability of a train accident is low. A systematic study of transportation accidents determined that the probability is 1.5 in a million miles. This was based on nationwide data for transportation of all types of freights and for all operating conditions for the trains. The report noted that 83% of all train accidents evaluated involved derailments.

The probability of a train accident spilling a cargo into a water body is even more remote. This is because of the small fraction of the rail system built on bridges, the low operating speeds, the protective guard rail on most bridges, and the buffer zone of land normally present when a rail line passes over or along a water body. It was concluded that the conditional probability of a train accident occurring on a bridge over water is 9 in 100,000. This probability when combined with the probability of 1.5 in a million accidents per car mile gives a net probability of 1.4 in 10 billion car accidents per car mile on a bridge. While the accuracy of these probabilities is not definitive, accidents are clearly low probability events.

If a crushed ore spill to the environment occurred, Flambeau Mining Co. would work with the rail carrier to implement corrective action. The specific techniques used to recover spilled crushed ore would depend on the nature, magnitude, and location of the spill. The crushed ore would be recovered to the maximum extent practicable.

Timely recovery of the spilled material and appropriate remedial measures should restrict impacts to short-term, localized, reversible, and primarily physical disturbance of the environment.

Power Disruption

Disruption of electrical power to the mine site would result in a shutdown of the wastewater treatment plant. For the duration of the power outage, wastewater would be collected until power was resumed.

Power outages, especially during thunderstorms and severe winter weather, are not uncommon events. However, most outages are relatively brief, rarely exceeding one hour. In the event of a power disruption, the wastewater treatment plant would shut down and water would accumulate in the ponds. If the surge pond and runoff pond reach capacity excess water would drain by gravity into the open pit.

Therefore, contaminated water would not be released to the environment. When power is restored, the untreated water in the open pit would be pumped back to the wastewater treatment plant.

Sabotage

Sabotage is a potential risk at any industrial project site. The mine site would be fenced and all gates would be either secured or manned during both operating hours and off-hours to control access to the mine site. During operation, a security officer or supervisors would monitor activities at the mine site to minimize the opportunity for sabotage. Based on the type of operation involved and the security to be provided, the risk of sabotage should be low.

In the event an act of sabotage occurs, the damage would be repaired and the situation evaluated so that security measures can be improved to prevent a reoccurrence of the act.

Severe Natural Phenomena

Severe natural phenomena that could pose a risk to the project include earthquakes, tornadoes, and flooding. The Flambeau site is in a region of very low seismic risk. Seismic safety factors have been incorporated into the design of surface and subsurface facilities; therefore, no unusual seismic risk exists for the facility.

While not as frequent as in other areas of the Midwest, relatively small tornadoes and downbursts have occurred in northern Wisconsin. The probability of such events is low. Damage at the project site would likely be slight under these conditions because of the safety margins incorporated into the structures for other extreme loads.

Unexpected significant flooding could occur due to a catastrophic flood on the Flambeau River following torrential precipitation. The flood control dike between the mine and the Flambeau River is designed to contain a 100-year, 24-hour event. However, a significant rise above the 100-year prediction mark, a very low probability event, would overtop the flood control dike and flood the mine. The probability of overflowing the flood control dike is further reduced because the flood control dike will, in reality, be at a level above this mark and the project is of relatively short duration.

A torrential rain event in excess of the 25-year, 24-hour storm event could overtop the four ponds in the water collection/wastewater treatment system. The release of contaminated water could have a short-term, although reversible, effect on the environment.

Since the low sulfur waste rock stockpile settling ponds discharge by gravity flow to the Flambeau River, overtopping of the ponds is a negligible risk. The settling ponds are designed to retain stormwater for 24 hours so that suspended solids would settle out and free iron would oxidize. If the 25-year, 24-hour design storm is exceeded, turbid water may be discharged to the river. This would be an event of limited duration, and impact on aquatic life would be minimal. The relatively low levels of contaminants would indicate that toxic effects are unlikely in this situation.

If a major storm threatens to overtop the surge pond and runoff pond, the water would overflow into the mine via an emergency overflow pipe, so the risk of overtopping of the ponds would be low.

If overtopping of the flood control dike occurs and the mine floods with river water, the open pit would be evacuated. Mining operations would not resume until the water had been pumped out of the mine and disposed of either in the settling ponds if the water quality is deemed appropriate, or through the wastewater treatment plant.

CUMULATIVE IMPACTS

If Flambeau Mining Co. receives permits for the mine, it would be the first metallic mining project authorized under the current regulations. It would also be the first base-metal mine in recent state history to be constructed. As such, permitting the Flambeau Mining Co. project could encourage development of the mining industry in Wisconsin. It's possible that other companies with orebodies would be more likely to pursue mining permits. The most likely candidate orebody would be Exxon's large deposit near Crandon. Several other metallic mineral occurrences are known in the state, but none appear likely to be developed.

Permitting the Flambeau Mining Co. mine may also encourage mineral exploration activity in the state. However, the major factors influencing both the exploration activity and the development of new mines are the world metal markets and the long-term outlook for metal prices. Any precedent established by the Flambeau Mining Co. project would be minor in comparison to the economic factors.

Ore from the Flambeau project would be transported out-of-state for benefication and refining. Benefication would involve grinding the ore to fine particle sizes and separating the metals. The tailings, or waste materials, from this process would need to be disposed of. The concentrate, which could be shipped to a different site or even overseas, would then be refined into a product. Depending on the locations and methods used to concentrate and refine the ore, impacts to groundwater, surface water and air quality could occur at the locations of these processes. However, the relatively small quantity of ore from the project would probably comprise only a fraction of the materials processed at these facilities, and it is unlikely that any significant increments of additional environmental impact would result from processing the Flambeau project ore.

CHAPTER FOUR
ALTERNATIVES AND THEIR IMPACTS

The viability of alternative facility siting or processing techniques is strongly influenced by the nature, location and orientation of the mineral deposit. Mining, by its very nature, places a major constraint on siting alternatives since the position of the deposit is fixed. Various alternatives have been evaluated by Flambeau Mining Co. since the project was first investigated in the early 1970's. The following discussion encompasses the range of alternatives which are considered reasonable in light of the constraints imposed by the orebody.

NO ACTION

The no-action alternative is no mining, either because the project is abandoned by Flambeau Mining Co. or because the necessary permits are not granted. Flambeau Mining Co. would probably maintain a temporary office in a company-owned house. Files and drawings would continue to be stored there as well as other project information and equipment. If no action is taken, the piezometer drill holes, soil borings and monitoring wells could be permanently abandoned and the sites graded and revegetated. The drill sites would eventually revert to forest or would become meadow or farmland. Permanently abandoning the drill holes would allow Flambeau Mining Co. to secure the release of its exploration bond.

The alternative of not proceeding with the project would allow the current environmental resource trends and cultural processes to continue assuming no other significant change occurs.

Impacts of the no action alternative on land use can be evaluated under two scenarios. If Flambeau Mining Co. maintained ownership of the project area and leased the property, existing land use within the project area would probably experience little if any change. The existing homes owned by Flambeau Mining Co. in the project area would continue to be leased as single-family residences. Lands being actively farmed would continue to be leased for agricultural purposes in the future. Flambeau Mining Co. could reconsider mining at some future point.

If Flambeau Mining Co. sold the project area land with mineral rights, the significance of any major land use change within the project area would largely depend upon who purchased the property. For example, if the property was purchased by another mining company, the potential for another mine proposal would be possible. If the Flambeau Mining Co. property was purchased by private individuals, land containing saw timber or pulp value could be cut, agricultural activities might change, and land use might change depending on owner activities. Wildlife habitat, as well as the appearance of the land could change significantly.

The no action alternative would eliminate the positive and negative impacts of the project on Rusk County, the Town of Grant, and the City of Ladysmith. Potential revenue and employment opportunities would be lost. Short-term aesthetic, noise, surface water and traffic impacts would not occur. Long-term concern over groundwater contamination would not exist.

Without the project, the socioeconomic conditions and trends as currently occurring probably would continue. The character and environmental quality of the area would remain in approximately its present state.

EXPAND THE PROJECT

Expansion of the project would involve removing additional minerals from below the bottom of the proposed pit. This could be accomplished by either expanding the open pit or by underground mining. Since the deeper, lower grade ore would probably not be economical to ship directly to a processing plant, facilities for concentrating the ore and for disposing of tailings would need to be built on or near the site. These facilities would result in additional environmental impacts and a long-term potential for groundwater contamination. The longer duration of an expanded project would provide additional employment and tax revenues.

Flambeau Mining Co. has conducted studies on the possibility of mining the deposit to a depth of approximately 600 feet beneath the surface using a combination of open pit and underground mining methods. Interpretation of these studies concluded that extraction of the lower portion, below 225 feet, would not yield sufficient return to warrant mining. In addition, Flambeau Mining Co. is, at this time, unable to mine this deep ore under the provisions of the current Local Agreement.

REDUCE THE PROJECT

Reduction of the project would involve mining only a portion of the orebody. The size of the waste rock stockpiles and the pit would be reduced and the duration of the project might be shortened. Employment and tax revenues from the project would also be reduced. Given the short-term nature of the proposed project, a significant reduction in the project is probably infeasible.

ALTERNATIVE MINING METHODS

Several mining methods are available for extracting the copper orebody: underground; open pit; or a combination of open pit and underground techniques.

UNDERGROUND MINING TO 225 FEET

The deposit could be mined by sinking a shaft or decline near the center of the deposit and extracting ore to a depth of approximately 225 feet below the surface.

This approach would be very expensive, has greater risk to workers, would result in less complete ore removal, and would be more difficult to backfill compared with the open pit method. Flambeau Mining Co. would probably not proceed with the project if this approach was dictated.

COMBINED OPEN PIT AND UNDERGROUND MINING TO 225 FEET

An open pit with underground mining between the east bank of the river and the west edge of the pit was considered by Flambeau Mining Co. Various distances, ranging from 140 to over 550 feet, were evaluated based on setbacks dictated by state locational criteria, county zoning, and engineering considerations.

Combined open pit and underground mining of the deposit was not considered a viable alternative. In addition to safety and environmental considerations, the high capital and operating costs required for underground mining to recover the ore between the various pit limits and 133 feet from the normal river edge were substantially higher than the proposed open pit method. This technique could slightly increase overall ore production.

OPEN PIT DESIGN

Design of an open pit and ultimate perimeter is dependent upon many variables, some of which include geometry of the deposit, preferred production rate, equipment size, waste-to-ore ratio, economics, worker safety, and pit-wall slope. Two pit slope angles were evaluated: one involving an inter-ramp angle of approximately 35° and another at 50°. Slopes steeper than 50° were rejected because of safety considerations.

A 50° slope was preferred over a flatter slope for several reasons. Reduced operating costs and fewer truck trips would result since the total quantity of waste rock removed is reduced. This means less consumption of fuels, less fugitive dust, and lower ambient noise levels. Less surface area is disturbed during excavation of the open pit, and less land is required for storage of waste rock. Impacts to wetlands also are reduced. Less precipitation caught within the pit area results in fewer gallons handled in the wastewater treatment plant.

The 35° slope design would increase the tonnage of waste rock dramatically, would cost more, and more land surface would be disturbed because of the expanded pit perimeter and larger waste rock storage areas.

ALTERNATIVE MINE PRODUCTION RATES

In general, the size and geometry of the deposit, mining method, and number of working hours per day determine the range of ore production rates. Daily ore production fluctuations are common to the mining industry due to mine scheduling, maintenance, and weather conditions. Under the proposed mine plan it is expected that the Flambeau ore production could range from zero to 2,000 tons per day, averaging 1,300 tons per day over the life of the mine.

EXPAND AVERAGE PRODUCTION RATE

The size of the deposit and the resultant open pit configuration limit the size of the mining equipment and, thereby, restrict the hourly production rate. The daily and annual production rate can be increased by mining more than eight hours per day and/or five days per week as proposed. The Local Agreement, however, does preclude significant increases in mining time since blasting, crushing, and rail shipment are restricted to daylight hours. The upper limits of ore production are also influenced by the available capacity of the processing mills under consideration.

A shortened mine life due to an expanded production rate would lessen the time for potential environmental impacts but socioeconomic impacts to the community would be intensified due to a shorter employment period for more workers. The advantages of an expanded production rate are higher annual employment, higher tax revenues per year, shorter term for land surface impacts, and less total water to treat and discharge from the wastewater treatment plant. The disadvantages are increased dust emissions due to increased vehicular traffic, increased noise and aesthetic impacts due to round-the-clock activities, and increased commuter traffic.

Temporary increases in the proposed daily production rate are likely because of the need to make up for days when the mining rate is lower than planned. A significantly higher average daily production rate would be unlikely over a long period of time due to constraints of pit size, equipment capabilities and the limitation of receiving processing facilities.

REDUCE AVERAGE PRODUCTION RATE

Operating at a reduced average production rate is also possible. Major reasons for reducing average production rates would be a significant lower metal demand and copper prices. Temporary reduced daily production rates are likely over short periods of time due to equipment failure or scheduled maintenance, transportation problems, fire, or other reasons.

The advantages include reduced fugitive dust and noise impacts per day and slightly less impact on the community infrastructure since the work force is fewer in number. The disadvantages are more total wastewater to treat and discharge from wastewater treatment plant and an extended time-frame for the land surface impacts.

This option is economically less attractive to Flambeau Mining Co. because of the reduced annual cash flow without a corresponding decrease in capital investment. It would also result in fewer, but longer term, jobs for local residents and less annual tax revenue to the state.

MINE WATER INFLOW CONTROL ALTERNATIVES

Four methods of water inflow control were considered. They are perimeter dewatering wells, slurry walls, an in-pit perimeter trench, and an in-pit sump system. The intent of any of these systems is to decrease water inflow thus minimizing treatment costs and discharges.

Due to the inherent climatic and hydrogeologic conditions, some groundwater inflow will occur regardless of what water inflow control measures are employed. This inflow into the pit must be treated before discharge.

PERIMETER DEWATERING WELLS

Perimeter dewatering wells would intercept clean groundwater thus minimizing inflow to the pit. The intercepted water could be discharged or used for mitigation and other mining activities. Several hydrogeologic studies predict that a perimeter dewatering well system would be marginally effective due to low soil permeabilities unless numerous wells were installed. This alternative would have high construction and operating costs.

PERIMETER SLURRY WALL

This system could effectively minimize inflows, and would have minimal operational costs. Installation costs would be high and greater land disturbance would occur. In addition, even though most of the groundwater seepage would be stopped, an in-pit sump would still be required to collect rainwater for wastewater treatment.

IN-PIT PERIMETER TRENCH

An in-pit water collection trench was considered, but soil borings and groundwater monitoring well data indicate the Precambrian bedrock surface is quite irregular. Therefore, the perimeter trench would have to be cut into the highly weathered bedrock to be effective. If this were not done, groundwater could seep below the trench in areas where the trench rested on or above Cambrian sandstone or glacial sands and gravels.

IN-PIT SUMP SYSTEM

Current hydrogeologic data indicate groundwater seepage into the pit will not be uniform around the perimeter. Some areas, such as the outwash on the north side of the pit, will probably supply moderate amounts of groundwater throughout the life of the project. It is also proposed that preproduction pit dewatering take place before starting excavation of the ore in the open pit. A series of trenches parallel to the deposit, dug to a depth which is above the bedrock but not greater than the limit of the excavating equipment, should assist in reducing the amount of groundwater seepage when the project proceeds into mining.

This approach is highly flexible since sumps with trenches located parallel to the pit perimeter can be constructed. Sumps are less costly to construct and maintain since excavation and installation is simple and only relatively small amounts of material must be removed to intercept any significant seepage. The in-pit sump collection system with trenches is the most efficient, flexible and practical method to intersect groundwater inflow.

The disadvantages are that the operational cost to pump, transfer, and treat collected water will be higher than a single perimeter trench system.

SURFACE FACILITIES SITING ALTERNATIVES

This section addresses alternative locations for the surface facilities of the project. These surface facilities include three major items: 1) low sulfur waste rock stockpile, 2) high sulfur waste rock stockpile, and 3) physical plant facilities such as the wastewater treatment plant.

Site selection for the surface facilities are predicated on the location and orientation of the deposit. Capital and operating cost considerations, wetlands, and various other environmental concerns were used individually or in combination in order to arrive at the proposed site layout described in the mine plan and in Chapter 1.

Ideally, all surface facilities should be close to the haulage road exit from the pit for logistic and mine operation cost considerations. At the Flambeau site, this would be on the north side of the mine. Land surface restrictions, setbacks, and natural barriers such as the Flambeau River do not allow for location of all surface facilities on one side of the pit.

SURFACE FACILITY SITE SCREENING

Areas considered for alternative sites included 1) north of Blackberry Lane in Section 9, 2) south of the deposit in Section 16, and 3) east of the deposit in Section 10.

Factors considered when evaluating alternate sites included costs during construction and operation, and proximity of the high sulfur waste rock stockpile, crusher, and ore loadout facilities to the wastewater treatment plant. Locating the plant facilities as far south of Ladysmith as possible to minimize noise and dust impacts was a factor also.

Northern Alternative

Blackberry Lane, located north of the deposit, partially separates land owned by Flambeau Mining Co. from privately owned land. Site selection north of Blackberry Lane was discontinued because of the following disadvantages: proximity to the community of Ladysmith and land held in private ownership, less suitable soil conditions, close proximity to the Flambeau River, and conflict with the active gravel pit operation.

Southern Alternative

The area south of the proposed project area in Section 16 and extending to Meadowbrook Creek was also considered but rejected early in the site selection process. Haulage distances around the east end of the pit and south into Section 16 are long. Available land for waste rock storage is limited, being restricted to a narrow, elongated strip located between the STH 27 setback on the east and the river to the west. Haulage distance to the south end of the site and return to the pit is over two miles. Environmentally, the site is unattractive, as it is located in a mature forest parallel to the Flambeau River.

Consideration was given to locating the crusher and crushed ore conveyor south of the high sulfur waste rock stockpile in Section 16. However, the need to control contact water from this location would require construction of another costly high-density-polyethylene (HDPE)- lined system and pumping facilities. This was not considered a viable alternative.

Eastern Alternative

An alternative site for all surface facilities lies in Section 10 east of STH 27 and west of the railroad track. Doughty Road and Jansen Road lie to the north and south respectively. Preliminary screening of alternative surface facility layouts concluded that this option was undesirable due to increased aesthetic intrusions due to bridge construction and truck operations; increased land area affected for extended haul road; increased air emissions and noise from additional truck traffic; and the need to collect and return contact water to the mine site or discharge to wetlands in Section 10. Although this alternative would eliminate the need for variances from setback criteria from STH 27 for surface facilities, the environmental disadvantages offset the advantages of setback compliance.

Split Site Alternative

Another alternative is a split facility layout as shown in Figure 4-1. This layout could be configured to comply with most setback requirements. Storage of low sulfur material and topsoil would be in Section 10 near the proposal rail corridor. The high sulfur waste rock stockpile could then be moved north of the open pit to the area presently proposed for the low sulfur materials stockpile. The plant facilities south of the pit close to the spur track, also could be rearranged to comply with setback requirements.

Locating the low sulfur waste rock stockpile in Section 10 would have similar impacts on topsoil and landforms as the location proposed in Chapter 1. The only significant difference would be the additional area disturbed when constructing the haul road to the stockpile. Storage of the low sulfur material in Section 10 adds about 4,000 feet of additional haul road to the overall haul distance for the project. This alternative increases TSP emissions by about 40% and significantly increases the potential area affected.

The alternative location is 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 Flambeau Mining Co.-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-Flambeau Mining Co.-owned residences to the north of Blackberry Lane west of STH 27 and along the south side of Jansen Road east of STH 27 would be downgradient. The glacial till at this location could adsorb the metals leaving from the stockpile. It is likely that the metal constituents of the leachate would be reduced to background levels before reaching any of the private wells.

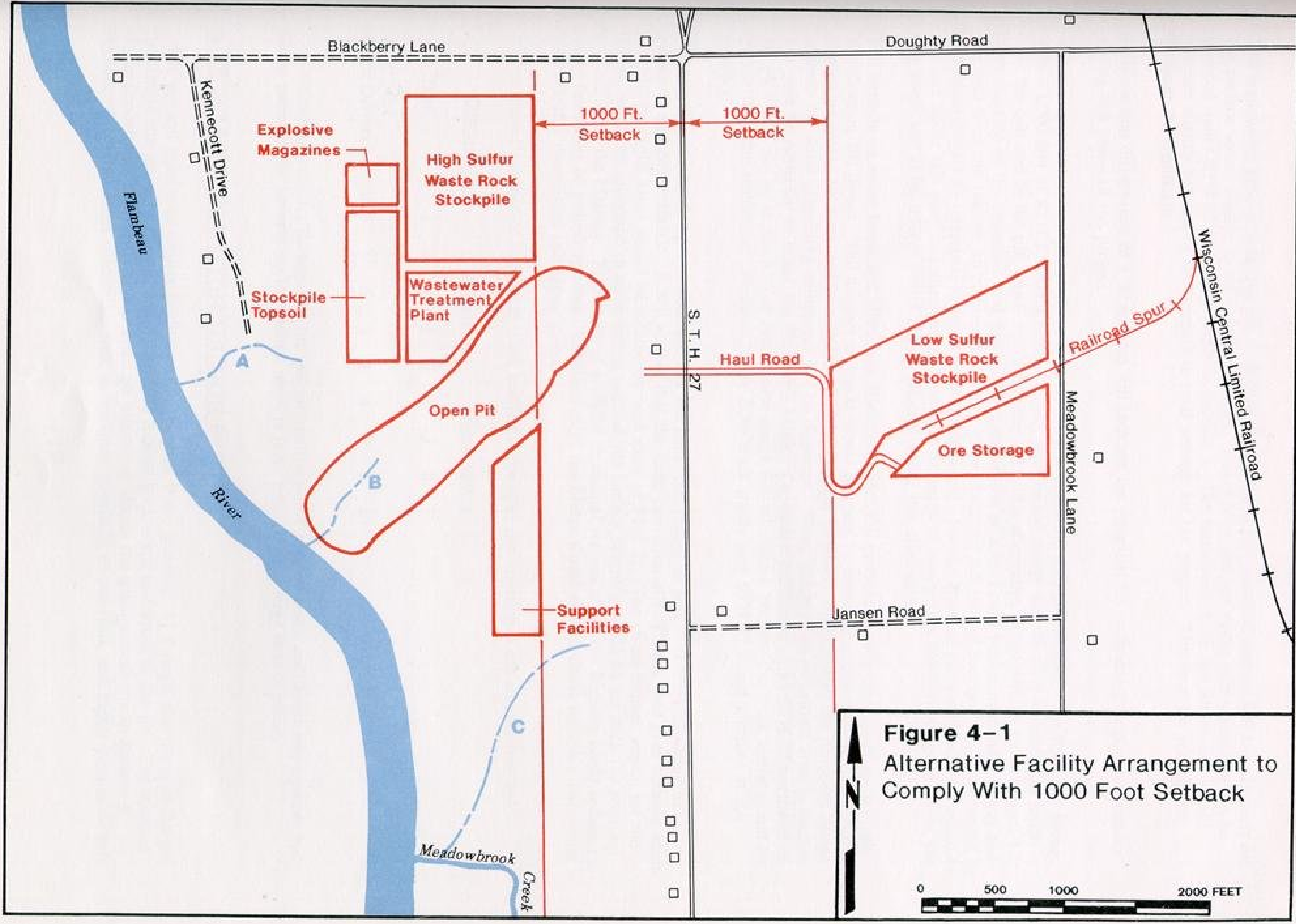


Figure 4–1
Alternative Facility Arrangement to Comply With 1000 Foot Setback

The wastewater generated by the use of Section 10 for low sulfur material storage will have impacts on the surface waters similar to the proposed design. Water from the low sulfur 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.

