Draft environmental impact statement: Flambeau Mining, Inc., copper mine, Ladysmith, Wisconsin. 1989

Madison, Wisconsin: Department of Natural Resources, 1989

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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. The DNR has prepared this draft environmental impact statement (DEIS) to evaluate the potential environmental effects of Flambeau's proposal. The EIS process must be completed before the DNR can act on Flambeau's applications.

This DEIS is being circulated for review to state, federal, and local agencies, as well as the public. An informational meeting will be held to receive public comments on the DEIS. Comments, oral and written, submitted at the meeting or within the review period will be used to develop the final EIS (FEIS). The FEIS also will be circulated to the commenting agencies and the public for review. Following the final review period, hearings will be held on the FEIS and permit applications. The DNR will provide notice of the hearing procedures, locations, and dates.

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

Comments on the DEIS 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

PROJECT DESCRIPTION

Flambeau Mining Co., a wholly owned subsidiary of Kennecott Corporation, proposes to open pit mine 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 will be 32 acres in size and will be approximately 550 feet wide, 2,600 feet long and 225 feet deep. Ore produced at a rate of approximately 1,300 tons per day (320,000 tons/year) will 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 140 acres in total will be physically disturbed by project activities.

Low sulfur waste rock, containing less than 1% sulfur, and glacial overburden will be stored on a 40-acre, 60-foot high, unlined stockpile north of the pit. High sulfur waste rock, containing greater than 1% sulfur, will 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 will 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 will be preceded by a nine-month construction phase and followed by a nineteen-month reclamation phase. During the construction phase, about 70 employees will be on-site. The project workforce will peak at 160 employees during a four-month period when facility construction and preproduction mining are occurring simultaneously. About 60 people will be employed on-site during the operating and reclamation phases of the project. The company estimates the majority of the employees will probably reside in or within 10 miles of the Rusk County border.

Reclamation of the project area will return the site to its approximate original contours. All waste rock, glacial overburden, and soils, as well as some building demolition wastes, will be returned to the open pit site in its approximate original sequence after mining has been completed. The high sulfur waste rock will be placed in the bottom of the mined out pit to minimize the potential for contamination of the overlying aquifers and surface water. The company will be responsible for monitoring and maintaining the site of the former open pit for a period of 30 years following reclamation. The remainder of the site is under the reclamation bond, a portion of which will be retained for up to 20 years.

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 quality is good and is primarily carried in the glacial outwash and sandstone at the mine site. 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 138 acres of land, including about 45 acres of open land, 39 acres of forest and 8 acres of wetlands. An additional 10 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 release 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 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 could be adversely affected by the drawdown. Flambeau Mining Co. would be responsible for replacing any water supplies impacted by the mining project.

Wastewater from the mining project would be discharged into the Flambeau River. The proposed wastewater treatment system would probably treat the wastewater sufficiently to meet regulatory limits. The wastewater could nonetheless have toxic 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. 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 does not propose a final land use for most of the mine site. The planned revegetation would include non-native species which could interfere with the establishment of natural communities. The 5-acre wetland which would be created at the west end of the pit would be of uncertain biological and hydrological value.

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 proposed monitoring activities may not detect significant releases of pollutants to the environment. No monitoring of air, surface water, or terrestrial or aquatic ecology is proposed. The proposed groundwater monitoring program would not include enough sample points to assure that unexpected problems were identified.

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 inmigration 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 $1.5-18.9 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 0-$18.3 million. Additional tax revenues would accrue from employee income taxes, sales taxes and property 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. Additional well nests could be added to better detect changes in groundwater quality and levels. Collection basin lysimeters could be installed under facilities to monitor discharges to groundwater. Wells in the backfilled pit could be used to monitor the chemical reactions in the waste rock. Water quality, sediment, and aquatic life in the Flambeau River could be monitored to detect any impacts from the project. Wetlands, terrestrial ecology and air quality could be monitored to identify project-induced changes.

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. Final land use alternatives could include forestry, recreation, wildlife or agriculture. An alternative final use for the surface facilities would be for other industrial purposes.

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CHAPTER ONE
DESCRIPTION OF THE PROPOSED PROJECT

LOCATION

Flambeau Mining Co., a wholly owned subsidiary of the Kennecott Corporation, proposes to use open pit mining techniques to remove ore from the Flambeau deposit in northwestern Wisconsin. The orebody is located 1.6 miles south of Ladysmith and 0.3 miles west of Highway 27 in the Town of Grant, Rusk County (Figure 1-1). The project site can be reached by traveling south on State Trunk Highway 27 from its junction with U.S. Highway 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 170 acre proposed mine site is completely owned by Kennecott, including both the surface and mineral rights. The same is true of Section 10 between Highway 27 and the Wisconsin Central Ltd. main line track where the rail spur will 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 State Highway 27, north of the south line of Section 9, and south of Blackberry Lane. Also included is a 24 to 36-foot wide corridor east of State Highway 27 on which the railroad spur line is to be constructed.

- Mine Site - This is defined as an area, about 170 acres, within the project area which will be enclosed by a security fence. The proposed open pit, stockpiles, wastewater treatment facilities, and other ancillary surface facilities will be contained in this area.

HISTORY

The copper-enriched Flambeau orebody was discovered as a result of airborne exploration 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, permanent tailings disposal areas but did not involve 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. County officials indicated the necessary zoning approvals would not be issued to Kennecott. Kennecott withdrew it's 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. This EIS, particularly Chapter One, is based on the information contained within Kennecott's permit applications and EIR. In July, 1989 the Kennecott Corporation changed the name of the company from Kennecott Minerals Co. to Flambeau Mining Co.

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. This agreement, developed to facilitate the approval of local permits needed for mining, establishes terms and conditions Kennecott 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

The DNR determined the validity of the Kennecott submittals through a process of review and/or verification. Several approaches were used to review/verify the Kennecott 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 Kennecott'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 Kennecott'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, the conditions placed upon the permit will 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 Kennecott'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 operation. In either case, the Local Agreement and permit conditions will 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 will be 32 acres in size and involves removing the enriched, upper 150-200 feet of the orebody. It will be approximately 2,600 feet long, 550 feet wide, and will be excavated to a maximum depth of 225 feet. The southwest corner of the pit will be separated from the Flambeau River by approximately 140 feet. A slurry wall and dike will be constructed at the southwest end of the pit to minimize water inflow. The pit will 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.