Construction disturbance of a larger area will increase the potential for sediment transport and erosion during this phase of the project.

The configuration of the pit would remain unchanged under the split site design. 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 would disturb an additional 1.3 acres because of the extended haul road. The construction of a 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. There would be additional impact to terrestrial ecosystems with this layout. Similar types of plant communities would be affected under this proposed alternative. However, 5.0 acres of low-quality northern sedge meadow, the dug pond, and alder thicket would not be affected under this alternative.

The impacts on noise levels and vibrations discussed under the proposed action also apply to the split site (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 proposed design because the noise generating equipment will be dispersed. Thus, although an additional area in Section 10 would be subjected to noise, the Flambeau Mining Co.-owned residences along STH 27 northeast of the pit would not be exposed to as much noise under this alternative because the truck traffic would be further from the residences. However, noise from truck traffic over STH 27 would increase at the crossing.

Visually, Section 10 changes in land use and the haul road bridge to pass over STH 27 would be perceived as more dramatic. It will appear that the mine operation affects more land area because waste material stockpile areas would be located on both sides of STH 27. The visual impact, except for the bridge, would be mitigated to some extent because the surface facilities would be set back the required distance from the highway. Placement of artificial or natural screens along the highway could reduce the visual intrusions of project features. Elimination of the bridge would reduce visual intrusion but would add to traffic congestion and safety issues.

The estimated number of additional truck traffic for the split site alternative are summarized below:

	Construction	Operations					Reclamation		
Year	1	2	3	4	5	6	7	8	9
Additional Truck Drivers	5	4	5	3	1	4	5	5	6

The additional truck traffic required for this alternative would provide some additional employment but would increase the adverse environmental impacts (e.g., noise, dust, energy consumption).

SITE SELECTION WITHIN SECTION 9

Three general layouts of project facilities within Section 9 are possible: 1) a single site north of the pit, 2) a single site south of the pit, and 3) facilities located both north and south of the pit. The location of the deposit and resultant ultimate open pit effectively bisects the acreage available in Section 9. Because of this and other constraints such as wetlands, proximity to the river, and highly permeable soils in the northwest corner of Section 9, a split layout was considered by Flambeau Mining Co. to be the most viable of these three alternatives.

Waste Storage Areas

The acreage required for the stockpiles is a function of the amounts of waste materials identified within the pit, pit wall slope (ore-to-waste ratio), angle of repose of the truck-dumped materials, and height of the waste pile. Height limitations of 75 feet for storage of waste rock are contained in the Local Agreement. Given this height limitation these areas were determined to be 40 acres and 27 acres in size for the low sulfur and high sulfur waste rock stockpiles, respectively.

Site selection involves consideration of economics, distance from the community, zoning restrictions, proximity to wetlands, underlying soil conditions, and groundwater flow direction. Siting of either stockpile must consider the attenuation capacity of native soils. Leach volume testing and local soil attenuation studies concluded it is preferable to locate stockpiles over silty soils where metal ions in the seepage could be attenuated. These soils are absent or thin in the gravel pit and northwest of the ore body. It is also desireable to preserve the Flambeau River environment and aesthetics and, for this reason, to locate the stockpiles as far away from the river as practically possible.

Locating the high sulfur waste material north of the pit would improve project economics through shorter haulage distance, decrease fuel consumption and utilize existing tree screens along the west side of STH 27. On the negative side, seepage from the storage area, would have increased potential of entering the groundwater and the Flambeau River because of the greater permeability of underlying soils. If the stockpile were located north of the pit, it would be hydraulically downgradient of the open pit, the pit would not intercept any contaminated groundwater. The ability to combine the ore and high sulfur material handling facilities (crusher, ore loadout and waste rock stockpile) onto a common lined area would be lost. It would be visible from the Flambeau River and closer to the community of Ladysmith. A variance to construct the facility within 1,000 feet of STH 27 would be required.

Locating the low sulfur waste rock stockpile south of the pit would result in a reasonably short haulage distance and would not be visible from the Flambeau River. It would, however, still be visible from STH 27 and a variance to construct the waste storage area close to the highway would be required.

Filling the existing inactive gravel pit northwest of the proposed open pit with low sulfur material is an alternative, but this would add to the operating cost given the longer haul distances, site topography, and reclamation plan. It would also not provide the native silty soils for attenuating metals in the seepage.

Topsoil Stockpiles

Both of the alternative topsoil storage sites under consideration and the proposed alternative are located within Section 9. The vehicular traffic variations between the three stockpile locations studied are very minor. TSP emissions during construction and reclamation for the two alternative topsoil stockpiles are within five to ten percent of the emissions projected for the proposed location.

One of the alternative locations for the topsoil storage is the inactive gravel pit northwest of the open pit. The waste characterization study showed the topsoil is capable of releasing iron and manganese. Since gravel has little capacity to absorb significant quantities of metals, 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 Flambeau Mining Co.-owned residences along the river south of Blackberry Lane, means that the impact on groundwater quality could be greater under this alternative.

Placement of the stockpile in the abandoned gravel pit would not affect any natural communities. It would limit access to a portion of the gravel resource during the construction, operation, and reclamation phases. Use of the gravel pit was rejected since the haul distance is the longest, and because it could complicate removal of gravel should any be required during and after the operation.

Another alternative location of the stockpile is between the abandoned gravel pit and the open pit area. This location would affect seven acres of old field/early successional and upland mixed forest communities. This intermediate site offers no distinct advantages (e.g., energy use, aesthetics, etc.) over the proposed site.

Neither of the alternative sites would have significant land use disturbances. For example, there will be no wetlands or residential homes impacted under any of the topsoil stockpile siting alternatives.

The stockpile would not be visible from the highway for either of the alternate sites. The alternative locations, however, would not provide the screening effect achieved with the proposed topsoil stockpile with respect to pit noise, truck egress from the pit, and related operations. Other screening measures could be provided.

Railroad Spur Alignments

Two railroad spur alignments were considered. In choosing spur line alignments, factors such as length of line, utilization of natural contours to minimize cut and fill, and avoidance of wetlands were considered. The first alignment runs parallel and north of Jansen Road. The second alternative crosses STH 27 at the same location as the first alternative, then proceeds north to join the proposed design. These two alternatives, however, were rejected by Flambeau Mining Co. as being too close to the intersection of Jansen Road and the plant access road to STH 27.

Treated Wastewater Discharge Points

Treated wastewater could be discharged at alternate locations on the Flambeau River or to one of the intermittent streams near the site. Effluent limitations would provide equal water protection to either receiving water. Discharge into the intermittent stream, while possibly having economic advantages, could increase stream bed erosion and flooding risk.

Settling Ponds

The primary alternative site for the settling ponds to serve the runoff from the low sulfur waste rock stockpile is the abandoned gravel pit. The gravel pit would be aesthetically well-positioned and could accept water via gravity from the low sulfur waste rock stockpile. This site would be more difficult to discharge to Wetland 1 if needed. A pump system would be required to lift and transport the clarified water out of the gravel pit to the river for disposal.

This location would have no affect on any natural community. A portion of the pit, however, would not be available for gravel if required for the project. Ponds within the gravel pit could also seep considerable quantities of wastewater into the groundwater.

ORE TRANSPORTATION ALTERNATIVES

There are two major transportation systems for delivery of ore to out-of-state processing plants. Rail haulage is the most efficient way to deliver ore out-of-state. Truck haulage was rejected because of the long distances involved and the low unit value per ton of material. Such a method is not considered viable for interstate hauling, but is an alternative for taking crushed ore to the mainline railroad system.

Two alternatives for transporting crushed ore from the plant to the existing mainline railroad are available. Trucking would require the construction of a costly bridge over STH 27 and haul road along the proposed spur line corridor to minimize the impact of truck traffic on public roads. A conveyor system is feasible, but would have higher operational costs than the proposed rail spur. There would, however, be less environmental disturbance along the corridor.

Either of these alternatives would require loadout facilities at the mainline track. These loadout facilities would need to be lined and captured contact water would need to be transported back to the wastewater treatment plant by tank truck or pipeline.

Appreciably higher vehicular emissions, approximately 25% greater than the proposed design would be associated with hauling ore to the railroad mainline by truck. Construction of a bridge over the highway would present a visual intrusion that cannot be effectively screened. 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 additional employment might be offset by the loss of employment by others under the proposed action.

While this alternative does remove the inconvenience of rail cars crossing STH 27 (about 8 round trips per week) , it poses additional aesthetic impacts, adverse economics, and contaminated water handling.

OPERATIONAL ALTERNATIVES

INTERNAL PIT STORAGE OF WASTE ROCK

This alternative was evaluated to determine the viability for minimizing the handling and storage of waste materials.

Under this scenario, mining would be conducted in four phases. The first phase would entail removal of all glacial till, sandstone, and saprolite from the proposed pit to a stockpile. During the second phase the west one-half of the deposit would be mined with the waste rock deposited over the east end of the proposed pit. Phase 3 would involve backhauling the Phase 2 waste rock to its original position followed by mining the east one-half of the deposit, using the west end of the pit as a storage area. Upon completion of mining at the east end of the pit, the waste rock would be backhauled to the east end of the pit. In the final phase, saprolite, sandstone, and glacial till from the stockpile would be returned to the pit and the surface would be reclaimed.

This option would minimize fugitive dust due to shorter hauling distances, consume less fuel, and minimize land disturbance. Over the project life, the dust emissions for this option would be about 8% lower than for the proposed operation. Other emission rates for this alternative would be the same. Site aesthetics would be improved because there would be only one waste stockpile. This would reduce reclamation time and cost at the end of the operation.

In-pit storage of waste rock would disturb approximately 27 fewer acres than the proposal since the high sulfur waste rock stockpile would not be required. This option would not affect the need for or the size of the low sulfur waste rock and topsoil stockpiles. The volume of the piles, however, would be 25% and 15% smaller, respectively. The long-term effects on soil and landforms are largely the same as those produced by the proposed method.

Approximately five acres of low quality disturbed wetlands would not be affected under the in-pit option, compared to the proposed design.

About 27 acres of six different plant communities (e.g., agricultural, upland mixed forest, old field/early successional, northern sedge meadow/alder thicket, dug pond, and northern sedge meadow), none of which are unique, would remain undisturbed and would not require reclamation.

During construction the aesthetic impacts of the in-pit storage of waste rock would differ slightly from the proposed design. The high-sulfur waste rock stockpile would be located in the pit and would be visible from slightly different viewpoints. The height of the low sulfur waste rock stockpile would be 25 percent lower.

Under this option, the in-pit stockpile would reach a height of 50 feet. The stockpile would be visible from the river during much of the second half (project years 4 to 6) of the operational period when it is piled over the backfilled western half of the pit.

The in-pit stockpile over the eastern half of the open pit would create a 60-foot-high pile behind the proposed topsoil stockpile and observation platform during project years 2 and 3. Portions of the in-pit stockpile may be visible depending on the viewer's position and the height of the stockpile. The visual impact of the in-pit stockpile will be of shorter duration (two to three years) than the proposed design.

All other visible features of the project described in Chapter 1 would be similar under the in-pit storage alternative.

The disadvantages of this alternative include safety concerns due to increased height of waste piles and decreased operating room. Mining efficiency and flexibility would be reduced because of smaller operating pits and fewer ore faces exposed. No cash flow from the project would occur when switching from the west end to the east end of the pit. This alternative would present greater difficulty in separating, managing, and backfilling waste rock because of the restricted size of the pit perimeter. Collecting and controlling contaminated water from in-pit stockpiles would be more difficult.

Conveyor Versus Truck Haulage

Truck or conveyor techniques are the feasible alternatives for ore removal from the open pit. Waste rock would need to be hauled by truck because the quantity and multiple destination points renders conveying uneconomic and operationally awkward. Conveying the ore also would require the placement of a mobile crushing unit within the pit. Listed below are the advantages and disadvantages of using an in-pit crusher and conveyor systems to transfer ore out of the pit.

In-pit crushing would reduce fugitive dust emissions and ambient noise levels at the site perimeters. It should reduce the quantity of contaminated water from requiring treatment because ore haul and surface crushing eliminated or significantly reduced.

The disadvantages include restricted flexibility and maneuverability in the pit during mining; high capital cost and operational costs due to frequent readjustment of the conveyor system.

In-pit crushing and conveyor belt of ore from the Flambeau pit is less practical because it is long, narrow and short-lived. Conveyor systems are most advantageous in a large open pit where the benches are wide and conveyor realignments are infrequent.

SLUDGE HANDLING AND DISPOSAL

An alternative method of preparing wastewater treatment plant sludge for disposal may be to produce a sludge having 50% solids by weight as opposed to the proposed sludge containing 25% solids. The 50% solids option would utilize a vacuum filter in the wastewater treatment building to produce the thickened sludge. Sludges this thick present a material handling problem. They are sticky and colloidal in nature, and require a specially designed dump truck for transport. Disposal on the stockpile would be by "tailgating" from the dump truck which could result in less uniform layering at the disposal site. Operational costs would also be higher.

An alternative method of disposing of the sludge would be to place the material into a suitably designed landfill. This could include a Flambeau Mining Co. constructed on-site landfill or a suitable facility at another location. Sludge would probably need to be thickened in order to be landfilled. Landfill disposal could provide secure, long-term containment of the sludge and treatment of any leachate from the facility. Such a facility, however, would probably increase the regulatory licensing timeline and would add to project construction, operation, and closure costs. An on-site landfill may permanently restrict the land use of a small parcel of land.

Sludge from the settling ponds could be disposed of on the high sulfur waste rock stockpile. This would ensure that any metals in the sludge would be contained within the high sulfur waste rock or the wastewater treatment system.

WASTEWATER TREATMENT AND DISCHARGE ALTERNATIVES

Treatment Alternatives

Three alternative treatment technologies for the wastewater were evaluated: ion exchange, reverse osmosis, and brine concentration.

Ion exchange would involve the following steps: filtration, treatment by both cation and anion resins in separate exchange units, pH adjustment, aeration, and filtration. The treatment resins would need to be periodically regenerated with acid and caustic, producing a hazardous waste stream at about 10-15% of the influent rate.

Reverse osmosis would entail filtration to remove suspended solids and then forcing the wastewater through a semi-permeable membrane to remove heavy metals. This treatment alternative would produce a hazardous brine at about 10-20% of the influent flow.

Brine concentration is a process in which the wastewater is filtered, heated, deaerated and vaporized. The vapor is then compressed, condensed and discharged. About 2% of the influent flow is produced as a hazardous brine.

A facility to retain treated wastewater for a period of time prior to discharge could be included with the proposed design. Retention time would allow testing of the wastewater before it is discharged and could facilitate removal of any hydrogen sulfide present in the effluent.

Settling Ponds Design Alternatives

The proposed design for the settling ponds does not include any type of lining on the pond bottoms. As a result, substantial quantities of wastewater could seep through the bottoms of the ponds into the groundwater. An alternative design would be to decrease the permeability of the pond bottoms in order to minimize seepage of wastewater. This could be accomplished by removing high permeability soils from the pond bottoms during excavation and lining the ponds with processed on-site soils. Seepage from the ponds could be virtually eliminated by lining them with a synthetic material similar to the HDPE which would be used under the high sulfur waste rock stockpile. Lining the settling ponds would minimize or eliminate the discharge of contaminants to the groundwater and would be consistent with the design requirements for wastewater lagoons of other industries.

Wastewater Disposal Alternatives

The primary alternative for disposal of project wastewater would be land disposal. This alternative would utilize methods such as seepage basins, spray irrigation, ridge and furrow fields, or subsurface absorption beds. Any of these methods of disposal would require additional land disturbance. Also, land disposal is primarily suitable for effluents which contain biologically degradable pollutants.

Flambeau Mining Co.'s wastewater would contain inorganic pollutants such as metals. Metal cations would tend to be adsorbed by soil particles but would not otherwise be degraded or removed from the soil system.

MONITORING ALTERNATIVES

The monitoring alternatives primarily involve increasing the intensity of proposed monitoring or adding new monitoring techniques. Alternative monitoring plans could be implemented for groundwater, surface water, air quality and terrestrial ecology.

In general, monitoring could be enhanced by increasing the number of samples and/or the number of parameters analyzed in each sample. However, the proposed monitoring scheme provides a minimally adequate sampling intensity for groundwater, surface water and ecological monitoring, and additional sampling would be increasingly less cost effective.

Monitoring could also be enhanced by extending the duration of monitoring after the project ends. The proposed plan calls for ending surface water monitoring and ending or decreasing groundwater monitoring at various points after project closure. Continued monitoring would provide additional assurance that conditions at the reclaimed mine site have progressed as expected and stabilized.

Monitoring at project facilities could serve as an early indicator if facilities were not functioning as expected. Collection basin lysimeters are monitoring devices commonly used beneath facilities such as landfills to determine the quality and quantity of leachate seeping through the facility. Collection basin lysimeters could be used under the high sulfur waste rock stockpile to determine if the liner system was performing as designed. Lysimeters could also be installed under the settling ponds to monitor the quality and quantity of wastewater seeping to the groundwater. Monitoring with lysimeters at these facilities would lessen the need for an extensive groundwater monitoring network.

Total Suspended Particulates (TSP) emitted from the mine site could be monitored with particulate monitors. These monitors would provide information on the amounts of dust released from the site and samples of the dust which could be analyzed to determine its composition. Another method to monitor TSP emissions would be to measure the opacity of the air near the site. Monitoring could also be conducted for other air pollutants, but would probably not be useful due to the low emission levels.

A wide variety of alternative monitoring techniques exist. However, none of the alternative techniques offer distinct advantages over proposed techniques.

MITIGATION ALTERNATIVES

Impacts to Wetland 1 from the groundwater drawdown could be mitigated with groundwater obtained from a well rather than with wastewater. This alternative would provide a source of supplementation water during the years after the mine has closed but before the groundwater has rebounded to near the pre-project level. If the groundwater seep to Wetland 1 does not reappear, this alternative would not be a viable permanent mitigation measure.

Other wetlands which could be affected by the groundwater drawdown (5c and 6c) could be monitored, and mine-related impacts to water levels could be mitigated in a similar fashion. Constructing and operating a system to deliver well water to affected wetlands would involve additional costs to Flambeau Mining Co.

Seismic vibrations could be minimized by using the minimum effective charge per blast or by using more delays per blast. Reducing the charge weight would reduce peak particle velocities but would increase the frequency of blasting. Modifying the blasting procedures in response to monitoring data or public complaints would help mitigate adverse impacts.

Noise impacts from the crusher could be mitigated by enclosing the crusher in a building or by locating the crusher below surface grades. Noise impacts from truck operations are largely unavoidable, but could be partially mitigated by minimizing nighttime operations.

Dust emissions from the stockpiles could be minimized by the use of chemical dust suppressants and sealers. Emissions from the crusher could be mitigated by enclosing the crusher in a building with a filtered exhaust. Dust from vehicular operations could be partially mitigated by paving frequently traveled roads and minimizing vehicle speeds.

RECLAMATION AND FINAL LAND USE ALTERNATIVES

One alternative for reclaiming the mine site would be to not backfill the pit, allowing the pit to fill with water to form a lake. The creation of a small lake could increase the aesthetic value of the project site and add to the land value. This alternative was considered in detail in the 1970s. Landscaping of the pit prior to flooding could involve sloping and contouring to provide a useable and visually pleasing shoreline. In addition, tree plantings could be made to assist in slope stabilization together with establishment of ground cover. Once completed, this lake could provide recreational benefits at the site. This alternative would also require permanent disposal of the waste rock on the land surface. Waste rock on the land surface would pose a long-term potential for groundwater contamination. An engineered facility for waste rock disposal would entail additional costs, and would restrict future land uses over the disposal areas. A modification of this option would be to backfill the high sulfur waste into the bottom of the pit and cover it with saprolite, forming a more shallow lake. The remaining pit walls could be sloped to create a desirable littoral zone, establishing a lake with enhanced recreational values. Excess waste materials could be sloped for ski trails and sledding hills, hiking trails, etc.

The site could be reclaimed to support forestry or agricultural uses. These land uses are common in the area. A variety of revegetation schemes could be employed to support the proposed and alternate land uses. The site could be planted to simulate the existing vegetation. This alternative would be less beneficial for wildlife and offers no distinct advantages.

Wetland restoration could be more extensive to provide additional ecological and hydrological value to the site. The wetland over the backfilled pit could be larger or additional wetlands created elsewhere on the site. The small wetlands directly impacted by the project could be restored. Additional restored wetland acreage would help to assure that wetland impacts are fully mitigated. Storing hydric soils in an alternate location would minimize impacts to the remnant of Wetland 2.

The reclamation plan could include a proposal to monitor settling of the land surface over the pit and to regrade the area if necessary after settling is complete. This alternative would ensure that long-term land uses over the pit were not impaired by uneven topography and that surface water drainage patterns were maintained.

Different material, such as a lower permeability clay or a bentonite admixture, could be used to replace or augment the saprolite layer on top of the backfilled waste rock. However, the function of the saprolite layer is only to impede water movement from the overburden aquifer into the backfill and the slightly lower permeability which could be achieved by using an alternate clay would not significantly contribute to this function. Use of an alternate clay would involve additional costs and off-site impacts.

Reclamation wastes such as demolition debris could be disposed of in a separate off-site facility. The on-site facility could be located elsewhere on the property, but alternate sites would entail additional environmental disturbances without any significant environment. Some of the reclamation wastes could also be salvaged and recycled. Metals and perhaps the plastic liners could be segregated from the wastes and sold or given to salvage dealers.

The primary alternative for final use of the surface facilities would be for a different industrial use. The railroad, access road, utilities and building facilities from the mining project could be utilized for a variety of industrial purposes. Upon completion of mining, alternative uses of the surface facilities would be re-evaluated. If no desirable alternative uses of the surface facilities are found at that time, the buildings, equipment, rail line, and pavement would be removed and disposed in accordance with the reclamation plan.

CHAPTER FIVE
COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND RESPONSES

GOVERNMENT AGENCY COMMENTS

The DEIS was distributed to federal, state and local governmental agencies having special expertise, interests or jurisdiction related to the project period. Comment letters from these agencies are reproduced in their entirety in the following section. Each comment requiring a response is numbered in the margin. In the subsequent section, DNR's corresponding response to each numbered comment is provided.

United States Department of Agriculture
Soil Conservation Service
6515 Watts Road, Suite 200
Madison, WI 53719-2726

RECEIVED - DNR
SEP 18 1989
ENVIRONMENTAL ANALYSIS

September 13, 1989

Ms. Kathryn A. Curtner
Director, Bureau of Environmental
Analysis and Review
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

Dear Ms. Curtner:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Flambeau Mining Company's proposed open pit copper mine near Ladysmith, Wisconsin. The anticipated work will have no adverse impact on agricultural land or operations.

We appreciate the opportunity to comment.

Sincerely,

DUANE L. JOHNSON
State Conservationist

1 Enclosure

The Soil Conservation Service is an agency of the Department of Agriculture

---

Tommy G. Thompson
Governor
Gerald Whitburn
Secretary

Mailing Address:
201 E. Washington Avenue
Post Office Box 7946
Madison, WI 53707-7946
Telephone (608) 266-7552

State of Wisconsin
Department of Industry, Labor and Human Relations

September 19, 1989

RECEIVED - DNR
SEP 22 1989
ENVIRONMENTAL ANALYSIS

Ms. Kathryn A. Curtner, Director
Bureau of Environmental Analysis and Review
State of Wisconsin
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

Dear Ms. Curtner:

Thank you for sharing a copy of the Draft Environmental Impact Statement (DEIS) for the Flambeau Mining Company's proposed open pit copper mine near Ladysmith, Wisconsin.

The Division of Safety and Buildings has reviewed the DEIS in terms of the agency's programs on responsibilities and finds that the proposal does not adversely affect the Safety and Buildings' operation.

If you have any specific questions, please contact Richard Meyer at 266-3080.

Sincerely,

Gerald Whitburn
Secretary

cc: Richard Meyer

SEC-7792 (R. 7/89)

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1421 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-1479

October 5, 1989

REPLY TO ATTENTION OF

Construction-Operations
Regulatory (89-1782N-23)

Mr. George Albright
Chief EIS Development Section
Department of Natural Resources
P. O. Box 7921
Madison, Wisconsin 53707

RE: 1630

Dear Mr. Albright:

We have reviewed the Draft Environmental Impact Statement (DEIS), Flambeau Mining Inc. - Copper Mine, Ladysmith, Wisconsin, pursuant to the Corps of Engineers operation and maintenance, civil works, and water regulatory authorities.

Those portions of the project covered by Corps of Engineers regulatory jurisdiction are authorized by an existing nationwide Department of the Army permit (enclosure). The determination has been fowarded to BP Minerals America and was based on: "Application for water regulatory permits and approvals for the Kennecott-Flanbeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 1989." If the design, location, or purpose of the work authorized by the permit is changed, additional review may be required by this office to insure that the work covered by Corps of Engineers regulatory jurisdiction complies with the terms and conditions of permit.

If you have any questions, write or call David Dralle at the Corps, (612) 220-0374

Sincerely,

Ben Wopat
Chief, Regulatory Branch
Construction-Operations Division

Enclosures

Copy furnished:
Mr. L. E. Mercando
Project Manager, Flambeau
BP Minerals America
1515 Mineral Square
Salt Lake City, Utah 84112

TESTIMONY OF THE WISCONSIN PUBLIC INTERVENOR AT THE PUBLIC HEARING ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE KENNECOTT/FLAMBEAU MINING APPLICATION

OCTOBER 6, 1989

Ladysmith, Wisconsin

My name is Kathleen Falk, and I am a Wisconsin Public Intervenor. The Public Intervenor Office is located in the Wisconsin Department of Justice and is directed by state statute to be a "watchdog" for the environment, to intervene wherever necessary to protect "public rights" in the natural resources of our state. Our office is advised by a Citizens Advisory Committee which is composed of citizens from around the state, who are appointed by the Attorney General, to select priorities and particular cases for intervention. Mr. Dale Daggett, a Town of Grant dairy farmer, has been a member and leader on the Citizens Advisory Committee for many years and he is with me here tonight.

At its June 1987 meeting, immediately following Kennecott's announcement that it intended to seek permits to mine a copper body in Rusk County, the CAC requested the intervenors review the Kennecott mine proposal and speak out on behalf of public rights in the natural resources. This was not a surprise nor a new direction for our office. We have been deeply involved in mining issues since the mid-1970's when Kennecott first attempted to obtain mine permits and commence an era of modern day mining in Wisconsin. At that time, the CAC recognized that Wisconsin was not in any position to intelligently determine whether, or under what conditions, Kennecott or any other mining company should be permitted to mine here. It was very evident that Wisconsin did not have an adequate regulatory scheme for metal mining. There was a long agenda of work to do. Many unanswered environmental questions in the mining laws existed; and there were many questions that had known, but disturbing answers.

And so, given the environmental risks at stake with mining, and the lack of adequate regulation to protect Wisconsin, the Public Intervenor's Citizen Advisory Committee directed the intervenors to vigorously oppose the Kennecott mine fourteen years ago. The culmination of efforts of many citizens stopped the mine permitting process. Our office and others then turned our attention to the Wisconsin Legislature to set in place a better regulatory scheme by which to judge future mine applications. The laws that exist now set the standards by which this mining application is to be judged, and bring us to the hearing tonight--which concerns the Department of Natural Resources' first attempt at summarizing for the public the potential environmental effects of this project and the alternatives to it.

It was thought that the first test of these news laws would be by Exxon U.S.A., when it announced in the early 1980's its intention to mine a very large zinc deposit in Crandon, in the northeastern part of the state. But two years into the mine permit process, and just short of issuance of the final environmental impact statement, the company withdrew its applications due to adverse market conditions, i.e., the low price of zinc.

Given this history, the CAC's 1987 decision that we should participate in the Kennecott application was surely no surprise. This time around, however, two facts were very different. First,

the company does not propose to do any processing in Wisconsin, thereby eliminating one of the most significant and long-term environmental questions about mining--how to handle the long-term pollution effects of mine "tailings." And second, the citizens' concern about the toxicity of an open pit that would fill up with water over future years will not be an issue given the company's environmently preferable choice of backfilling the open pit with waste rock.

These significant facts, as well as the ever present fact that our office receives citizens calls nearly every day of the year asking us to help them on other environmental problems, caused our Advisory Committee to direct the intervenors to concentrate on the groundwater aspects of this proposal. Because it appears that the most significant effects of the mine to the environment would be on groundwater, our office has not devoted the time and attention to other issues such as noise, air pollution, and surface water discharge as we have to questions about how this project may affect both the groundwater quality and groundwater levels in Rusk county in future years.

This choice by the CAC should in no way be interpreted to mean that other potential impacts of the mine are not important. It merely means that the CAC made a choice to devote limited Public Intervenor resources to what it viewed as the potentially most signifiant impacts.

Another significant point about the Committee's 1987 decision was its emphasis that our office should try to obtain as much environmental protection as we could, starting from the day the company first announced its intention to mine, rather than by reacting to the company's applications several years later. The Committee believed that the environment would get the most protection, the biggest "bang for the buck" so to speak, by watchdogging the DNR and the company from the outset before the applications were even filed--as the company gathered data about the existing site, developed technical modeling techniques on how to predict future impacts, reviewed alternatives, and made major decisions on how it would propose to mine. It was the CAC's hope that early and constant advocacy during the preapplication process would make the application more environmentally sound and the need for ardent advocacy much less likely than would have been required had the company filed its applications, after the time when both the company and the DNR may have committed themselves to a course of action and had come to their own conclusions about the project.

And so our office hired a University of Wisconsin--Milwaukee hydrogeologist, Professor Douglas Cherkauer, to advise our office, the company, DNR, and anyone else interested, on his professional views of how best to determine what impacts a mine could have on the groundwater flow and quality in the Town of Grant. Literally, on a day-to-day basis, Professor Cherkauer and our office have reviewed and generated volumes of technical documents and information, expressing our views and urging the strictest environmental protection possible under the law.

Where we find ourselves tonight, is at the point where formal public participation in the review of the mining company's application and the Department of Natural Resources environmental

documents first begins. Over the next months, both these efforts will be subject to further scrutiny and a "master hearing" will culminate in the spring of 1990 where citizens are able to articulate and advocate their viewpoints on the permit applications. On October 19 the first "prehearing" conference will be held here to begin and to discuss the process leading up to the "master hearing."

While we have devoted two year's worth of resources and efforts to advocacy thus far, we have been very appreciative of the company's efforts to answer our questions and more importantly, to take into consideration our urgings as they have drafted and designed their project. This was indeed a very different exchange than occurred fourteen years ago, when numerous lawsuits and enormous antagonism abounded. However, our work is not done and there are still questions that need to be answered before we believe the state is ready to decide upon whether or not this project meets the state standards. Our primary concerns at this stage are in the areas of monitoring and mitigation. I will now be turning over our presentation to Professor Cherkauer for him to summarize those remaining issues and state our concerns and position.

Thank you very much for considering our comments.

Testimony on Proposed Mine near Ladysmith

by

Douglas S. Cherkauer
Associate Professor of Hydrogeology
Department of Geosciences
University of Wisconsin-Milwaukee

At the direction of the Public Intervenor, I have reviewed all of the documentation produced by the company and DNR regarding past, current and projected ground water conditions at the site of the proposed Kennecott mine on the Flambeau River near Ladysmith. I have also examined the procedures used to predict the location and magnitude of impacts to the ground water system which will result from mining and post-mining activities. My remarks are restricted to the ground water system at the mine.

The ground water system consists of glacial sediments and sandstone overlying Precambrian rocks. Ground water flows through each of these materials, predominantly from east to west where it discharges to the Flambeau. Ground water also provides water to several domestic wells and supports several wetlands in the vicinity of the proposed mine.

Impacts from the mine are of two broad types, those affecting ground water levels or water quantity (including impacts on surface water bodies) and those affecting ground water quality. Mining of the ore body will require lowering the water table at the mine to provide a dry working surface. The effect of dewatering will be an area around the pit where the water table is drawn down from its current position. This drawdown will lower water levels in wells and reduce, or perhaps reverse, ground water discharges to wetlands and rivers within the affected zone. It will be a temporary effect, with water levels rebounding toward their present position after the mine is filled and water removal ceases.

To assess the magnitude of these impacts on quantity, the company has performed a computer simulation of present and future ground water flow conditions. A model was developed which accurately reproduces present-day observed conditions at the site. It was then programmed to simulate the excavation and dewatering and then the ultimate refilling of the mine.

The results of the simulation are documented in the DEIS. To summarize, the model projects drawdowns ranging up to over 100 feet in the vicinity of the mine during operation which dissipate within about a decade after reclamation is complete. The high drawdowns will be confined to an area immediately around the mine. Farther from the mine, where supply wells exist, drawdowns will be significantly less. Two supply wells will see drawdowns of around 15 feet, another 3 between 5 and 15 feet, and all others less than 5 feet.

The mining will also induce less than 100 gpm to flow from the Flambeau to the pit. This water will be collected with other pit inflow, treated and returned to the river. The mine drawdowns will cause all ground water to flow toward the pit for distances of up to 1000 feet during mining.

After mining, water levels will recover within 15 to 20 years to near their pre-mine positions around the pit. Flow will be dominantly east to west again. The filled pit will act as something of a flow conduit and ground water which contacts the mine waste rocks will flow along the axis of the mine toward the southwest and the Flambeau. The model predicts that flow will be confined to the lower portions of the fill by a layer of compacted saprolite (clay) which will be returned to the pit during filling.

If the simulation is correct, flow to the wetlands will be decreased by approximately 4 gallons per minute (gpm). [It is (1) important to note here that the simulation did not include wetland 11 and therefore the impacts on it are unknown. Furthermore, 8.4 acres of wetlands will be removed or buried during the mining process.] Mitigation with treated waste water is proposed to minimize the impact on the remaining wetlands. It's my understanding that discussions are continuing on the mitigation of impacts to wetlands, including the possible creation of new wetlands after mining. Given the fact that the mine will destroy some wetlands entirely and impact others, the idea of re-creation has some merit. The Public Intervenor's office is willing to examine proposals to weigh their merit vs. those of trying to preserve existing wetlands.

Mining will destroy Intermittent Stream B. The simulation shows that the operation will reduce flows to Intermittent Streams A and C, but will have no effect on Meadowbrook Creek.

In my professional judgement, the simulation which has been done is reasonable. It is consistent with all observations made to date. Therefore, I believe that the projections made provide a scientifically reasonable estimation of the magnitude of impacts to ground water quantities which will occur. Well production will not be impaired. The diversion from the

Flambeau amounts to less than 0.01% of its average flow and less than 0.2% of the lowest flow ever recorded.

The results of this simulation are also germane to the likely impacts on water quality, because any contamination introduced by mining will travel in the direction of ground water motion. Projected contamination motion will therefore follow projected ground water flow paths.

Ground water quality impacts fall into two categories: those which may occur during mining and those post mining. During operation, waste rock containing metallic sulfides will be sorted based on its sulfur content and stored in 2 areas adjacent to the mine. High sulfur waste (>1%) will be stored in a lined repository with a leachate collection system, while low sulfur rock will be in an unlined facility. Both storage areas are in locations where the flow model shows that flow will be toward the mine during their active lives and for some time afterwards. While the mine is operating, any escaping leachate from these storage areas will therefore drain toward the pit where it will be collected and treated. Based on my assessment of the validity of the flow model, it is my judgement, therefore, that there will be no permanent impact to ground water quality during mining as long as pit dewatering occurs.

After mining ceases, the waste rocks will be returned to the pit. Water levels will rise in the pit until ground water flow back toward the river is resumed. The simulation indicates that when this occurs approximately 4 gpm of ground water will flow through the high sulfur waste rocks toward the river. This water will pick up contaminants from the waste rock and will deliver them to the ground water in the zone between the pit and the river (the river pillar) and then to the river. This flow will contaminate the ground water in the river pillar. The company's estimates indicate that the maximum concentrations of sulfate and manganese which could occur are 1360 and 0.52 mg/l, respectively. The company has also estimated upper limits on copper and iron, but I have some question regarding the validity of those numbers. Tests presented in the company's Environmental Impact Report showed concentrations as high as 4800 and 570 ug/l for Cu and Fe, respectively, when pH control is maintained on high sulfur waste rock. Writers of the EIS have adopted results of a second analysis by the company which shows considerably lower concentrations. I still question why the EIS chooses to rely on the lower values. This disparity should be resolved. (2)

Regardless of which concentrations are used, the mine waste will cause contamination of all ground water in the river pillar. There are no supply wells or wetlands within this zone. It is also a relatively small portion of the total ground water system which is so affected, about 800 by 140 feet, and containing about 900,000 gallons of water. That is roughly the same amount of water which passes the river pillar every minute in the Flambeau.

The contaminated ground water will discharge to the Flambeau at the rate of about 4 gpm. That discharge and its contaminants will be diluted by 800,000 gpm of river water. The result will be increases in sulfate and metal concentrations in the river which will not be measurable or detectable.

Consequently, it is my professional judgement that ground water contamination will occur adjacent to the site, but that it will be confined to a very small area which will not directly affect humans and which will produce no measurable changes in the quality of the Flambeau River.

All of my judgements are predicated on the reliability of the ground water flow simulation. In my opinion, it is a good simulation, but it is a simulation nontheless. That means it is only as good as the assumptions and measurements put into it. If any of those should prove incorrect in the future, the simulated impacts could also prove wrong. I do not believe this will be the case, but prudence says that the company should carefully monitor the site to verify that it is behaving as the simulation predicts.

In my estimation then, a monitoring system must be designed for the site which allows determination of how ground water is flowing and whether any contamination has occurred. The monitoring system described in the DEIS is not adequate to meet this need. It needs to be expanded. In particular, there are 3 critical areas where the performance of the simulations can best be judged and these need to be monitored. These are:

(3) 1. Beneath and adjacent to the surface waste rock storage areas - Is water really moving toward the pit? Has any leachate escaped? Does any leachate remain when flow reversal occurs after mine closure?

2. In the river pillar - Is the slurry wall continuing to function as simulated? Is post-fill flow toward the river really 4 gpm? What are the concentrations of

contaminants in the water?

(3) 3. In the filled pit itself - Is the saprolite behaving as a confining layer? Is flow through the saprolite always downward? Is the fill acting as a conduit?

The Public Intervenor's office will be happy to review proposals by the company to augment the proposed monitoring system. Some suggestions that I would make would be inclusion of piezometers to measure heads in the refilled pit above and below the saprolite, a sampling piezometer in the river pillar between the slurry wall and the river, and additional piezometers and/or lysimeters around or beneath the surface waste storage areas. A viable monitoring system will allow the company and the DNR to answer my above questions.

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
GREAT LAKES AGENCY
ASHLAND, WISCONSIN 54806-0273

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

Land Operations

October 18, 1989

RECEIVED - DNR
OCT 20 1989
ENVIRONMENTAL ANALYSIS

Mr. George Albright, Chief EIS Development Section
Bureau of Environmental Analysis and Review
Department of Natural Resources
P.O. Box 7221
Madison, WI 53707

Dear Mr. Albright:

We have reviewed the Draft Environmental Impact Statement of Flambeau Mining, Inc. on the proposed open pit copper mine near Ladysmith, Wisconsin. Even though this document covers the environmental impacts rather extensively we find that some are not covered in sufficient detail or depth to give reasonable assurance that the least amount of environmental damage will result from this project. It is these areas that we will be addressing in our comments. Unless these issues are satisfactorily resolved we cannot support this project and the findings that no significant impacts will result from this proposed open pit copper mine.

1. First and foremost issue are the impacts on the surface and groundwater resources.

   a. Surface water. In order to insure no water quality impacts we recommend that effluent should not be of (4) lesser water quality then the water quality is in the Flambeau River is currently. However, if drinking water or other water quality standards are higher for any parameter then that standard should apply. Furthermore, we recommend that all effluent be assumed to contain toxic levels of hydrogen sulfide and be treated to remove this compound. Bioassays should be (5) used to determine the effectiveness of the treatment to remove the hydrogen sulfide and adjustments made to the treatment level or intensity according to the bioassay results.

   We are also concerned about the surface run-off water from precipitation at the mine site. The mine and the crusher operations will produce dust that will settle (6) on the surrounding area. The settled dust will be available to be washed by run-off into the creeks and the Flambeau River. This issue has not been addressed at all and could have significant water quality impacts.

(7) We are also concerned about the transportation of the crushed rock from the mine site to processing plant. Open car shipments could result in dust being blown over an undetermined size area and causing environmental impacts. Also the open cars could serve as precipitation collectors and the collected precipitation (particularly if it is acidic) could result in some of the crushed rock constituants becoming soluable and being introduced into the environment through leakage or drainage.

(8) b. Groundwater. We are not convinced that the groundwater issue has been adequately addressed and evaluated. For instance, the water collected from the low sulphur waste rock storage area and the settling pond. Since both of these areas will be unlined and the water allowed to percolate into the ground will most likely result in dissolved solids, leachable materials, and various metals entering the groundwater supply. To avoid this possibility we recommend that all areas of storage be lined and that all of the collected water be treated at the water treatment facility before it is released into the environment.

(9) Comparison of Figures 2-7 and 3-7 indicate that there will be some changes in the groundwater flow. However, these changes may not be significant enough to impact the groundwater supply and the wetlands on the surface. But examination of Figure 2-4 and comparison with the above cited two figures shows that the monitoring wells are placed in such locations that little data will be produced showing water quality impacts on the groundwater that may result from the closing of the mine and subsequent groundwater level restabilization. We would recommend that at least three additional monitoring wells be placed between the mine pit and the Flambeau River and one monitoring well above the mine site along the inflow channel into the mine as indicated in Figure 3-7.

(10) 2. Wetland impacts. The proposed open pit mine will directly impact approximately 8.4 acres of wetlands. Most of these wetlands are considered to be high quality wetlands whose loss will have an environmental impact. Additional wetland acreage will be impacted by the groundwater cone of depression and by the discharge of effluent from the water treatment facilities. We look at this loss of one of this nations nonrenewable resource as a serious matter and therefore, we recommend that the Flambeau Mining, Inc. be required to mitigated this wetland loss prior to the start of mining operation. The mitigation should be carried out at a minimum rate of 1.5 acres of mitigated wetlands for every 1 acre of natural wetland being impacted directly or indirectly. Mitigation should be carried out according to recommendations made by WDNR and USF&WS. In addition, the company should be required to implement the wetland creation project at the end of the mining operation which is proposed in the draft EIS.

We hope that our comments will help to improve the project and reduce the environmental impacts. If we may be of further service, please feel free to contact us at (715) 682-4527.

Sincerely,

[signature]

ACTING Superintendent

Northwest REGIONAL Planning COMMISSION

an economic development district

RECEIVED - DNR
OCT 24 1989
ENVIRONMENTAL ANALYSIS

October 23, 1989

Mr. George Albright
Chief, EIS Development Section
Bureau of Analysis and Review
Wis. Dept. of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921

RE: Flambeau Mining Company Ladysmith Copper Mine Project Draft Environmental Impact Statement

Dear Mr. Albright:

Northwest Regional Planning Commission, following staff review of the Draft Environmental Impact Statement of September 19, 1989, would like to go on record objecting to the inclusion of the copper ore deposit near Crandon, Wisconsin, owned by Exxon, as having cumulative environmental impacts on the Copper Mine at Ladysmith.

(11) We feel that it is an inappropriate use of cumulative environmental impact analysis to consider the mining operation at Crandon to have impacts at Ladysmith. It is over 100 miles between the two deposits. They are located in totally different water sheds. Whether or not the mine at Crandon will materialize is speculation at this time.

Therefore, we request that the DNR exclude from cumulative impact consideration the mineral deposit at Crandon.

Sincerely,

Stephen C. Andrews
Executive Director

ld

302 Walnut Street Spooner Wisconsin 54801
715 635-2197 FAX-715-635-7262

NORTHWEST REGIONAL PLANNING COMMISSION 30th ANNIVERSARY 1959 1989

Wisconsin Department of Transportation

DIVISION OF HIGHWAYS AND TRANSPORTATION SERVICES
Office of Environmental Analysis
4802 Sheboygan Avenue
P.O. Box 7916
Madison, WI 53707-7916

RECEIVED - DNR
OCT 25 1989
ENVIRONMENTAL ANALYSIS

October 23, 1989

Mr. George Albright, Chief
EIS Development Section
Bureau of Environmental Analysis and Review
Department of Natural Resources
P.O. Box 7921
Madison, Wisconsin 53707

Mr. Albright:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Flambeau Mining Inc.-- Copper Mine; Ladysmith, Wisconsin and offer the following comments:

<u>TRANSPORTATION IMPACTS</u> PAGES 75 AND 76

1) Level Of Service (LOS)--This discussion appears to have minor omissions or inaccuracies regarding the concepts of LOS. For example, it is not clear whether the increases of 115 vph (2nd paragraph) or 41 vph (4th paragraph) in the afternoon peak hour would be:

(12)
a) Entering or exiting the peak hour traffic stream on STH 27;
b) Whether they contain trucks;
c) What percentage of them would be using the same entrance/exit.

For your information, LOS "C" is considered acceptable in Wisconsin, particularly for short term conditions such as those generated by the proposed mine.

We suggest that you confer with D.L. Wilson, Chief Planning Engineer of Transportation District 8 (715) 392-7933 to obtain the appropriate information and clarification about LOS related issues.

2) Traffic Disruptions--We agree that minor effects on traffic are likely to occur during construction, operation and closing of the proposed mine. Certain activities will require permits from our Transportation District 8 Office. Activities needing permits include:

a) Access to STH 27. (This should be no more disruptive than the construction of any major new access to the State Trunk Highway System.)

DT87

b) Stopping traffic during blasting activities. (This permit will place requirements and conditions on blasting operations to protect the STH 27 user. When and how traffic may be stopped on STH 27 would be subjects addressed in such a permit.)

c) Installation of the railroad spur across STH 27. [Automatic flashing signals would be required and the effects of 8 train crossings per week should not be overly disruptive. Prior to construction, however, it must be determined whether the railroad crossing would require the closing of STH 27 and a detour provided. If a detour would be provided, it is necessary to indicate how long it would be needed and its location. A detour must be approved by WisDOT and all detour related costs and environmental documentation (if needed) would come from the mining company. On August 3, 1989 a Public Hearing was held on the rail spur crossing of STH 27. After the hearing an agreement was reached whereby WisDOT will issue a permit for the rail crossing contingent on the above requirements.]

(13) 3) The last sentence of the sixth paragraph on page 76 may be overstated since the gravel hauling activity would only add about 0.2 to a year's worth of truck traffic. There are no seasonal weight limits on STH 27 and we would expect that the additional truck traffic would not significantly decrease the pavement's life expectancy.

(14) 4) Our proposed 1990 improvements in this area include a short section of 4 lanes from the existing WCL rail crossing to USH 8, plus a traffic signal at USH 8. This should accommodate peak hour traffic at this location even with the addition of mine related traffic.

Thank you for the opportunity to review and comment on this Draft EIS.

John Roslak, Director

JBN
cc: Trans. Dist. 8

UWEX WGNHS
UNIVERSITY OF WISCONSIN—EXTENSION
WISCONSIN GEOLOGICAL and NATURAL HISTORY SURVEY
3817 Mineral Point Road · Madison, WI 53705 · (608) 262-1705
M.E. Ostrom Director and State Geologist

October 23, 1989

Mr. George Albright
Chief, EIS Development Section
Bureau of Environmental Analysis
and Review
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

Sir:

On behalf of the Wisconsin Geological and Natural History Survey, University of Wisconsin-Extension, I am submitting the following comments on the Draft Environmental Impact Statement (DEIS) prepared by the Wisconsin Department of Natural Resources for the Flambeau Mining Company proposed open-pit copper mine near Ladysmith, Wisconsin. The DEIS was reviewed by several members of our staff and comments specific to a particular individual have been annotated for your convenience in order to facilitate any necessary clarification of comments at some later date. Comments not annotated should be considered as general WGNHS review comments. Questions of clarification or intent should be directed to Tom Evans, Mineral Resources and Mining Information, (608) 263-4125. Individuals who reviewed the DEIS include Dr. Michael G. Mudrey, Jr. (MM), Dr. Kenneth Bradbury (KB), Dr. Stanley Nichols (SN), and Tom Evans (TE). Tom Evans is responsible for overall document review and compilation of individual review comments.

GENERAL REMARKS

(15) 1. The DEIS would be measurably improved by being reviewed by an editor prior to final publication. I appreciate the short timeline under which the draft has been prepared, but I would encourage the department to take sufficient time for the Final Environmental Impact Statement (FEIS) to be thoroughly edited. Such an editorial review should catch the misspellings, errors in grammar, and errors in sentence structure that might distract the general reader or obscure the intended meaning of the document. I have not listed the specific examples of spelling or grammatical errors noted in the DEIS, but encourage the department to carefully edit the FEIS.

(16) 2. The DEIS, of course, makes many statements of fact and reaches specific conclusions; however, such statements are not referenced in any way. The list of Information Sources (p. 123) is helpful, but these are documents that are commonly secondary references, yet which may include primary references, too. The listing of the number of the reference, even if it's a secondary source, from which a statement of

(16) fact is made would be helpful to those readers who would like more information or who would like to investigate more fully the data upon which a statement is based.

SPECIFIC COMMENTS

(17) 3. Page ii, paragraph 6. The sentence beginning with "Groundwater quality is good..." should be rephrased to read "Groundwater occurs principally within the glacial outwash and sandstone at the mine site. Groundwater quality is good." This rewording avoids possible confusion concerning the implication that "groundwater quality is carried" in the aquifers in which it is found, since quality is dependent not only on the aquifer characteristics, but also on the source of contaminants or other constituents that might occur within the groundwater. The suggested rephrasing states more clearly the intended meaning. [MM]

(18) 4. Page iii, paragraph 1. Only 102 acres are specifically annotated in this paragraph. What are the other 36 acres of the 138 acres directly impacted by the project? These should be listed. [MM]

(19) 5. Page iii, paragraph 4. The second sentence could be read to mean that the treated wastewater would not have to meet regulatory limits; clearly this is wrong. I suggest that the sentence be rephrased to read "Wastewater would have to be treated to meet regulatory limits and the proposed wastewater treatment system appears to be able to treat wastewater sufficiently to comply with such limits." [MM]

(20) 6. Page iii, paragraph 4. Define the word "synergism" in the glossary. This is an important technical term in the context of this sentence. [MM]

(21) 7. Page iii, paragraph 6. It is not clear that the conclusion "The project would not result in violation of any air quality standards" is based on whether dust-suppression methods are used or not, since the sentence starts with an "If..." Restate sentence to remove the ambiguity. [MM]

(22) 8. Page iii, paragraph 8. The tone of this summary is more negative in our view than is warranted by the DEIS and the sections of the Mining Permit Application (MPA) referring to the Reclamation Plan. The statements in this paragraph are not incorrect, but they also do not convey the applicant's proposed revegetation plan, the backfilling of the pit, nor the final land use implied in the MPA. Clearly the department feels that portions of the Reclamation Plan are not sufficiently explicit or adequately documented, but the terse, selectively negative summary here is not warranted by the information contained in the DEIS or MPA. [TE]

(23) 9. Page iii, paragraph 9. This paragraph conveys only a negative tone and fails to mention that no significant releases of pollutants to the environment are expected. For example, statements like "The results [of comparisons of contaminate loading from pit leachate with existing water quality] show that addition of the maximum concentrations of contaminants in groundwater flowing through the backfilled pit would not adversely affect water quality in the Flambeau River." (DEIS, p. 47) are not reflected in the substance or the tone of this paragraph. This paragraph does not fairly reflect the expected situation that is to be monitored. [TE]

(24) 10. Page iv, paragraph 2. Total net proceeds tax could range from $0.3 to 18.9 million and corporate income taxes could range from $0 to 22.8 million (DEIS, pp. 80 and 81). This summary paragraph should reflect the full range of revenues or, alternatively, a range should be made specific to a particular price/transportation cost scenario. [TE]

(25) 11. Page 1, paragraph 1. References to major highways and roads in the vicinity of the project should be consistent, e.g. STH 27 not Highway 27 or State Trunk 27. [MM]

(26) 12. Page 2, paragraph 3. Reference figure 1-2 (following p.2) in this paragraph. [TE]

(27) 13. Page 1, paragraph 3. Definition of mine site should be changed to clearly include the rail spur right-of-way and related loading facilities at the Wisconsin Central main line. What is the relationship between the area covered by the mining permit, mine site, and project area? This should be clearly stated and illustrated. [TE]

(28) 14. Page 1, paragraph 4. The Flambeau orebody was not discovered by airborne exploration; rather, it was exploratory drilling in 1968, based on earlier airborne electromagnetic surveys, that resulted in the discovery of this mineral deposit. Readers should not be led to believe that airborne reconnaissance can locate orebodies. [MM]

(29) 15. Page 1, paragraph 5. The FEIS should accurately reflect the corporate relationships among Flambeau Mining Co., Kennecott Corporation, BP-Minerals, Kennecott Explorations Ltd., Rio Tinto Zinc, etc. [TE]

(30) 16. Page 2, paragraph 1. Refers to Kennecott Explorations Ltd. See comments #15; what is the legal relationship between the applicant and Kennecott Explorations as the signatory to the Local Agreement? [MM]

(31) 17. Page 2, paragraph 1. References to the Local Agreement should be consistent. The DEIS refers to Local Agreement, local agreement, and "local agreement". Where reference is to the legal agreement signed by the City of Ladysmith, Rusk County, Town of Grant, and Kennecott Explorations Ltd. (or successor in interest), pursuant to s. 144.839, Wis. Stats. then use Local Agreement. [MM,TE]

(32) 18. Page 2, paragraph 6. Suggest rephrasing the third sentence to read "The southwest corner of the pit will be 140 feet from the high water mark of the Flambeau River." [MM]

(33) 19. Fig 1-1. Add a scale. [TE]

(34) 20. Fig 1-2. Clearly delineate "project area," "mine site", and the area subject to the proposed mining permit on this illustration. [TE]

(35) 21. Figure 1-3. Figure shows two small buildings (in black) along east edge of fenced area. Will these buildings remain on site or will they be removed? Explanation of the figure should clarify what those structures are in relation to the Proposed Project Facilities. [TE]

(36) 22. Figure 1-4. Use of term "bedrock" appears to exclude the sandstone, but the Cambrian-age sandstone is part of the area's bedrock. The hachure-symbol unit designated "bedrock" should be redesignated as "Precambrian crystalline rock" or "crystalline rock." See Figure 1-5. [MM,TE]

(37) 23. Page 4, paragraph 2. It is not clear whether the trucks used will be 35-ton or 50-ton trucks or trucks capable of handing 35 to 50 tons each. The "35-50 ton trucks" reference is unclear. [MM]

(38) 24. Page 5, paragraph 4. The third sentence lists major materials to be stored in the stockpiles, but does not list "sand and gravel." Where will these materials, which are not topsoil and not till, go? [MM]

(39) 25. Page 8, paragraph 1. The first sentence implies that the "one foot compacted glacial till layer" will collect leachate. How can this be? The till appears to be a part of the liner structure, but this is not clear from the text. What is the composition of the till being used for this purpose? Does it include sufficient fine-grained material to act as a liner? [KB]

(40) 26. Figure 1-7. The Location Map should include a scale. Section A-A, however, should state that no scale is implied; that is, that is a schematic cross-section. [TE]

(41) 27. Page 9, paragraphs 2 and 4. The relationship of the surface area of these ponds to their expected depth could lead to stratification and development of anoxic water in lower parts of the pond. Bottom outlet structures might then release deleterious water, which could degrade water quality. Please clarify the potential for pond water stratification. [SN]

(42) 28. Page 9, paragraph 4. What chemical reagents may be added to enhance sedimentation? [TE]

(43) 29. Page 10, paragraph 2 and Figure 1-9. Figure 1-9 is not a water balance, but rather a schematic of water flow through the project facilities. Precipitation, evapotranspiration, and so forth should be included to develop a true water balance picture of this operation. [KB,MM]

(44) 30. Figure 1-8. A scale should be added to both the Plan View and the cross-section view. [TE]

(45) 31. Page 12, paragraph 8. The term "lime slaking" should be included in the glossary. [MM]

(46) 32. Page 15, paragraph 7. How much lime is expected to be added to reduce acid formation? What evidence has been provided that this liming increment will be effective? [KB]

(47) 33. Page 15, paragraph 8. The distribution of "remaining excess material" (about 158,000 cubic yards) "over the project area" is too vague. Where will these materials actually be placed and what is the composition or nature of this off-site material? [TE]

(48) 34. Page 18, paragraph 4. The total annual cost of long-term monitoring appears low. What is included in this work? [KB,TE]

(49) 35. Page 18, paragraph 7. This statement is vague. How will "stress" be determined? What is the role of the department in evaluating the progress of the long-term care of the site? If there are to be performance standards (and there should be), in what document will they be specified? The FEIS should include these further clarifications. [KB,SN,TE]

(50) 36. Page 18, paragraph 9. On what basis were the parameters (those determined on a quarterly basis) selected? Other human health-related parameters that could be considered include chlorides, sulfates, nitrates, phosphates, zinc, arsenic, volalite organic constituents, and coliform bacteria. What rationale was used to select these parameters and not other health-related parameters? [SN]

(51) 37. Page 18, paragraph 10 and Page 19, paragraphs 1-3 The proposed groundwater monitoring plan is too limited. The number and placement of wells (four sites) is too sparse and the number of parameters sampled is too limited. A full inorganic parameter scan is necessary to assure quality control using the ionic-charge-balance approach. [KB]

(52) 38. Page 19, paragraph 1. "Specific conductivity" should be "specific conductance." [SN]

(53) 39. Page 19, paragraph 4. This paragraph should note that discharges from the mine site are regulated under WPDES permits which require monitoring of effluent quality. Also, we suggest additional surface water monitoring at one station upstream and one station downstream from the mine site. [TE]

(54) 40. Page 20, paragraph 3. Is "PM peak hour" in the afternoon or evening (depending on whether it's during construction or mining phases)? [MM]

(55) 41. Figures 1-11, 1-12, 1-13. These figures schematically depict the geometry of the railroad spur intersection with the Wisconsin Central Limited machine in two different ways. I suggest a figure be added that accurately depicts the intended intersection to some appropiate scale. [MM]

(56) 42. Figures 1-12 and 1-13. Figure 1-12 references non-Kennecott property north of Blackberry Lane and Figure 1-13 depicts property north of Blackberry Lane as Kennecott-owned property. Which is correct? Also, does Kennecott-owned property extend into the City of Ladysmith? Figure 1-13 should be redrawn to accurately depict property ownership, including any annexed land by the City of Ladysmith that is now a part of the project area. [TE]

(57) 43. Pages 21ff. Omit the word "glacial" when referring to "till". All till is glacial. [KB]

(58) 44. Page 21, paragraph 3. We are not aware that the sandstone overlying the Precambrian is Mt. Simon Formation. Our data suggest that it may well be the Galesville Member of the Wonewoc Formation. [MM] I suggest using the term "Cambrian-age sandstone" in place of "Mt. Simon" or Mt. Simon Formation." [TE]

(59) 45. Page 21, paragraph 4. Deformation of this region occurred before 1.8 billion years ago. There is no direct information to suggest deformation or metamorphism at 1.6 billion years ago. Use of a reference here would clarify the source of information using the 1.6 billion year old date for the deformation. [MM] Also, the term "early Precambrian" is not appropriate. All Precambrian-age rocks in this area are of Proterozoic or "middle Precambrian" age. [MM]

(60) 46. Page 22, paragraph 2. The second sentence implies that the soils were deposited by the wind, whereas the intent is to state the soils developed on windlaid silt and silty fine sand. This sentence should be reworded to clarify the intended meaning. [TE]

(61) 47. Page 23, paragraph 5. Suggest deleting "very weak" from third sentence. Its meaning is not clear. [TE]

(62) 48. Page 23, paragraph 6. "Super gene" should be "supergene" [TE]

(63) 49. Page 23, paragraph 7. Suggest deleting "containing" from the phrase "asbestos containing minerals" for clarity. [MM]

(64) 50. Figure 2-1. This figure represents an interpretation of the distribution of "Middle Pre-Cambrian [sic] Metavolcanic Rock" that is not correct based upon over 10 years of additional work since this figure was first published. A more current depiction of the distribution of thes rocks is readily available in the geologic literature. [MM]

(65) 51. Figure 2-2. The composition of the principal minerals should be listed for the reader in an explanation. The box illustrating "Position of Orebody to be Removed" should be redrafted to conform with the illustration; it currently does not. [MM]

(66) 52. Page 24, paragraph 4. Suggest adding a table listing current primary and secondary drinking water standards, perhaps as an Appendix. [TE]

(67) 53. Page 24, paragraph 5. The description of a "mounded watertable condition" is vague and is not a generally used hydrogeologic description. What is meant by this within this context? Also, how was the 5 inches/year recharge note determined? [KB]

(68) 54. Figure 2-5. Figure shows privately owned wells on land that Figure 1-3 indicates is Kennecott property. Which is correct? [TE]

55. Page 24 & 25 (Groundwater Flow).
(a) It is difficult to evaluate and compare the aquifer parameters when they are buried in various paragraphs. I suggest you include a table showing the number of samples, maximum and minimum, and median values for permeability or each aquifer unit.

(69) (b) Glacial Till should not be underlined. (C) Do the flow velocities reported for each unit refer to Darcy velocity, or average liner velocity is the appropriate velocity for contaminant transport discussion. (d) The ranges of velocity estimates for each unit should be indicated. (e) The FEIS should include discussions of other aquifer parameters, such as porosity and specific yield, in this section. [KB]

(70) 56. Page 25, paragraph 4. Pit inflow is stated elsewhere as being 95% from Precambrian bedrock, but here the statement indicates water moving through the Precambrian bedrock is limited. This would appear to be a contradiction. Please clarify. [TE]

(71) 57. Page 25, paragraph 5. Add phrase "in this area" to the end of the fourth sentence, since Precambrian bedrock may be an aquifer in other parts of the state. [MM]

(72) 58. Page 26, paragraph 3. Six wells are noted as producing water for private water supply from Precambrian bedrock. However, page 25 (paragraph 5) indicates that Precambrian bedrock is not an aquifer. How do these two statements relate to each other? Which is correct? [MM]

(73) 59. Page 26, paragraph 4. The concept of perched wetlands over a recharge requires additional explanation and documentation. [KB,TE,MM]

(74) 60. Page 26, paragraph 4. Reference the appropiate figure that lists the wetlands and their identifying number. [TE]

(75) 61. Page 27, paragraph 7. This section should include additional information on possible flood heights. The 100-year flood could be predicted from other gaging stations even through only a limited record exists for the Flambeau River. [KB,MM]

(76) 62. Page 28, paragraph 2. Reference is made to NR105 and Table 2-1 also mentions NR102. An appendix or table within the text should be added listing all relevant administrative codes and their titles or general subject matter that are relevant to the regulation of various aspects of this project. [TE]

(77) 63. Figure 2-9. Add numbers identifying individual wetlands and draw in boundaries delineating these more clearly. [TE]

(78) 64. Table 2-1. It is not clear how this table was derived. Are these standards specific to the Flambeau River? It would be useful to have high, low, and mean levels measured in the river from current monitoring programs. [SN]

(79) 65. Page 30, paragraph 5. Add "sand and gravel" before the word "mining" in the second sentence. [TE]

(80) 66. Page 31, paragraphs 6-8. It should be noted that all the game birds mentioned are migrating. This could have two implications: a) habitat at the mine site is not critical since these species can move, and b) contaminants, if any, picked up at the mine site could be transported elsewhere. [SN]

(81) 67. Page 38 and 39, Gross Value of the Orebody. This and subsequent discussion of taxation and revenues generated from the proposed operation should be revised to reflect recently published information indicating the ore tenor of the 1.9-million-ton orebody (proven and possible reserves) to average 10.5% copper, 0.1 oz/short ton gold and 2.1 oz/short ton silver. See Engineering and Mining Journal, August 1989, P.37.

(82) 68. Page 42, paragraph 4. Stabilization of fines on the stockpiles will also be a function of surface roughness given the size range of materials on the piles. Surface roughness will serve to limit fines movement by providing traps for fines to collect in and by disruption of air or water movement across the stockpile surfaces. [TE]

(83) 69. Page 42, paragraph 5. Pit depth and pit size are not consistent with previous discussion of these items. [TE]

(84) 70. Page 43, paragraphs 2 and 3. The final disposition of the land surface over the settling backfilled pit is unclear. Obviously we cannot predict this precisely, but what mitigation measures would be applied to this area? Is such an uneven surface acceptable? What is the effect of such a ground surface on projected revegetation programs? [TE]

(85) 71. Page 44, paragraph 4. The FEIS should include documentation concerning the precision of the model in terms of calibration and verification, possibly using an illustration to show how well the calibrated model reproduces the observed field conditions with respect to hydraulic head and flux. Possible errors and simplifications in the model should be discussed. The aquifer parameters used in the calibrated model should be listed in a table. [KB]

(86) 72. Figure 3-2 and figures following. The significance of parts A and B (asterisks) should be noted. [MM]

(87) 73. Page 45, paragraph 4. A figure should be added depicting the long-term water-table decline. [KB]

(88) 74. Page 52, Bioassays. This section and all references to synergistic effects of potential effluent constituents should be revised to reflect the results of bioassays completed by Kennecott in May 1989. The department should include its evaluation of these test results and, where appropriate, modify statements in the DEIS that reference departmental concerns with synergistic effects and the lack of bioassay testing. [TE]

(89) 75. Figure 3-10. What is the extent of wetlands #1, #11, #7, #10A, and #10B? This figure should be completed and then referenced in previous discussions of wetlands. [TE]

(90) 76. Page 55, paragraph 3. There is too little information provided on the hydrology of wetland #1 upon which to evaluate this discussion of wetland impacts and possible mitigation measures. Most wetland restoration projects have restored open marsh. Not much is known about restoring the wetland plant communities described here—Northern wet-mesic forest, bog, and alder shrub. [SN]

(91) 77. Page 57, paragraph 7. See previous comment [SN]

(92) 78. Page 60, paragraph 6. The last sentence refers to "past experience" indicating the effluent will be toxic. Who's past experience and where? The FEIS should reference the bioassay testing and should clarify on what basis such a broad statement of effluent toxicity is supportable. [TE]

(93) 79. Page 70, paragraph 4. Mention should be made of the potential for the disturbed wetlands to be invaded by undesirable plant species, such as purple loosestrife. [SN]

(94) 80. Page 71, paragraph 3. A sentence should be added stating "However, analysis of the proposed action and its effect on the surrounding environment indicates that no significant releases of pollutants to the environment are likely." As written, this paragraph does not fairly state the expected situation without this qualifying sentence being added. Whereas the proposed monitoring plan may not be as complete as desired by the department, the department states in many places in the DEIS that no adverse impacts are expected. [TE]

(95) 81. Page 72, paragraph 6. The acronyms vpd and vph should be included in the glossary or defined here. [MM]

(96) 82. Page 77, paragraph 8. The Wisconsin net proceeds tax is not strictly a tax on mine profits, since "profits" do not equal "net proceeds." I'm not sure that a term such as "gross profits" has any meaning, since profits, by definition, are what's left after all one's costs are subtracted. Change "gross profits" to "gross proceeds." [TE]

(97) 83. Page 77, paragraphs 8ff. Refer to previous comment citing necessity of do fiscal impact analysis using revised revenue figures based upon the higher-grade ore tenor reported in the August 1989 edition of Engineering and Mining Journal. [TE]

(98) 84. Page 79, paragraph 2. Part of the last sentence either has been left out or has been incorrectly printed. [TE]

(99) 85. Page 85, paragraph 3. More information on the City of Ladysmith annexation of 15% of the orebody would be useful. Was this accomplished by annexing only the mineral estate or was the surface annexed , too? Show the actual annexed land on a figure illustrating property ownership. [TE]

(100) 86. Table 3-18, page 85. "-$1.539" should be "$1.539" [TE]

(101) 87. Page 92, paragraph 5. Punctuation confusion here makes meaning unclear. [TE]

(102) 88. Page 93, Contingency Measures for Groundwater Pollution. This section is vague. The plan should include the following:
— a description of emergency response procedures to be followed in case of a large, onsite release of contaminants (fuel spill, wastewater leak, accident, etc.) How soon would cleanup begin? What facilities and equipment would be employed?

— greater detail on remediation techniques (pumping, cutoff walls, etc.) Are these techniques expected to be successful given the complex hydrogeologic setting? [KB]

(103) 89. Page 99, paragraph 2. Would a near vertical slope between benches be actually safer in that there would be no or little horizontal component to a rock fall within the pit? [MM]

(104) 90. Page 109, Groundwater Monitoring. This section is vague. How many additional monitoring wells are proposed? Where would they be? [KB]

(105) 91. Page 115FF, Glossary. Definitions of the following terms is inaccurate : gossan (add "iron" before "sulfide minerals"); Precambrian ("The oldest eon in the geologic time scale, equivalent to about 90% of geologic time. The Precambrian is divided into the Archean and Proterozoic Eras." Also, change "450,000,000" to "600,000,000"); pyrite (delete "readily decomposes" to "is slightly susceptible to decomposing") [Pyrite is relatively stable. Marcasite is the "readily decomposable" iron sulfide.] [MM]

(106) 92. Page 124, Appendix A. The value listed under Range for Aluminum is neither a range nor a minimum. [TE]

The preceding comments and remarks constitute our review of the Draft Environmental Impact Statement for the proposed Flambeau Mining Co. open-pit copper mine near Ladysmith. Please contact Tom Evans or the specific reviewer (indicated by initials) if you have any questions regarding these review comments.

It is my opinion that the DEIS, with the exception of the items noted in this review, adequately describes the environmental impact of the proposed action.

Respectfully,
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

M. E. Ostrom

Dr. M. E. Ostrom
Director and State Geologist

MEO/da

United States Department of the Interior

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ENVIRONMENTAL ANALYSIS

ER 89/769

November 2, 1989

Mr. George Albright
Chief, EIS Development Section
Bureau of Environmental Analysis and Review
Department of Natural Resources
P.O. Box 7921
Madison, Wisconsin 53707

Dear Mr. Albright:

The U.S. Department of the Interior has reviewed the Draft Environmental Impact Statement (DEIS) for the Flambeau Mining, Inc. - Copper Mine, Rusk County, Wisconsin.

We find the DEIS to be adequate concerning our areas of expertise and jurisdiction, and therefore have no comments to offer at this time. Thank you for the opportunity to review this document.

Sincerely,

Sheila Minor Huff

Sheila Minor Huff
Regional Environmental Officer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

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ENVIRONMENTAL ANALYSIS

REPLY TO THE ATTENTION OF:

3 NOV 1989

Mr. George Albright, Chief EIS Development Section
Bureau of Environmental Analysis and Review
Department of Natural Resources
Post Office Box 7921
Madison, Wisconsin 55107

Dear Mr. Albright:

The U. S. Environmental Protection Agency has reviewed the Wisconsin Draft Environmental Impact Statement (DEIS) for the Copper mine near Ladysmith in Ruske County, Wisconsin. These comments are advisory in nature, since you requested our Agency to review the state DEIS. The mine would be operated by Flambeau Mining Corporation. The project area is approximately 300 acres. This land is located east of Flambeau River, west of State Highway 27, north of the south line of Section 9, and south of Blackberry Lane. Included in the site is a 24 to 36 foot wide corridor east of State Highway 27. The railroad spur line, required for transportation of the ore, would be located in this corridor. The proposed mine site would consist of approximately 170 acres of land, which is owned by Kennecott Corporation. This project would include haul road, ore crusher, stock piles for; ore, topsoil, and waste rock, settling ponds, railroad spur, open pit, wastewater treatment facilities, and other ancillary surface facilities. The proposed open pit would be 32 acres in size and would require the removal of the enriched upper 150-200 feet of the orebody. The pit would be approximately 2,600 feet long, 500 feet wide, and would have a maximum depth of 225 feet. The pit would be separated approximately 140 feet form the Flambeau River. The pit and the river would be separated by a dike, and slurry wall. These structures would minimize water flow into the mining pit. The proposed project would operate for approximately 6 years.

The proposed project is not sponsored by a Federal Agency, however a Federal permit may be required and obtained from the Army Corps of Engineers for the placement of fill in wetlands under Section 404 of the Clean Water Act (CWA). Our Agency is responsible for the review and comment on the permit. Therefore, our comments are advisory on the application. These comments reflect our concerns and recommendations that would be taken on the permit. The following comments are on alternatives, wetland impacts and mitigation, groundwater, water quality, spill contingency plan, and bioassay.

The proposed project will require the filling of approximately 8.4 acres of wetlands, while potentially impacting surrounding wetlands not located in the project area.

The wetlands in the area consist of northern wet forest, northern sedge meadow, northern wet mesic forest, northern mesic forest, and bog. The largest of these wetlands is approximately 58 acres.

This 58 acre wetland is a perched wetland area that consists of bog, alder thickets, and northern wet forest plant communities, which would be outside the proposed project area. As stated in the DEIS, this area will not be
(107) affected by mining, but could possibly be adversely impacted by groundwater drawdown. To mitigate for the lack of groundwater flow, waste water from the settling pond would be pumped into this wetland area. The proposed mitigation for wetland losses must compensate for all adverse impacts to this wetland area.

The DEIS states that the wetlands and other environs will be reclaimed at the end of mining operations as part of the mitigation plan. Before a mitigation plan can be accepted, the amount of wetlands that would be lost must be
(108) minimized. An alternative route for the railroad spur that would totally avoid the wetland appears to exist. The present route could be move directly south of the wetland area. The use of this corridor should be thoroughly investigation. This investigation must assess the indirect affects from spills and runoff to the surrounding environments. The proposed mitigation for the loss of 8.4 acres wetlands is the replacement by 5 acres of wetlands. At this time this replacement is insufficient. A mitigation plan must provide
(109) full replacement of equivalent or greater functional value for all wetlands that would be lost throughout the entire operation of the mining project on a 1.5 to 1.0 basis. This wetland mitigation plan must consist of restoration or creation of wetlands to achieve the no net lost of wetlands.

The duration of mining operations for the proposed mine is approximately 6 years. Due to the length of operations and the time that would be required to reestablish the reclaimed wetland complexes, we recommend that additional mitigation for the lost wetlands be required. The function and value of these wetlands would be lost for a minimum of one decade. The preconstruction
(110) mitigation for the wetlands would off set this negative impact due to time. The mitigated wetlands could be developed adjacent to established wetland areas. This preconstruction mitigation should be in addition to the plan to reclaim the area after operations have ceased. In addition to the evaluation of converting the pit into a recreation lake, an evaluation to determine the feasibility of an alternative to convert the mined area entirely into a wetland complex for wildlife should be evaluated.

The information provided on groundwater protection has alleviated our concerns addressed in our October, 1987 letter. Our pervious identified concerns were the potential impact on groundwater quality form waste rock stockpile leachate, compliance with the State of Wisconsin groundwater quality standards, and documentation of private water supply well conditions. These concerns have been alleviated by the control measures, swales, liner, and leachate collection system. However, we do have the following recommendations for the groundwater permit. The forwarding of groundwater monitoring reports to WDNR should be a requirement of the Flambeau Mining groundwater withdrawal permit.

(111) The permit should require that the groundwater monitoring include analysis for pH, specific conductance, acidity, alkalinity, sulfate, metals, and chloride. This would ensure that groundwater intrusion and contamination would be detected and rectified.

The number of sampling stations for the wastewater treatment plant should be increase at least by one. This additional sampling station should be located in the area of the entry of effluent to the Flambeau River. This would
(112) provide baseline information and identify the potential changes of chemical and physical properties in the area and downstream from the proposed waste water treatment plant. This would establish wether or not the waste water treatment plant is the source of pollution and if so provide for the opportunity to take corrective action.

We recommend that a spill contingency plan to protect surrounding surface and groundwater be fully developed and put in place. This plan would provide remedial action and reduce the probability of a significant spill of petroleum and hazardous materials. The plan should provide a staging area for all
(113) powered machinery in a environmentally nonsensitive area. The plan should also include the actions to be taken to isolate and prevent spills from entering the surrounding environment. The plan should identify all the hazardous materials that would be used in the operation of the mine. This plan would aid in protecting both surface and groundwater water quality.

The DEIS stated because the results are not reliable, a bioassay would not be done to evaluate water quality until the mine was in operation. We agree that bioassays should be done after operations have commenced. However, the DEIS also stated that in past experiences with similar discharge, it was found that the effluent may fail the toxicity test. Based on this information, further
(114) investigation must be done to weigh the merit of simulating the mining and wastewater treatment process. Prior to any actual mining operations, the employment of a simulation of operations to generate treated wastewater and proper bioassay would provide for the possibility to detect adverse impacts to the surrounding environment. The use of bioassays for both pre and during mining activities would recognize and provide for the opportunity to significantly reduce the potential adverse impacts to the environment.

Thank you for the opportunity to provide comment on the Draft Environmental Impact Statement for the proposed copper mining project. We look forward to reviewing the Final Environmental Impact Statement. If you have any questions or comments, please contact AL Fenedick at (312) 886-6872.

Sincerely your,

William D. Franz

William D. Franz, Chief
Environmental Review Branch
Planning and Management Division

RESPONSES TO GOVERNMENT AGENCY COMMENTS

Response 1 - Groundwater drawdown due to mining is expected to be minimal in the sediments underlying Wetland 11. The slurry cut-off wall through the unconsolidated sediments between the pit and the river would limit flow of water from Wetland 11 sediments toward the pit. In addition, the river would serve as a constant source of water tending to maintain water levels in the adjacent sediments. It is, however, possible that water levels in the southern portion of Wetland 11 sediments may be lowered.

Response 2 - Concentrations of 4,800 ug/l and 570 ug/l for copper and iron, respectively, were reported for leachate resulting from the lime buffering (pH 7) of powdered waste rock sample WR-5 using a deionized water solution (see Table 3.5-12, EIR). These values exceed the maximum solubility concentration values (pH 6.5) of 140 ug/l and 320 ug/l, respectively, used by the Department for its worst case analysis of potential groundwater contamination from waste rock backfilled in the pit. It is most likely that the laboratory values are much greater than the theoretical equilibrium values because of limitations of the laboratory protocols. The leachate samples were passed through a 0.45 micron filter before analysis to remove solids, but some colloid-sized particles containing copper and iron compounds are able to pass through a 0.45 micron filter. Personnel conducting the laboratory procedures indicated that the samples remain slightly cloudy after filtering, confirming the potential for transfer of copper and iron in the colloid form. Since transfer of colloids through the groundwater would not be significant, the movement of these higher concentrations of copper and iron from the pit is not expected.

It is also possible that the short duration (1 hour) and constant stirring of the buffered laboratory leach test may have resulted in a short-term non-equilibrium condition. When equilibrium conditions are attained, the concentrations of copper and iron would be constrained by the theoretical solubility maximums. Thus, the Department believes that use of the theoretical solubility maximums for worst case analysis is reasonable.

Response 3 - The Department agrees that the monitoring proposal described in the DEIS was not adequate to monitor potential impacts to groundwater. Flambeau Mining Company's revised groundwater monitoring plan, along with the Department's analysis of its effectiveness, are presented in the DEIS.

Response 4 - The procedures for calculating water quality-based effluent limits are specified in NR 106, Wis. Adm. Code. Categorical effluent limits are applied whenever they are more stringent than the water quality-based limits. The Department does not have the authority to impose background water quality or drinking water standards as effluent limits.

Response 5 - The DEIS recognized the possibility of toxic concentrations of hydrogen sulfide in the effluent. The Department will propose that bioassays be used to test for toxicity of hydrogen sulfide and any other substances in the effluent. Hydrogen sulfide can be controlled with the proposed treatment facilities through pH adjustment or by retaining the treated effluent for a period of time prior to discharge.

Response 6 - Dust emissions from the mine facilities would be controlled by various techniques and limited in areal extent. No adverse impacts to water quality are expected from dust emissions.

Response 7 - Dust emissions from rail cars are expected to be minor. Most of the ore would be in particle sizes too large to be entrained by wind. Dust-sized particles would tend to settle toward the bottom of the rail cars, thus limiting their exposure to the wind. Also, the Department will propose that emission limits be applied to the rail shipments in order to establish regulatory controls on any dust emissions from the railcars.

Precipitation would not normally leach significant quantities of pollutants from the loaded rail cars. The large size of the crushed ore particles along with the limited time that precipitation would contact the ore would serve to limit acid formation and leachate.

Response 8 - Comment noted. The Department's analysis of these facilities in the DEIS indicated that these groundwater impacts would occur.

Response 9 - Comment noted. Figure 2-4 of the DEIS shows wells used to produce baseline information. The proposed groundwater monitoring wells were on Figure 1-11. Flambeau Mining Company has added an additional monitoring well between the pit and the river to its proposal. The Department's analysis of the effectiveness of the current monitoring proposal is included in the FEIS.

Response 10 - The Department does not have the authority to require this type of mitigation.

Response 11 - While the Department agrees that the relationship between the Flambeau project and the Exxon - Crandon mine project is tenuous or nonexistent, it believes this discussion is necessary to comply with the intent of the Wisconsin Environmental Policy Act and NR 150, Wis. Adm. Code.

Response 12 - Most or all of the vehicles would be entering the peak afternoon traffic stream on STH 27 from the mine's main gate. Since most truck traffic would arrive and depart the mine site during normal working hours, the peak afternoon traffic exiting the site is assumed to be all passenger vehicles. Thus, the vehicles per day estimates should be approximately equal to passenger cars equivalent per day.

Response 13 - The FEIS has been revised accordingly.

Response 14 - The FEIS has been revised to include this information.

Response 15 - The FEIS has been edited as thoroughly as time allowed.

Response 16 - Some additional referencing has been added to the FEIS. However, the Department feels that extensive referencing is not appropriate since an EIS is intended as a general informational document rather than a technical report. Also, many of the conclusions regarding project impacts are the result of staff analyses and therefore cannot be referenced to a specific source.

Response 17 - The FEIS has been revised accordingly.

Response 18 - This paragraph only summarized the major vegetation impacts. The 46 acres not specifically addressed were represented by 45 acres of old field habitat and one acre due to rounding error. Actual impacts to plant communities were provided in Table 3-6 of the DEIS.

Response 19 - The FEIS has been revised accordingly.

Response 20 - The word "synergism" has been added to the glossary.

Response 21 - This paragraph was rewritten to remove the ambiguity.

Response 22 - Comment noted. The summary of the reclamation plan impacts has been rewritten to reflect the revised reclamation plan.

Response 23 - Comment noted. The summary of impacts from the monitoring plan has been rewritten to reflect the revised monitoring plan.

Response 24 - Comment noted. The summary of the net proceeds tax payments in the FEIS reflects a revised tax analysis.

Response 25 - Comment noted.

Response 26 - The FEIS has been revised accordingly.

Response 27 - The FEIS was revised accordingly.

Response 28 - The FEIS was revised accordingly.

Response 29 - The FEIS reflects these corporate relationships. BP-Minerals apparently no longer has any relationship with Kennecott Corporation.

Response 30 - The FEIS has been revised to indicate that Flambeau Mining Company is a legal successor in interest to Kennecott Explorations Limited for the purposes of the Local Agreement.

Response 31 - Comment noted.

Response 32 - The FEIS has been revised accordingly.

Response 33 - Comment noted.

Response 34 - The "mine site" has been designated on this figure.

Response 35 - The ultimate disposition of these buildings was not specified by Flambeau Mining Company in its applications. These structures are outside of the regulated mine site.

Response 36 - Figure 1-4 was modified to address this concern.

Response 37 - This sentence has been revised in the FEIS to indicate that the trucks would be capable of hauling either 35 or 50 tons of material each.

Response 38 - The relatively minor amounts of sand and gravel which would be excavated would be stored in the low sulfur stock pile.

Response 39 - The function of the compacted till layer is to act as a subbase for the HDPE liner. The till proposed for use as a subbase would not be suitable for a liner. The position of the till in the liner system was shown in Figure 1-7 of the DEIS.

Response 40 - Comment noted.

Response 41 - Stratification is normally used to describe a phenomenon observed in deep (greater than 6m) lakes that occurs during the summer in areas with a continental climate. The settling ponds will collect runoff, allow solids to settle, and discharge the clarified water to the Flambeau River. It is unlikely that stratification would occur due to the short hydraulic residence time. The development of an anoxic hypolimnion layer is generally associated with eutrophic lake conditions. The runoff will not contain large amounts of material with a biochemical oxygen demand. Thus, anoxic conditions are not expected to develop in the ponds.

Response 42 - Settling of colloidal suspensions of solids can be enhanced by the addition of polyelectrolytes, which are long-chain, ionic, synthetic and natural polymers. When these commercial formulations are added at part per million concentrations, they disrupt the stability of the particle-water interaction, and allow particles to settle faster.

Response 43 - The FEIS has been revised accordingly.

Response 44 - Comment noted.

Response 45 - "The term "lime slaking" has been added to the glossary.

Response 46 - Flambeau Mining Company estimates that 2.5 pounds of lime per ton of high sulfur waste will be needed to maintain a pH of 6.5. The ability of lime to control pH in acid producing sulfide aqueous systems has been well established. Flambeau performed worst case laboratory analysis using crushed waste rock and water to specifically estimate the amount of lime need to control pH. (See page 3.5-52, EIR).

Response 47 - This section of the FEIS has been revised to reflect the current proposal and material balance estimates. Any excess material would be till since the backfilling sequence would be designated in the permit and the till is the last waste material to be placed.

Response 48 - This section has been revised to reflect the current proposal. The long-term monitoring and maintenance costs include site inspections, land form maintenance, environmental monitoring and administration costs. A detailed breakdown of Flambeau Mining Company's estimates of its long-term care costs is provided in its mining permit application.

Response 49 - This section has been revised in the FEIS. The role of the Department would be to conduct site inspections, review monitoring data, independently monitor as appropriate and evaluate long-term care activities to determine compliance with permit conditions and to adjust financial responsibility requirements as necessary. Performance standards for site reclamation would be specified in the mining permit. The Department feels these details of regulatory procedure are not appropriate for the text of the FEIS.

Response 50 - Both indicator parameters and constituents of health concern were chosen based on the results of the mining waste characterization. If monitoring shows elevation of any constituents, the parameter list could be expanded to include a broader range of parameters having health-related concerns.

Response 51 - The Department agrees that the groundwater monitoring plan initially proposed by Flambeau and described in the DEIS did not contain sufficient monitoring points. It is Department policy to utilize indicator parameters as a basis for a cost-effective monitoring program. Extended monitoring parameter lists, including a major anion-cation balance is usually required only when indicator parameters have become elevated or if concerns with the quality control of the analytical work arise.

Response 52 - Comment noted.

Response 53 - This section has been revised to reflect Flambeau Mining Company's current surface water monitoring proposal.

Response 54 - Peak project related traffic will vary depending upon the phase of the project. During project months 1-5, extended work shifts will likely be utilized, and peak project traffic would occur in the early evening. Project traffic would be greatest during project months 6-9 when vehicles would be entering STH 27 throughout the normal afternoon peak and into the evening hours. During operations, traffic exiting the site is anticipated to leave during the normal peak afternoon traffic. The DEIS presentation assumes that all project traffic would occur during the peak hour.

Response 55 - The railroad spur intersection has been correctly depicted on all of the FEIS graphics. This project feature does not have any significant characteristics which would warrant a separate figure.

Response 56 - These figures have been corrected to properly show property ownership. Figure 2-15 of the FEIS depicts property recently annexed by the City of Ladysmith.

Response 57 - Comment noted.

Response 58 - The FEIS has been revised accordingly.

Response 59 - The FEIS has been revised accordingly.

Response 60 - The FEIS has been revised accordingly.

Response 61 - Comment noted.

Response 62 - The FEIS has been revised accordingly.

Response 63 - The FEIS has been revised accordingly.

Response 64 - This figure has been revised for the FEIS.

Response 65 - The composition of the principal minerals is described in the text. The referenced graphic has been redrawn to improve its clarity.

Response 66 - A list of current primary and secondary drinking water standards has been added as an appendix.

Response 67 - The use of the "watertable mounding" description was meant to convey in a nontechnical way that the equilibrium condition resulting from the movement of the available groundwater recharge through aquifers having variable hydraulic conductivity distributions (both heterogeneous and anisotropic) varying thicknesses and flow distances, in a physiographic terrain having relatively low relief, results in a watertable closely approximating the topography with little separation between the land surface and the watertable.

The recharge value of five inches was estimated from basin-wide separations of base flow using stream hydrographs, and from soil profile water balance calculations similar to those of Thornthwaith and Mather, 1957.

Response 68 - Figure 2-5 of the DEIS was correct.

Response 69 - A table and text modifications were added to the FEIS to respond to most of this comment. The range of groundwater flow velocities is not precisely known. An order of magnitude deviation above and below the calculated average values would be a reasonable estimate of the variation of flow velocities expected in the mine site area.

Response 70 - As pit dewatering proceeds, the glacial and sandstone aquifers are dewatered and the majority of inflow occurs through the Precambrian orebody materials, which have hydraulic conductivity values about 1,000 times greater than the surrounding unaltered Precambrian rocks. In addition, the slurry cut-off wall through the glacial and fluvial sediments in this area would direct about 40% of the mine inflow from the Flambeau River through the altered Precambrian materials along the strike of the ore body and to the pit. Without the stress caused by mine dewatering, the general statement that flow through the Precambrian is limited is accurate.

Response 71 - The FEIS has been revised accordingly.

Response 72 - Although some wells penetrate the Precambrian and may derive some flow from that unit, it is likely that much of the flow in those wells is derived from overlying units open to the well screen or in communication with the Precambrian through fractures. It is possible that some of the wells produce water exclusively from the Precambrian, as in other areas of the state, but the yields are usually low. The Precambrian can best be described as having limited groundwater flow, but being used as a marginal aquifer when no other water-bearing materials are available.

Response 73 - The FEIS has been revised to more thoroughly discuss the available data and hydrogeologic interpretation for these wetlands.

Response 74 - The FEIS has been revised accordingly.

Response 75 - The estimated 100-year flood elevation has been included in the FEIS.

Response 76 - A table listing all Department approvals necessary for the project has been included in Chapter 1. A table listing all administrative codes which may apply to the project is not appropriate for an EIS.

Response 77 - This figure has been revised accordingly.

Response 78 - Table 2-1 of the DEIS was based on criteria codified in NR 105 to protect the uses specified in the table, and on the classification and hardness of the water in the Flambeau River. The standards are specific to the Flambeau River only in that they are based on its classification as a warmwater sport fishery stream with a hardness of 50 milligrams per liter. Any stream with these characteristics would have the same standards. Results from the background water quality monitoring program, including ranges and average values, were presented in Appendix A of the DEIS.

Response 79 - The FEIS has been revised accordingly.

Response 80 - The FEIS has been revised accordingly.

Response 81 - The FEIS has utilized this recently published information.

Response 82 - Comment noted.

Response 83 - The FEIS has been revised to use consistent figures for pit depth and size.

Response 84 - As indicated in the DEIS, no measures are proposed to mitigate uneven settling over the pit. The DEIS also indicated that uneven settling could make postmining land management activities difficult. The question of whether an uneven land surface over the pit is acceptable is appropriately addressed in the regulatory process, not the EIS.

Response 85 - This type of detailed technical information is not appropriate for presentation in an EIS. Technical reports documenting the collection of hydrogeological information and groundwater modeling of mining impacts are available in Department files for public inspection.

A comparison of measured versus modeled groundwater elevations at 47 points showed the median of the absolute differences was about 1.8 feet with the standard deviation of 2.1 feet. Although there was no local stream base flow data to which model computed flows could be calibrated, the model-predicted hydraulic head distribution was considered acceptable by the Department. A range of model input parameters was used in the modeling and the results were used to evaluate the uncertainty of the model predictions.

Response 86 - These figures have been revised as suggested.

Response 87 - This figure has been added to FEIS.

Response 88 - The FEIS has been revised to include results of the bioassays conducted by Flambeau Mining Company. This study was not completed until September 1989.

Response 89 - This figure was incomplete in the DEIS due to a printing error. The FEIS provides the correct figure.

Response 90 - A discussion of the hydrology of Wetland 1 was provided on page 26 of the DEIS. The discussion of wetland mitigation measures in the DEIS did not involve wetland restoration, but rather the discharge of wastewater into Wetland 1 to mitigate groundwater loses caused by dewatering the mine.

Response 91 - The impacts of the proposed wetland restoration effort are described in the FEIS.

Response 92 - This conclusion refers to past experience of Department staff and represents the professional opinion of qualified experts. See Response 88.

Response 93 - This potential has been noted in the FEIS.

Response 94 - This section describes the impacts of the monitoring proposal and is accurate. The expected impacts of the project on the various environmental components are described elsewhere in the DEIS.

Response 95 - These acronyms were previously defined in the text.

Response 96 - The FEIS has been revised accordingly.

Response 97 - See Response 81.

Response 98 - This error has been corrected in the FEIS.

Response 99 - Annexation describes changes to boundaries of incorporated municipalities and does not relate to property rights. Annexation applies geographically to surface and below-surface features. See Response 56.

Response 100 - The FEIS has been revised accordingly.

Response 101 - This section of the FEIS has been revised.

Response 102 - Proposed contingency measures for identified risks were briefly discussed in the DEIS on pages 88-96. Additional detail on contingency measures are included in the mining permit application.

The section referenced in this comment applies only to contingency measures for groundwater pollution detected by groundwater monitoring. The appropriate remediation technique would depend on the source and cause of contamination. All of the mentioned remediation techniques could potentially be successfully employed.

Response 103 - Steeper bench face angles would decrease the stability of the pit walls and increase the probability of failure. While a near vertical angle for the bench faces is ideal for minimizing wastes, blasting would break the bench face back along geologic structures, resulting in areas of pit wall with angles steeper than the design angle and decreasing pit wall stability.

Response 104 - This section was intended to describe the general alternative of an increased groundwater monitoring scheme. A variety of different combinations of well numbers and locations would adequately monitor groundwater impacts.

Response 105 - The FEIS has been revised accordingly.

Response 106 - The FEIS has been revised to include a range for aluminum values.

Response 107 - This comment is in error. The 58-acre wetland (Wetland 10) is not projected to be impacted by the groundwater drawdown (page 57, DEIS) and therefore is not involved in any mitigation proposal.

Response 108 - The DEIS graphic depicting wetlands was incomplete and implied that the wetland impacts from the railspur could be avoided by relocating the corridor further south. Figure 3-11 of the FEIS better shows the actual location of wetlands in the area. The Department's opinion is that the proposed rail corridor minimizes impacts to wetland values to the extent practicable.

Response 109 - The current proposal is to replace the 8.4 acres of wetlands impacted by the project with 8.5 acres of recreated wetland. The Department assessment of the probable functional values of the recreated wetland is provided in Chapter 3 of the FEIS.

Response 110 - Comment noted. The FEIS acknowledges the temporal impacts to wetland values and includes the alternative of creating wetland over the entire pit during reclamation.

Response 111 - Comment noted. The Department will include its list of preferred groundwater monitoring parameters in the draft permits for the project.

Response 112 - Comment noted. As indicated in the FEIS, the Department believes that the proposed surface water monitoring scheme would be adequate to detect impacts from the wastewater discharge.

Response 113 - The DEIS provided a brief description of the risks of chemical and fuel spills and of the proposed contingency plan to address these spills (pages 89-91, DEIS). Additional detail is available in the mining permit application. Also, a spill prevention, control and counter measures plan pursuant to the Clean Water Act must be prepared prior to the commencement of site operations.

Response 114 - The applicant has conducted bioassay testing on synthesized wastewater effluent since the DEIS was prepared. A discussion of the results of this bioassay testing is included in the FEIS.

SUMMARY OF PUBLIC COMMENTS AND DEPARTMENT RESPONSES

Public comments on the DEIS were solicited by the Department from September 6, 1989 through October 23, 1989. In addition to the government agency letters, 70 individual comment letters and two form letters were received. At the public information meeting held on October 6, 1989, 44 verbal statements and 5 written statements were received into the record. The following is a summary of public comments on the DEIS and the Department responses to those comments. Comments similar to those from a government agency which were addressed in the previous section are not repeated here. Specific requests for modifications to the project or for permit conditions are not included, but were provided to the proper regulatory unit of the Department. Editorial comments or suggestions for minor textual changes were incorporated as appropriate and are not summarized. Comments supporting or opposing the project or mining in general are also not included.

COMMENTS FROM THE APPLICANT

Comment: The DEIS should note that most of Wetland 1 is relatively remote from the groundwater drawdown. Wetlands 5C and 6C are moderate to low value wetlands which are probably perched above the groundwater table.

Response: Most or all of Wetland 1 is within the predicted groundwater drawdown and the drawdown under the southeastern edge of the wetland could be up to 15 feet. Also, the major impact to the wetland would probably result from eliminating the groundwater seep, an impact which would occur with only a few feet of drawdown. Therefore, describing Wetland 1 as being relatively remote from the major drawdown effects would not contribute to an understanding of the potential impacts to this wetland. The DEIS accurately described the functional values of Wetlands 5C and 6C and the available hydrogeological data.

Comment: Most of the private wells north of the mine which could be affected by the drawdown are owned by Flambeau Mining Company. Those potentially affected wells not owned by Flambeau would experience water level drops of only two to three feet and should not be adversely affected.

Response: As the DEIS indicated, the Department's analysis showed that four wells would have between two to five feet of drawdown and one well would have about eight feet of drawdown. While it is true that the wells with only a few feet of drawdown would probably not be adversely affected, the actual impact of a decline in the water level cannot be stated with certainty without information on the well construction details.

Comment: The DEIS implies an unwarranted uncertainty about the performance of the wastewater treatment system. Bench testing shows that the wastewater treatment process will adequately treat the wastewater to meet the regulatory discharge limits.

Response: The FEIS has been modified to incorporate the results of the bioassay testing. However, the discussion still acknowledges the uncertainty inherent in bench scale testing and in performing bioassays on synthesized effluent.

Comment: The statements that no final land use for the site is proposed and that inappropriate plant species are proposed for reclamation are not accurate.

Response: The Department believes that the original statements in the DEIS are essentially correct. However, Flambeau Mining Company has proposed a revised reclamation plan which includes new land use proposals and species lists, and it is this reclamation plan which is evaluated in the FEIS.

Comment: The statements indicating that the settling ponds are not lined in order promote infiltration and that a substantial fraction of the runoff to the settling ponds would percolate through the pond bottoms are not accurate. The FEIS should quantify the potential infiltration as approximately 10 percent of the inflow to the ponds.

Response: The reference to promoting infiltration has been removed in the FEIS. The Department believes that the assumptions utilized to derive the 10 percent estimate were not sufficiently conservative. The FEIS has been revised to indicate that more than 10 percent of the inflow to the settling ponds would infiltrate through the pond bottoms.

Comment: Wetland 11 is not influenced by seasonal flooding as indicated and, based on its hydrology and vegetation, should not be designated as a wetland.

Response: The Department believes that its description of Wetland 11 in the DEIS is essentially correct. While the Department recognizes that Wetland 11 possesses only marginal wetland characteristics, it is the opinion of Department experts that Wetland 11 is properly characterized as a wetland.

Comment: Monitoring of water quality in the backfilled pit is not necessary. The data show there is no possibility of impacts to the Flambeau River from seepage through the backfilled pit.

Response: The Department feels this monitoring is necessary to detect any unexpected developments within the backfilled material. Flambeau Mining Company has included this monitoring in the revised monitoring plan which is evaluated in the FEIS.

Comment: The discussion of the wastewater discharge implies that beryllium would be present in the discharge when the available data indicates that it will not be found on the site.

Response: Table 3-3 of the FEIS has been revised to indicate that the expected beryllium concentrations in the effluent would be substantially less than the effluent limit.

Comment: Due to the low concentrations of metals in the effluent and groundwater discharge, monitoring for bioaccumulation is not necessary.

Response: The Department believes that monitoring bioaccumulation of metals and acquatic organisms is appropriate, and Flambeau Mining Company has included this monitoring in its revised permit applications.

Comment: The discussion of noise impacts from equipment operations at the pit and stockpile over-states the potential impacts.

Response: The FEIS has been revised to clarify that the noise levels described in Chapter 3 are peak levels rather than average levels.

Comment: An on-site archaeologist should not be necessary during construction since the probability for any unknown archaeological resources to occur on the site is very low.

Response: The Department agrees that the probability of discovering an archeological site during construction activities is low. However, the statement in the DEIS that the presence of a qualified archaeologist would be necessary to ensure the protection of any sites exposed by project activities is correct.

Comment: The discussions of alternatives for additional groundwater and wetland monitoring, land surface monitoring and regarding, and additional dust suppressant measures all address alternatives which are not necessary due to the minor impacts associated with these resources.

Response: Both state law (NR 150, Wis. Adm. Code) and federal law (Council on Environmental Quality regulations - 403 CFR 1502) require that an EIS analyze a full range of feasible alternatives. An EIS does not conclude whether alternatives which are described are "necessary".

GENERAL PUBLIC COMMENTS

Comment: Would the wastewater in the settling ponds be toxic to waterfowl?

Response: The settling ponds would contain runoff from the low sulfur stockpile and noncontact pit water. This water is not expected to have concentrations of any contaminants which would be toxic to waterfowl. Also, these ponds would only operate during the initial pit development and after rainfalls. Thus, the ponds would be drawn down or empty much of the time.

Comment: The DEIS does not state that RTZ Corporation owns Kennecott Corporation which in turn owns Flambeau Mining Company.

Response: This was not included in the DEIS since it is of no consequence to the prediction of environmental impacts from the project.

Comment: The EIS should evaluate the environmental track record of Kennecott Corporation and/or RTZ Corporation.

Response: The purpose of an EIS is to evaluate the probable environmental impacts of a project and alternatives to major project components. The state regulates mining projects based on the specific features of each mining proposal. There is no provision in the state regulations which would allow an applicant's track record to be considered in making permit decisions. Also, a permittee is free to sell a project and the associated permits to any other qualified company. Thus, an applicant's environmental track record has no relationship to the probable environmental impacts of a project and is not an appropriate component of an EIS.

Comment: The DEIS does not provide data on existing employment in the tourism, farming, and forestry industries and does not recognize that adverse economic impacts to these industries could offset the economic benefits from the mine.

Response: This comment presupposes that the mine would cause significant environmental impacts which would in turn affect these other industries. The DEIS concludes that impacts of this magnitude are very unlikely and, therefore, that the project would have no significant effects on other industries. As a result, no baseline data on these industries are necessary.

Comment: The DEIS proposed inadequate reclamation and monitoring plans.

Response: The DEIS did not propose the monitoring or reclamation plans. Rather, it presented the applicant's plans and analyzed the probable impact of those plans. The DEIS concluded that the applicant's plans were not adequate to achieve the necessary objectives. Flambeau Mining Company has since submitted revised monitoring and reclamation plans. The FEIS provides a description of these plans in Chapter 1 and an analysis of the plans' effectiveness in Chapter 3.

Comment: The DEIS did not provide sufficient information on the geology of the orebody and waste rock. The geological character of the site cannot be considered verified unless DNR did its own core sampling and analysis.

Response: Some additional information on the geological and geochemical nature of the orebody and waste rock has been added to the FEIS. Due to its technical nature, a detailed presentation of this information is not considered appropriate for the FEIS. Additional information is available in

Department files. The Department has independently verified the geological character of the site, but has not conducted its own core sampling and analysis.

Comment: The DEIS does not mention the possibility of radioactive materials occurring in or near the orebody.

Response: The DEIS did not address radioactive materials because there is no legitimate basis for expecting radioactive elements to be present at the Flambeau site.

Comment: The potential water quality impacts to the Holcombe flowage should be described.

Response: A discussion of potential water quality impacts to the Holcombe flowage has been added to the FEIS.

Comment: The DEIS seems to rely too much on Flambeau Mining Company data. The Department should conduct more independent studies.

Response: The Department is responsible for the veracity of the data it uses for the EIS. Department staff have satisfied themselves that significant data used for impact evaluation were reasonably accurate and representative of actual conditions. Department verification activities ranged from independent sampling and analysis to making best professional judgements.

Comment: The DEIS does not address the cumulative impacts of multiple mining projects on Northern Wisconsin.

Response: The potential for cumulative impacts related to the Flambeau Project was described in the DEIS on page 96. The establishment of multiple projects with compound impacts is not a reasonably probable or foreseeable consequence of the Flambeau Project. Also, there is no way to apply this analysis of a hypothetical situation in regulatory decision making.

Comment: The use of federal maximum contaminant levels (MCL's) as groundwater standards allows too much contamination and does not adequately protect surface water resources.

Response: State law specifies that MCL's are the groundwater standard to be applied to mining. MCL's are the most commonly applied groundwater standard across the country. MCL's are not, however, applied as surface water standards to protect aquatic life. The surface water standards applicable to the Flambeau Project are those specified in NR 102 through NR 105, Wis Adm. Code.

Comment: The EIS should address the additional pollution which would result from refining and smelting the ore, even if those impacts would occur out of state.

Response: A brief discussion of these impacts has been included in the final EIS.

Comment: The DEIS does not describe the proposed wastewater treatment system. Also the DEIS should have more information on alternative wastewater methods.

Response: The proposed wastewater treatment system was described on pages 9 and 10 of the DEIS. The Department believes the DEIS provides a reasonable discussion of the full range of feasible alternatives for wastewater treatment.

Comment: The DEIS does not describe the crushing mill which would be used.

Response: The project proposal involves only primary crushing, e.g., to less than 12 inches in diameter (DEIS page 5). Secondary crushing and fine grinding would be conducted at the out-of-state processing site. The crusher proposed for primary ore crushing would be a 30 inch by 42 inch jaw crusher.

Comment: The EIS should specify where the ore would be shipped for processing.

Response: The ultimate destination for the ore has not yet been determined and is not under the regulatory review of the Department. Possible locations for ore processing would include White Pine, Michigan and Bingham, Utah.

Comment: The potential for blasting to increase the fracturing of bedrock around the pit should be evaluated. Increased fracturing could increase the amount of inflow into the pit during operations, and increase the long-term groundwater flow through the backfilled pit.

Response: A discussion of the effect of blasting on the integrity of the pit perimeter and on pit inflows has been added to the FEIS.

Comment: The EIS should evaluate the impacts of an extended suspension of mine operations.

Response: Due to the short-term nature of the project, the Department feels that the probability of an extended suspension of operations is so remote that this scenario does not warrant an evaluation.

Comment: The company's proposal to store/dispose of topsoil in the gravel pit would have adverse impacts on groundwater quality.

Response: The company has not proposed to store or dispose of topsoil in the gravel pit. This alternative and the associated impacts were discussed on page 104 of the DEIS.

Comment: The FEIS should discuss the alternative of using a less permeable clay for "capping" the pit.

Response: A discussion of this alternative has been added to the FEIS. However, it should be noted that the design concept does not rely on the saprolite layer to perform a "capping" function. Rather, the saprolite would be replaced in its original stratigraphic position and compacted to help minimize the exchange of water between the backfilled pit and the overlying aquifer.

Comment: The Land Use/Noise Compatibility Matrix is of questionable validity, particularly where it indicates that decibel levels over 75 are normally acceptable for open land/wildlife habitat.

Response: This matrix was generated by the U.S. Department of Housing and Urban Development, and was used as one of several indexes to help provide a frame of reference for assessing noise impacts.

Comment: The aesthetic impacts of the project would be more severe than indicated in the DEIS. The FEIS should include additional drawings which would better show the potential visual impacts of the project.

Response: The Department feels that while the project would have significant aesthetic impacts during its operation, the short-term nature of the project limits the overall aesthetic impacts and that these limited impacts do not warrant additional graphics in the FEIS.

Comment: The FEIS should assess the impacts of the slurry wall failing.

Response: There is no feasible mechanism for a catastrophic failure of the slurry wall. Even if the slurry wall was completely nonfunctional, pit inflows would increase by only 40 gpm and the impacts would be insignificant.

Comment: The FEIS should address the need for the project in terms of copper demand.

Response: The current demand for copper is sufficient to support a market price which makes the Flambeau Mine a viable project. It is beyond the scope of an EIS to project or speculate on the future copper demand.

Comment: The FEIS should discuss the potential conflict between the state permitting authorities and the Lake Superior Chippewa Tribe's treaty rights in the ceded territory.

Response: These are intergovernmental legal issues which are beyond the scope of an EIS.

Comment: The FEIS should evaluate potential impacts from blasting to the pipeline crossing the Flambeau River and to the natural gas line providing service to the mine site.

Response: A discussion of potential impacts to these pipelines has been added to the FEIS.

Comment: The statement in the DEIS that the alignment of the pit along the groundwater flow path would limit the potential for groundwater contamination does not account for the longer time of groundwater contact with the wastes. Also, the DEIS does not indicate that chemical kinetics and rate processes were considered in evaluating groundwater impacts.

Response: The DEIS used a worst case assumption that groundwater exiting the backfilled pit contained the theoretical maximum solubility concentrations of contaminants. Therefore, residence time and chemical kinetics are irrelevant. The DEIS indicated that the pit/groundwater flow path alignment would limit the areal extent of groundwater impacts.

Comment: Lime addition to the backfilled high sulfur waste rock may only be temporarily effective. Acidic water moving through the backfilled pit could, over time, negate the effect of liming. Also, the possibility of hydrogen sulfide being generated in the backfilled pit should be addressed.

Response: The potential for acid generation is within the backfilled waste itself. The liming would prevent acid formation in the pit. No external source of acid exists. No mechanism for generation of significant quantities of hydrogen sulfide would be present in the backfill.

Comment: The FEIS should provide a more detailed description of the proposed reclamation plan, including the selected plant species and reclamation techniques.

Response: The FEIS provides an overview of the proposed reclamation plan. Additional detail on the plan is available in Flambeau Mining Company's Mining Permit Application.

Comment: How were estimates of the quality of the treated wastewater derived? Did DNR verify these estimates?

Response: Projections of the treated wastewater quality were derived by first estimating the quality of the raw wastewater (from both field and laboratory work) and then conducting bench scale analyses to determine the effectiveness of various treatment technologies. The Department has verified various steps of this process and has concluded that the projected wastewater quality is consistent with published data on these commonly used treatment technologies.

Comment: The FEIS should assess the health impacts of dust emissions from ore trains in the City of Ladysmith.

Response: A discussion of these impacts has been added to the FEIS.

Comment: The analysis of impacts of air emissions should include the effects on individuals with debilitated health at the hospital and nursing home north of the mine site.

Response: The ambient air quality standard for particulate matter established by state law provides protections for sensitive individuals with an adequate margin of safety. Individuals at these facilities would be adequately protected through application of these standards.

Comment: The FEIS should include a discussion of the historical effect that the mining controversy has had on local communities.

Response: This discussion would have no role in the projection of impacts from the project, and therefore, is beyond the scope of the EIS.

Comment: A more detailed and long-term analysis of socioeconomic impacts from the project, including studies of analogous areas, should be provided in the FEIS.

Response: Due to the small scale and short-term nature of the project, a more detailed analysis is not necessary in order to accurately predict the socioeconomic impacts of the project. An analogous areas study would only be suitable for a much larger and long-term project for which a comparable location and project could be found.

Comment: The projections of tax revenues from the project encompass too wide of a range. Can these be narrowed?

Response: The ranges in projected tax revenues result from only two variables; metals prices and transportation costs. Neither of these variables can be predicted with any greater accuracy. The mid-points of these ranges are considered to be suitable figures to use for planning purposes.

Comment: How long can the structural integrity of the backfilled pit be assured? Will the permeability of the bedrock surrounding the pit or in the river pillar increase over time?

Response: Backfilling the pit would support the pit walls and would insure structural stability over the long-term. Changes in the permeability of the bedrock surrounding the pit over time would not occur.

Comment: The FEIS should provide details on the proposed blasting charge and the delays between charges.

Response: Flambeau Mining Company has not proposed specific charge weights or delays in its permit applications. Typically, test blasting is conducted at the onset of a project to optimize the blasting parameters. Flambeau Mining Company's consultants have estimated that production blasting in the ore would involve 20-30 four-inch holes, each containing up to 30 pounds of explosive. Waste stripping blasts would probably involve 50-60 holes with approximately 100 pounds of explosive per hole. It was assumed that a maximum of approximately five holes would be fired in any delay period.

Comment: The EIS should provide a description of the chemical reactions which would take place within the backfilled pit.

Response: The DEIS provided a brief discussion of the most likely chemical reactions within the backfill on page 46. Additional detail can be found in Appendix L of the Mining Permit Application - "Prediction of Groundwater Quality Downgradient of the Reclaimed Pit for the Kennocott Flambeau Project."

Comment: Would the wastewater treatment sludge dry when spread on the high sulfur waste rock pile and become wind-borne? Would the sludge cause an odor?

Response: The sludge would be applied as a semi-liquid and would tend to flow into voids in the waste rock pile. The applied sludge would subsequently be covered as waste rock piles are built. Also, dust suppression measures employed to prevent emissions from the waste rock handling would minimize the potential for the sludge to desiccate. The sludge would be inorganic in nature and would not be odoriferous.

Comment: The FEIS should describe who would be financially responsible for environmental damage during and after the long-term care period.

Response: The mining company and/or its parent company(s) would be liable in perpetuity for any damages caused by the mine. The long-term care period relates only to physical maintenance of the mine site and does not relate to financial responsibility for environmental damages.

Comment: The DEIS contains differing estimates of pit inflow.

Response: This error has been corrected in the FEIS.

Comment: The surge pond and runoff pond do not have the capacity to handle a 25 year/24 hour storm event. Why are surface drainage facilities designed for this storm event?

Response: Both the surge pond and the runoff pond will be constructed with an overflow pipe to discharge water to the open pit if the ponds become full. Flambeau Mining Company judged that a 25 year/24 hour storm design was appropriate given the short project duration and the capacity of the pit to store excess water.

Comment: The DEIS does not consider the possibility of water in the pit contaminating the underlying groundwater.

Response: The bedrock in the bottom of the pit would have a very low permeability and little water flow would occur. Any groundwater flow which did occur would be flow into the pit since groundwater gradients in the bedrock at depth are upward.

Comment: The till under the low sulfur stockpile will initially sorb contaminants, but once the ion exchange capacity is exhausted contaminants will leach through the till into the groundwater.

Response: The Department believes that studies produced by Flambeau Mining Company adequately demonstrate that the till has sufficient capacity to sorb contaminants from the low sulfur waste materials. See "Prediction of Chromium Copper and Iron Concentrations in Vadose Zone Water Reaching the Water Table Beneath the Unlined Type One Stock Pile for the Kennocott Flambeau Project" - Mining Permit Application, December 1989.

Comment: The FEIS should include a list of variances requested by the company.

Response: This list has been added to the FEIS.

Comment: The FEIS should include a description of bonding requirements which would assure that money is available for reclamation, monitoring, environmental repair, and tax payments.

Response: The company is required to post a bond covering the entire costs of reclaiming the site and to demonstrate its financial responsibility for long-term care activities. A variety of programs could apply to environmental repair activities, depending on the circumstances and sources of the problem. There are no bonding requirements related to tax payments. Details of these financial requirements can be found in the mining regulations and are not appropriate for an EIS.

Comment: What are the chemical constituents of the dust which would be emitted from the project?

Response: Since dust would primarily be emitted from handling of waste materials, the constituents of the dust would be the same as those described for the waste materials in Chapter 2 of the FEIS. While the composition of the ore is generally known, Flambeau Mining Company has not provided a detailed analysis of this material.

Comment: What groundwater model was used to predict impacts from the mine?

Response: The model used was a modified version of the two dimensional flow model called the Prickett-Lonnquist Aquifer Simulation Model (PLASM).

Comment: Why is a new well required for potable water at the plant site?

Response: The existing potable well at this location does not meet current design standards.

Comment: The EIS should address the commercial value of the groundwater which would be contaminated by the mine.

Response: As indicated in the DEIS, no significant contamination of groundwater from the mine is expected. Also, groundwater at the mine site currently has little or no commercial value.

COORDINATION, SCOPING AND PUBLIC INVOLVEMENT

Following Flambeau Mining Co.'s July 1987 submittal of a Notice of Intent (NOI) to collect data, the DNR took steps to bring other agencies, local governments, and the public into the environmental review process. A public hearing on the NOI was held by the DNR in Ladysmith in September, 1987.

A Draft Environmental Impact Statement (DEIS) on the project was released for public review in September, 1989. An informational meeting on the DEIS was held in Ladysmith in October, 1989. During the course of the public review, approximately 10 letters from government agencies, 70 letters from individuals, 44 verbal statements and 5 written statements were received.

Other important interagency coordination, public participation and scoping initiatives to date include:

1. Distributing Flambeau Mining Co.'s Environmental Impact Report, permit applications, and supporting documents to state and federal agencies for review.

2. Asking state and federal agencies to determine their Wisconsin Environmental Policy Act (WEPA) and National Environmental Protection Act (NEPA) responsibilities relating to the proposed project and to work with the DNR to avoid duplication effort.

3. Seeking public review of the EIR and establishing two repository libraries where the EIR, permit applications, and related reports are available. Using public and agency comments in DNR's project review as feasible.

4. Compiling project mailing list of interested and affected citizens.

Based on internal DNR review and concerns expressed by other agencies and the public during the scoping process, permit review and impact evaluation efforts focused on the following issues:

1. Impacts to groundwater quality from waste rock storage and mine backfilling.

2. Impacts to groundwater quantity and quality resulting from mine dewatering.

3. Impacts to surface water quality and wetlands.

4. Impacts to the quality and quantity of private water supplies.

5. Impacts to aquatic and terrestrial ecosystems from the construction, operation and reclamation of the waste rock storage areas and the open pit mine.

6. Socioeconomic impacts.

This FEIS is also being distributed for public and government agency review. A public hearing on the FEIS will be held as part of the project Master Hearing.

LIST OF CONTRIBUTORS

Department of Natural Resources Employee	Job Title or Area of Expertise	Bureau or Location
George Albright	Section Chief	Environmental Analysis
Joe Ball	Planning Analyst	Water Resources Management
William Clark	Environmental Impact Coordinator	Spooner
Roger Gerhardt	Hydrogeologist	Water Supply
Jim Hansen	Environmental Specialist	Park Falls
Thomas Hunt	Mine Reclamation Specialist	Solid Waste
Roger Jasinski	Water Regulation Specialist	Park Falls
Ed Jepsen	Environmental Specialist	Environmental Analysis
Dan Johnston	Engineer	Air Management
Lawrence Lynch	Environmental Specialist	Solid Waste
Percy Mather	Engineer	Wastewater Management
Frank Pratt	Fish Manager	Hayward
Robert Ramharter	Coordinator-Flambeau Mining Co. Project	Environmental Analysis
Robert Read	Ecologist	Environmental Analysis
Gordon Reinke	Mine Reclamation Coordinator	Solid Waste
Danny Ryan	Water Resources Specialist	Spooner
Ted Smith	Water Resources Management Supervisor	Spooner
William Tans	Environmental Specialist	Environmental Analysis
Steven Ugoretz	Environmental Specialist	Environmental Analysis
Frank Vanecek	Wildlife Manager	Ladysmith
Ken Wade	Hydrogeologist	Solid Waste

REVIEWING AGENCIES AND PARTIES

Copies of this FEIS have been sent for review to the following agencies and parties:

I. Federal Agencies

Environmental Protection Agency - Region V
Army Corps of Engineers
Department of Agriculture
- Soil Conservation Service
- Forest Service
Department of Interior
- Fish and Wildlife Service
- Geological Survey
- Bureau of Mines
- Bureau of Indian Affairs
Council on Environmental Quality

II. State Agencies

Department of Administration
Department of Agriculture, Trade and Consumer Protection
Department of Development
Department of Health and Social Services
Department of Industry, Labor and Human Relations
Department of Justice - Attorney General
Department of Justice - Public Intervenor
Department of Public Instruction
Department of Revenue
Department of Transportation
Geological and Natural History Survey
State Historical Society
Public Service Commission

III. Local and Regional Agencies and Units of Government

Northwest Regional Planning Commission
City of Ladysmith
Rusk County
Town of Grant

IV. Libraries - Copies of this FEIS are available for public review at the following libraries:

Ladysmith Public Library
L.E. Phillips Memorial Public Library (Eau Claire)
Reference & Loan Library (Madison)

V. This FEIS has been sent to the following elected officials:

Governor Tommy Thompson
State Senator Walter Chilsen
State Representative Robert Larson

GLOSSARY

Term	Definition
Acoustical	Pertaining to hearing or sound.
Aerobic	Chemical reactions that require the presence of oxygen, particularly important for the oxidation or weathering of pyrite in the waste rock. Organisms that only can exist in the presence of oxygen.
Algae	A class of plants including microscopic, single-celled, and more complex, such as seaweed. Occurring in water and soil.
Alkaline	A measure of the buffering capacity of a solution, i.e., the capacity to neutralize an acid. A solution ranging between 7 and 14 on the pH scale.
Amphibians	Cold-blooded vertebrate animals with gilled larvae but air-breathing adults.
Anaerobic	The absence of oxygen.
Aquifer	A geologic formation, group of formations, or part of a formation containing sufficient saturated permeable material to yield economical quantities of water to wells and springs.
Archaeological	The study of historic or prehistoric areas or peoples by analysis of their artifacts and other remains.
Artesian	A well or spring deriving its water from a confined aquifer in which the water level stands above the ground surface.
Attenuation	A decrease in the concentration of a pollutant in a fluid resulting from physical, chemical, and/or biological processes with the soil.
Backfill	Waste rock or other non-salvageable material used to fill the pit created during the mine operation.
Background Conditions	Concentration of a parameter or pollutant naturally occurring in the environment. Also called ambient conditions.
Benthic	All bottom terrain, from a shoreline to the greatest depth of a water body.
Berm	An elongated man-made earthen mound, usually built to break a long slope or channel runoff water to minimize erosion.

Bioassay	A test used to determine the toxicity of pollutants in wastewater on an aquatic organism.
B.O.D.	Biological oxygen demand.
Boomshocking	Use of an electric shocking device, mounted on a long pole, to collect live fish.
Canopy Species	A species of tree forming the uppermost, spreading, branchy layer of a forest.
Carnivorous	Flesh-eating.
cfs	Cubic feet per second.
Chlorite	A group of greenish, platey minerals. Chlorite is common in low grade metamorphic rocks.
C.O.D.	Chemical oxygen demand.
Composite Sample	A sample created by combining a number of individual samples.
Cone of Depression	A conically shaped area of dewatered sediments caused by groundwater drawdown.
Creel Census	Fish sampling data compiled from a census of fishermen.
Critical Flow Condition or $Q_{7,10}$	The mean seven-day low flow of a stream during a 10-year period. This is often abbreviated as $Q_{7,10}$ where Q=quantity of flow, 7=days and 10=years.
CTH	County Trunk Highway.
dBA	Noise measurements in decibels using the A-weighted scale.
Decibels	A measure of the noise intensity; referred to as a decibel level. A logarithmic unit which expresses the ratio between two sound pressures or loudness.
Deposit	A term used to designate a natural occurrence of a useful mineral or collection of minerals in sufficient quantity and quality to invite mining.
Detritus	A residual material produced by the disintegration of rock or organic materials.
Demographics	Statistical study of population characteristics and trends.
Diatom	A microscopic, single-celled plant which grows in marine or fresh water.
Dip	Angle of inclination of a rock surface or formation from the horizontal.

Dispersion	A process resulting in the spread of a substance or contaminant throughout a system.
Dissolved Oxygen (DO)	The amount of oxygen dissolved in water. Adequate dissolved oxygen is necessary to support a diverse aquatic community. Low dissolved oxygen concentrations generally are due to excessive organic residues; e.g., decaying vegetation in lakes or organic wastes in wastewater.
Effluent	A term for wastewater flowing from a treatment plant.
Effluent Limitation	Any restriction established by the state or the EPA on the quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged by a point source into surface waters.
EIR	Environmental Impact Report.
EIS	Environmental Impact Statement.
Endangered Species	Species, listed by a federal or state agency, that are in danger of extinction throughout all or significant portions of their ranges.
Evapotranspiration	The combined loss of water from a given area by evaporation from land and water surfaces and transpiration from plants. Transpiration is the process by which water vapor is released by foliage during respiration and photosynthesis.
Fauna	A collective term referring to all the animals of a particular area or time.
Fiscal	Pertaining to governmental revenues and costs.
Footwall	The formation on the underside of an inclined orebody.
Formation	The basic geologic unit in the description or organization of rock sequences in a given area. A formation is a body of rock thick enough to be mapped and contains features which distinguish it from adjacent rock units.
Geomembrane	A manufactured or synthetic material with very low permeability.
Gill Netting	A fish sampling method which uses nets to capture fish by their gills.
Gossan	A yellow to reddish deposit of hydrated iron oxides produced near the surface by the oxidation and leaching of iron sulfide minerals.
gpd	Gallons per day.

gpm	Gallons per minute.
Ground Cover	Fast growing herbaceous plants grown to keep soil from eroding in areas disturbed by construction or other activities.
Groundwater	Water contained in saturated, porous rocks or sediments. That portion of the subsurface water that is in the zone of saturation, below the water table.
Groundwater Model	A series of mathematical equations used in a computer to analyze the physical and chemical processes influencing groundwater quality, quantity and/or flow patterns.
Groundwater Table	The fluctuating, upper surface of the zone where all the pore space within the rock layers or sediments are water filled.
Habitat	The environment which supplies the life needs of a plant or animal.
Hanging Wall	The rock formation on the upper side of or overlying an inclined orebody.
Hardness	The characteristic of water which is defined by measurements of salts of calcium, magnesium and iron such as bicarbonates, carbonates, sulfates, chlorides, and nitrates.
HDPE	High density polyethylene. A material commonly used to line facilities containing contaminated leachates to prevent environmental pollution.
Hydraulic Gradient	The rate of change of total groundwater head per unit of distance of flow in a given direction.
Hydroxides	A compound of an element, such as a metal, with hydrogen and oxygen.
Infiltration	The movement of water into the pores of the soil or waste rock from an outside source,; e.g. precipitation.
Influent	A term for wastewater flowing into a treatment plant.
Intermittent	Alternately ceasing and starting again. A stream or lake where water flows only part of the time.
Jointing	Discontinuous fractures in rock along which no appreciable rock movement has occurred.
Leachate	A liquid, usually water, which has percolated through waste material and has become contaminated with dissolved and/or suspended substances.

Leaching	The selective removal of soluble constituents from ore or rock by percolating water.
Lime Slaking	The process of combining lime (calcium oxide) with water or moist air to form calcium hydroxide.
Liners	A layer or layers of low permeability materials such as native clay, bentonite-amended soil or a manufactured geomembrane (hypalon, PVC, or polyethylene) used to contain contaminated liquids.
Lithology	The character of a rock formation.
Lysimeter	A device used to measure the quantity and/or quality of leachate seeping from a waste containment facility.
Macroinvertebrates	Macroscopic animals without backbones.
Massive Ore	An orebody containing greater than 50% sulfide minerals by volume. The massive ore of the Flambeau deposit is copper-enriched.
Mean	Average.
Median Household Income	The middle income point, where an equal number of incomes fall above it and below it.
Metamorphism	The altering of rocks by pressure, heat, and introduction of new chemical substances.
ml	Milliliter. One thousandth of a liter.
mg/l	Milligrams per liter. Can also be thought of as parts per million (ppm).
Monitoring Well	A well used to obtain water samples for water quality analysis and/or measurement of groundwater levels.
MSL	Mean sea level.
Net Fiscal Balance	The difference between total government revenues and total government expenditures.
Non-assessed Land	Land which is not assessed for property tax purposes.
Nondedicated Revenues	Revenues that have not been assigned to specific uses.
One-hundred-year Flood	The flood elevation of a river, such that the level is encountered, on the average, only once every 100 years.
Orebody	A volume of rock containing extractable mineral commodities which can be mined and sold at a profit.
OSHA	Occupational Safety and Health Administration.

Outwash	Glacial sand and gravel washed and sorted by meltwater streams.
Overburden	Loose friable material, which, for this project includes soil, gravel, till, sandstone and saprolite materials which can be readily ripped by a bulldozer and which overlies the unrippable bedrock.
Own-source Revenues	Revenues coming from local sources, not from intergovernmental transfers.
Oxidation	The chemical process whereby a substance combines with oxygen. Often associated with the weathering of rocks or the decomposition of organic matter.
Palustrine	Pertaining to material deposited in a swamp environment.
Parameter	A parameter is a substance or element in water, air or soil which can be easily measured and serves as an indicator of environmental quality.
Perched	Refers to an aquifer or wetland separated from an underlying body of groundwater by an unsaturated zone.
Percolation	Downward flow or filtering of water through pores or spaces in rock or soil.
Periphyton	Aquatic biotic community living on a submerged, fixed substrate. Includes plants and animals.
Permeability	The capacity of a material to conduct or transmit liquids or gases. Materials with larger, interconnected pores (e.g., sands and gravels) can transmit large quantities of water (high permeability) while materials with small, poorly connected pores (e.g., silts and clays) transmit low quantities of water (low permeability).
pH	The unit used to indicate the acid-alkaline balance of a substance. The pH scale ranges from 0-14 with 0-7 being acid and 7-14 being alkaline.
Phytoplankton	Floating plants, such as diatoms.
Piezometer (PZ)	A groundwater observation well used to measure groundwater levels or determine direction of flow.
Pleistocene	A period starting about one million years ago, characterized by widespread glacial ice.
Polymer	Long-chained, ionic natural or synthetic substances used to acid in settling suspended solids from wastewater.

Precambrian	The oldest eon in the geologic time scale, equivalent to about 90% of geologic time. Rocks in this era were formed between the earth's formation and 600,000,000 years ago.
Precipitate	A solid that separates from a liquid because a chemical/physical change occurs in a solution such that dissolved substances form insoluble compounds.
Prehistoric	Prior to recorded history.
psi	Pounds per square inch.
PVC	Polyvinyl chloride, a plastic material commonly used in making pipes.
Pyrite	Iron disulfide, (FeS_2). A material which decomposes when exposed to air and water releasing strong acidity.
Reagent	A substance used to produce a desired chemical reaction; e.g. to separate and precipitate soil particles and dissolved metals during water treatment.
Recharge	Process by which water percolates through the soil and into the aquifer.
Riverine	Pertaining to a river.
Runoff	The portion of precipitation that flows across the ground surface to a wetland, stream or lake. Runoff can pick up pollutants from the air or the land and carry them to receiving waters.
Saprolite	A soft, clay-rich, thoroughly decomposed rock that is characterized by the preservation of structures present in the unweathered parent rock.
Slurry	A mixture of water or liquid and other substances, such as clay particles.
Sociocultural	Pertaining to the interaction of social and cultural elements.
Socioeconomic	Pertaining to the interaction of social and economic factors.
Sorption	Includes both absorption and adsorption; binding processes important to removing pollutant particles.
Species	The basic category of biological classification of plants and animals; the major subdivision under the genus.
Swale	A slight, marshy depression or drainageway in level land.
Synergism	The characteristic property of a mixture of toxicants that exhibits a greater-that-additive cumulative toxic effect.

T.D.S.	Total dissolved solids.
Threatened Species	Species, listed by a federal or state agency, which are likely to become endangered unless measures are taken to restore the population.
Till	A very poorly sorted mixture of gravel, sand, silt, and clay directly deposited by glacial ice without being reworked by meltwater or gravity flow.
Translocation	A transfer from one place to another.
TSP	Total Suspended Particulates. Soil or organic particles in the ambient air.
TSS	Total suspended solids in water or other liquid. Those particles that have not settled out of the water column.
Turbidity	A measure of the amount of suspended solids in water.
ug/g	Microgram per gram; equivalent to parts per million.
ug/m^3	Microgram per cubic meter.
Understory	The plants of a forest undergrowth.
USEPA	U.S. Environmental Protection Agency.
Vertical Hydraulic Gradient	The flow of a fluid in a vertical direction.
Waste Rock	Rock removed during mining operations whose mineral composition is not of economic value.
Watershed	The land area contributing runoff to a stream, lake or wetland.
Water Table	See Groundwater Table.
WDNR	Wisconsin Department of Natural Resources.
Wetlands	Areas where water is near, at, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation.
Zooplankton	Animal forms of plankton which consume phytoplankton.

INFORMATION SOURCES

A variety of information sources were utilized by Department staff to develop this Environmental Impact Statement. These sources include the pertinent permit applications, the Environmental Impact Report, Groundwater Modeling Studies, the EIS on the former project, Department files, technical literature and field studies. Additional analysis was provided to the Department by staff members from the Department of Transportation and Departments of Revenue in Wisconsin. The following applicant-sponsored reports were major sources for the document.

- Air pollution control permit application for the Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. March 1989.

- Application for water regulatory permits and approvals for the Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. December 1989.

- Chronic toxicity test report - Kennecott-Flambeau Project Ladysmith, Wisconsin. Prepared by Thomas A. Prickett and Associates, Inc. and Engineering Technology and Associates, Inc. July 1989.

- Environmental Impact Report for the Kennecott-Flambeau Project. Prepared byl Foth and Van Dyke and Associates, Inc. December 1989.

- Final Engineering Report for wastewater treatment facilities for the Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. December 1989.

- Groundwater model for the Kennecott-Flambeau Project Ladysmith, Wisconsin. Prepared by Thomas A. Pickett and Associates, Inc. and Engineering Technology and Associates, INc. July 1989.

- Groundwater withdrawal permit application for the Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. December 1989.

- Mining permit application for the Flambeau Project. Prepared by Foth and Van Dyke and Associates, INc. December 1989.

- Notification of Intent to Collect Data Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. July 1987.

- Prediction of chromium, copper, and iron concentration in vadose zone water reaching the water table beneath the unlined Type I stockpile for the Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. July 1989.

- Prediction of groundwater quality downgradient of the reclaimed pit for the Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. December 1989.

- Scope of Study Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. October 1987.

- Wetland inventory and assessment Kennecott-Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. March 1989.

- WPDES permit application for the Flambeau Project. Prepared by Foth and Van Dyke and Associates, Inc. December 1989.

APPENDIX A

RECLAMATION PLANT SPECIES LIST

Savannah Plant List

Trees	Shrubs	Understory
Trembling Aspen	Witch Hazel	Jack-in-the-Pulpit
Red Maple	Smooth Sumac	Buttercup
Paper Birch	American Cranberry Bush	Sweet White Violet
Basswood	Viburnum	Big Leaved Aster
Sugar Maple	Grey Dogwood	Bunchberry
White Ash	Beaked Hazelnut	Rice Grass
Butternut Hickory	Blueberry	Twisted Stalk
Red Oak		
Yellow Birch		
Silver maple		
Hemlock		
White Pine		
Black Walnut		
Balsam Fir		
Ironwood		
Bur Oak		

Total Plants per Acre (excluding understory) 400

Wetland Plant List

Trees	Shrubs	Understory
Red maple	Red-Osier Dogwood	Bulrush
Black Ash	Tag Alder	Bur Reed
Balsam Fir		Wild Rice
Hemlock		Lake Sedge
		Blue Flag
		Yellow Pond Lily
		Water Lily
		Pickerel Weed
		Arrowhead
		Sago Pondweed
		Wild Celery
		Sweet Flag

Total Plants per Acre (excluding understory) 400

Shrubs

Sumac

Understory

WET SOILS SEED MIX

Canada Anemone
New England Aster
White Wild Indigo
Turtlehead
Canada Tick-Trefoil
Shooting Star
Joe Pye Weed
Bottle Gentian
Alum Root
Wild Iris
Prairie Blazing Star
Turk's Cap Lily
Great Blue Lobelia
Bergamot
Yellow Coneflower
Sweet Black-Eyed Susan
Cup Plant
Spiderwort
Ironweed
Culver's Root
Prairie Cordgrass
Spotted Joe Pye Weed
American Black Currant
Meadowsweet

DRY-MESIC SOILS SEED MIX

Leadplant
Thimbleweed
Common Milkweed
Butterfly Weed
Sky Blue Aster
Heath Aster
New England Aster
Canada Milk Vetch
Cream Wild Indigo
New Jersey Tea
Stiff Coreopsis
Canada Tick-Trefoil
Shooting Star
Purple Coneflower
Flowering Spurge
Western Sunflower
Alum Root
Ox-Eye Sunflower
Pearly Everlasting
Prairie Brome
Canada Wild Rye
Needle Grass
Rough Blazing Star
Prairie Blazing Star
Bergamot
Smooth Penstemon
Smooth Aster
Yellow Coneflower
Black-Eyed Susan
White Wild Indigo
Sweet Black-Eyed Susan
Stiff Goldenrod
Spiderwort
Culver's Root
Big Bluestem
Little Bluestem
Switch Grass
Indian Grass
Prairie Dropseed
Roundheaded Bushclover
Sweet Fern
Bracken Fern
June Grass

GRASSLAND SEEDING RATE = 235 lbs./acre

APPENDIX B

GROUNDWATER QUALITY SUMMARY

The following groundwater quality summary is a composite of sampling data collected in 1987 and 1988. This data was collected on and off the mine site from the glacial overburden, shallow Precambrian (labeled Shallow PC), deep Precambrian (labeled Deep PC) and private wells (labeled Pvt. Wells). NA stands for not applicable and indicates sampling for this parameter was not conducted.

Alkalinity	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	260	340	260	370
Minimum	14	81	150	17
Median	60	170	180	170
Mean	74	172	186	159
# of Tests	126	60	5	97
# of Detects	126	60	5	97
% of Detects	100.0%	100.0%	100.0%	100.0%

Aluminum	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.337	0.158	NA	NA
Minimum	0.034	0.034	NA	NA
Median	0.078	0.086	NA	NA
Mean	0.086	0.084	NA	NA
# of Tests	40	20	NA	NA
# of Detects	40	20	NA	NA
% of Detects	100.0%	100.0%	NA	NA

Arsenic	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.021	0.003	0.022	0.0015
Minimum	0.003	0.003	0.003	0.0015
Median	0.021	0.003	0.010	0.0015
Mean	0.003	0.003	0.010	0.0015
# of Tests	126	60	5	8
# of Detects	1	0	4	0
% of Detects	0.8%	0.0%	80.0%	0.0%

Barium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.50	0.50	0.25	0.04
Minimum	0.25	0.25	0.25	0.04
Median	0.25	0.25	0.25	0.04
Mean	0.27	0.27	0.25	0.04
# of Tests	126	60	5	8
# of Detects	0	0	0	0
% of Detects	0.0%	0.0%	0.0%	0.0%

Beryllium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0010	0.0005	NA	NA

Minimum	0.0005	0.0005	NA	NA
Median	0.0005	0.0005	NA	NA
Mean	0.0005	0.0005	NA	NA
# of Tests	40.00	20.00	NA	NA
# of Detects	1	0	NA	NA
% of Detects	2.5%	0.0%	NA	NA

Cadmium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0170	0.0240	0.0045	0.0002
Minimum	0.0002	0.0002	0.0035	0.0002
Median	0.0010	0.0012	0.0039	0.0002
Mean	0.0016	0.0025	0.0040	0.0002
# of Tests	126	60	5	8
# of Detects	96	37	5	0
% of Detects	76.2%	61.7%	100.0%	0.0%

Calcium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	95	56	52	47
Minimum	8	17	31	15
Median	13	36	35	35
Mean	25	35	38	32
# of Tests	126	60	5	8
# of Detects	126	60	5	8
% of Detects	100.0%	100.0%	100.0%	100.0%

Chloride	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	230.0	6.0	9.0	81.0
Minimum	0.5	0.5	2.0	1.2
Median	3.0	1.0	3.0	8.0
Mean	24.1	1.8	5.0	16.7
# of Tests	126	60	5	97
# of Detects	83	27	5	83
% of Detects	65.9%	45.0%	100.0%	85.6%

Chromium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0025	0.0025	0.0025	0.008
Minimum	0.0025	0.0025	0.0025	0.001
Median	0.0025	0.0025	0.0025	0.002
Mean	0.0025	0.0025	0.0025	0.003
# of Tests	126	60	5	8
# of Detects	0	0	0	4
% of Detects	0.0%	0.0%	0.0%	50.0%

Cobalt	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.025	0.025	NA	NA
Minimum	0.025	0.025	NA	NA
Median	0.025	0.025	NA	NA
Mean	0.025	0.025	NA	NA
# of Tests	40	20	NA	NA
# of Detects	0	0	NA	NA

% of Detects	0.0%	0.0%	NA	NA

COD	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	90.0	85.0	5.0	130.0
Minimum	2.5	2.5	2.5	2.5
Median	10.0	10.0	2.5	6.0
Mean	13.2	16.1	3.0	10.1
# of Tests	126	60	5	97
# of Detects	84	44	1	52
% of Detects	66.7%	73.3%	20.0%	53.6%

Copper	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.046	0.085	0.031	0.068
Minimum	0.003	0.003	0.010	0.005
Median	0.005	0.005	0.011	0.021
Mean	0.009	0.013	0.015	0.026
# of Tests	126	60	5	8
# of Detects	48	22	5	7
% of Detects	38.1%	36.7%	100.0%	87.5%

Fluoride	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	2.50	0.60	0.30	0.2
Minimum	0.05	0.05	0.20	0.1
Median	0.20	0.20	0.30	0.1
Mean	0.35	0.26	0.26	0.1
# of Tests	126	60	5	4
# of Detects	68	51	5	3
% of Detects	54.0%	85.0%	100.0%	75.0%

Hardness	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	400	240	1,137	390
Minimum	2	63	143	1
Median	68	150	150	170
Mean	111	145	369	168
# of Tests	126	60	5	97
# of Detects	126	60	5	96
% of Detects	100.0%	100.0%	100.0%	99.0%

Iron	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	21.00	0.95	0.05	830.00
Minimum	0.05	0.05	0.05	0.03
Median	0.05	0.14	0.05	3.30
Mean	1.43	0.22	0.05	18.82
# of Tests	126	60	5	97
# of Detects	53	35	0	91
% of Detects	42.1%	58.3%	0.0%	93.8%

Lead	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0025	0.0025	0.0025	0.004

Minimum	0.0025	0.0025	0.0025	0.001
Median	0.0025	0.0025	0.0025	0.003
Mean	0.0025	0.0025	0.0025	0.003
# of Tests	126	60	5	8
# of Detects	0	0	0	6
% of Detects	0.0%	0.0%	0.0%	75.0%

Magnesium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	41.0	24.0	19.0	15.0
Minimum	2.4	5.4	11.0	3.4
Median	5.7	14.0	13.0	10.5
Mean	9.7	13.9	13.8	9.9
# of Tests	126	60	5	8
# of Detects	126	60	5	8
% of Detects	100.0%	100.0%	100.0%	100.0%

Manganese	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	1.40	0.75	0.29	0.6300
Minimum	0.03	0.03	0.03	0.0055
Median	0.09	0.36	0.23	0.2550
Mean	0.25	0.35	0.19	0.2171
# of Tests	126	60	5	8
# of Detects	74	58	4	5
% of Detects	58.7%	96.7%	80.0%	62.5%

Mercury	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.00240	0.00025	0.00025	0.00025
Minimum	0.00025	0.00025	0.00025	0.00025
Median	0.00025	0.00025	0.00025	0.00025
Mean	0.00027	0.00025	0.00025	0.00025
# of Tests	126	60	5	8
# of Detects	2	0	0	0
% of Detects	1.6%	0.0%	0.0%	0.0%

Molybdenum	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.08	0.06	NA	NA
Minimum	0.01	0.01	NA	NA
Median	0.01	0.01	NA	NA
Mean	0.02	0.03	NA	NA
# of Tests	40	20	NA	NA
# of Detects	13	8	NA	NA
% of Detects	32.5%	40.0%	NA	NA

Nickel	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.067	0.028	NA	NA
Minimum	0.004	0.004	NA	NA
Median	0.015	0.015	NA	NA
Mean	0.018	0.012	NA	NA
# of Tests	94	45	NA	NA
# of Detects	29	9	NA	NA

% of Detects	30.9%	20.0%	NA	NA

NO3+NO2-N	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	2.90	0.42	0.15	3.5
Minimum	0.03	0.03	0.07	0.1
Median	0.30	0.35	0.10	2.0
Mean	0.56	0.08	0.10	1.9
# of Tests	126	60	5	4
# of Detects	105	21	5	4
% of Detects	83.3%	35.0%	100.0%	100.0%

pH	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	7.07	7.38	7.04	6.93
Minimum	5.25	5.78	6.56	4.78
Median	6.21	6.52	6.93	6.16
Mean	6.24	6.58	6.86	6.12
# of Tests	126	60	5	97
# of Detects	126	60	5	97
% of Detects	100.0%	100.0%	100.0%	100.0%

Selenium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0025	0.0025	0.0025	0.0015
Minimum	0.0025	0.0025	0.0025	0.0015
Median	0.0025	0.0025	0.0025	0.0015
Mean	0.0025	0.0025	0.0025	0.0015
# of Tests	126	60	5	8
# of Detects	0	0	0	0
% of Detects	0.0%	0.0%	0.0%	0.0%

Silver	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0073	0.0070	0.0002	0.0002
Minimum	0.0002	0.0002	0.0002	0.0002
Median	0.0002	0.0002	0.0002	0.0002
Mean	0.0009	0.0009	0.0002	0.0002
# of Tests	126	60	5	8
# of Detects	10	5	0	0
% of Detects	7.9%	8.3%	0.0%	0.0%

Sodium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	30.0	33.0	14.0	6.6
Minimum	1.2	1.4	9.6	3.0
Median	6.1	14.0	11.0	4.9
Mean	7.7	14.1	11.3	4.8
# of Tests	126	60	5	8
# of Detects	126	60	5	8
% of Detects	100.0%	100.0%	100.0%	100.0%

Spec. Cond.	Shallow PC	Deep PC	Pvt. Wells	
Maximum	954	876	439	716

Minimum	84	128	298	30
Median	159	315	339	260
Mean	245	324	344	284
# of Tests	126	60	5	97
# of Detects	126	60	5	97
% of Detects	100.0%	100.0%	100.0%	100.0%

Sulfate	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	46.0	48.0	10.0	25.0
Minimum	2.5	2.5	2.5	5.3
Median	11.0	8.0	5.0	6.0
Mean	11.3	9.9	5.8	10.6
# of Tests	126	60	5	4
# of Detects	96	45	3	4
% of Detects	76.2%	75.0%	60.0%	100.0%

TDS	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	1,400	350	280	NA
Minimum	14	67	180	NA
Median	130	200	200	NA
Mean	247	213	210	NA
# of Tests	126	60	5	NA
# of Detects	126	60	5	NA
% of Detects	100.0%	100.0%	100.0%	NA

Thallium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.0025	0.0025	NA	NA
Minimum	0.0025	0.0025	NA	NA
Median	0.0025	0.0025	NA	NA
Mean	0.0025	0.0025	NA	NA
# of Tests	40	20	NA	NA
# of Detects	0	0	NA	NA
% of Detects	0.0%	0.0%	NA	NA

Tin	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.136	0.285	NA	NA
Minimum	0.034	0.034	NA	NA
Median	0.034	0.034	NA	NA
Mean	0.042	0.068	NA	NA
# of Tests	40	20	NA	NA
# of Detects	4	7	NA	NA
% of Detects	10.0%	35.0%	NA	NA

Titanium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.028	0.004	NA	NA
Minimum	0.002	0.002	NA	NA
Median	0.002	0.002	NA	NA
Mean	0.004	0.002	NA	NA
# of Tests	40	20	NA	NA
# of Detects	8	1	NA	NA

% of Detects	20.0%	5.0%	NA	NA

Uranium	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.017	0.011	0.007	NA
Minimum	0.001	0.001	0.004	NA
Median	0.002	0.003	0.006	NA
Mean	0.002	0.003	0.006	NA
# of Tests	126	60	5	NA
# of Detects	81	45	5	NA
% of Detects	64.3%	75.0%	100.0%	NA

Zinc	Overburden	Shallow PC	Deep PC	Pvt. Wells
Maximum	0.320	1.800	0.070	0.1200
Minimum	0.005	0.005	0.025	0.0055
Median	0.025	0.025	0.025	0.0205
Mean	0.036	0.080	0.039	0.0464
# of Tests	126	60	5	8
# of Detects	31	12	2	6
% of Detects	24.6%	20.0%	40.0%	75.0%

APPENDIX C

SUMMARY OF SURFACE WATER QUALITY
SAMPLING RESULTS - FLAMBEAU RIVER (10-87 TO 9-88)

	Average	Range mg/l
Aluminum	0.062	0.042-0.111
Arsenic	<0.005	<0.005
Barium	<0.5	<0.5 - 1
Beryllium	<0.001	<0.001 - 0.001
Cadmium	<0.003	<0.0003 - <0.0010
Calcium	15.0	9.9 - 19.0
Chloride	6.0	2.0 - 9.0
Chromium (+6)	<0.05	<0.05
Total Chromium	<0.005	<0.005
Cobalt	<0.005	<0.005
Copper	<0.005	<0.005 - 0.030
Flouride	0.1	<0.1 - 0.2
Iron	0.39	0.16 - 0.54
Lead	<0.0005	<0.0005
Magnesium	3.9	2.7 - 4.5
Manganese	<0.05	<0.05 - 0.08
Mercury	0.0005	<0.0005
Molybdenum	<0.029	<0.029 - 0.067
Nickel	<0.007	<0.007 - 0.030
Ammonia Nitrogen	0.28	<0.1 - 2.2
Nitrate/Nitrite-Nitrogen	0.12	<0.05 - <0.35
Total Kjeldahl Nitrogen	<1.0	<1 - 2
Selenium	<0.005	<0.005
Silver	<0.0004	<0.0004 - <0.005
Sodium	6.8	5.1 - 8.4
Sulfate	10	<5 - 15
Sulfur	1.7	2.9 - 4.2
Thallium	<0.005	<0.005
Tin	<0.067	<0.067 - 0.093
Titanium	<0.004	<0.004 - 0.004
Uranium	0.003	<0.001 - 0.011
Zinc	<0.05	<0.05 - 0.068
Dissolved Oxygen (field)	9.9	6.0 - 12.0
Total Alkalinity (as $CaCO_3$)	44	27 - 60
Total Hardness	52	37 - 71
Total Dissolved Solids	99	21 - 140
Total Suspended Solids	3	1 - 15
Total Organic Carbon	11.4	0.26 - 23.1
Chlorophyll-a	0.004	<0.001 - 0.012
C.O.D.	26	10 - 40
B.O.D.	0.9	<0.9 - <10
pH (s.u.)(field)	6.8	6.2 - 8.0
Specific Conductivity (micro ohms/cm)	142	101 - 179
Temperature (C°)(field)	10.2	1.0 - 24.5

APPENDIX D

PROPOSED GROUNDWATER QUALITY STANDARDS

The following is a list of the groundwater quality standards proposed by the Department for application at the NR 182 compliance boundary. With the exception of manganese, the standards are identical to those applied statewide to all facilities regulated under NR 140.

Inorganic Primary MCLs	Standard (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	4.0
Lead	0.05
Mercury	0.002
Nitrate + Nitrite as N	10.0
Selenium	0.01
Silver	0.05

Secondary MCLs	Standard (mg/l unless noted otherwise)
Chloride	250
Color	15 color units
Copper	1.0
Foaming Agents	0.5
Iron	0.30
Manganese	Baseline 0.09 (overburden) 0.36 (shallow Precambrian) 0.23 (deep Precambrian)
Odor	3 (threshold odor #)
Sulfate	250
Total Dissolved Solids	500
Zinc	5

Organic Chemical Primary MCLs	Standard (mg/l)
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-Dichlorophenoxyacetic Acid	0.1
2,4,5-Trichlorophenoxypropionic Acid	0.01
Benzene	0.005
Vinyl Chloride	0.0002
Carbon Tetrachloride	0.005
1,2-Dichloroethane	0.005
Trichloroethylene	0.005
1,1-Dichloroethylene	0.007

1,1,1-Trichloroethane	0.20
para-Dichlorobenzene	0.075
Total trihalomethanes	0.10

Radioactivity MCLs	Standard (pCi/l)
Radium226 + Radium228	5
Gross Alpha Particle Activity	15
Beta particle and photon radioactivity	4 millirem/year

Turbidity MCL	Standard (NTU)
Monthly average	1
2 Consecutive days	5

Other Health Related Substances	Standard (ug/l)
Alachlor	0.5
Aldicarb	10
Atrazine	3.5
Bacteria, Total Coliform	**
Butylate	67
Carbofuran	50
Cyanazine	12.5
Cyanide	200
1,2-Dibromoethane	0.01
1,2-Dibromo-3-chloropropane (DBCP)	0.05
1,2-Dichlorobenzene	1250
1,3-Dichlorobenzene	1250
1,1-Dichloroethane	850
1,2-Dichloroethylene	100
Dinoseb	13
EPTC (Eptam)	250
Ethylbenzene	1360
Flourotrichloromethane	3490
Methylene Chloride	150
Metolachlor	15
Simazene	2150
Tetrachloroethylene	1.0
Tetrahydrofuran	50
Toluene	343
1,1,2-Trichloroethane	0.6
Xylene	620

** - The standard for bacteria is dependent on the analytical method used. See s. NR 140.10 for additional discussion.

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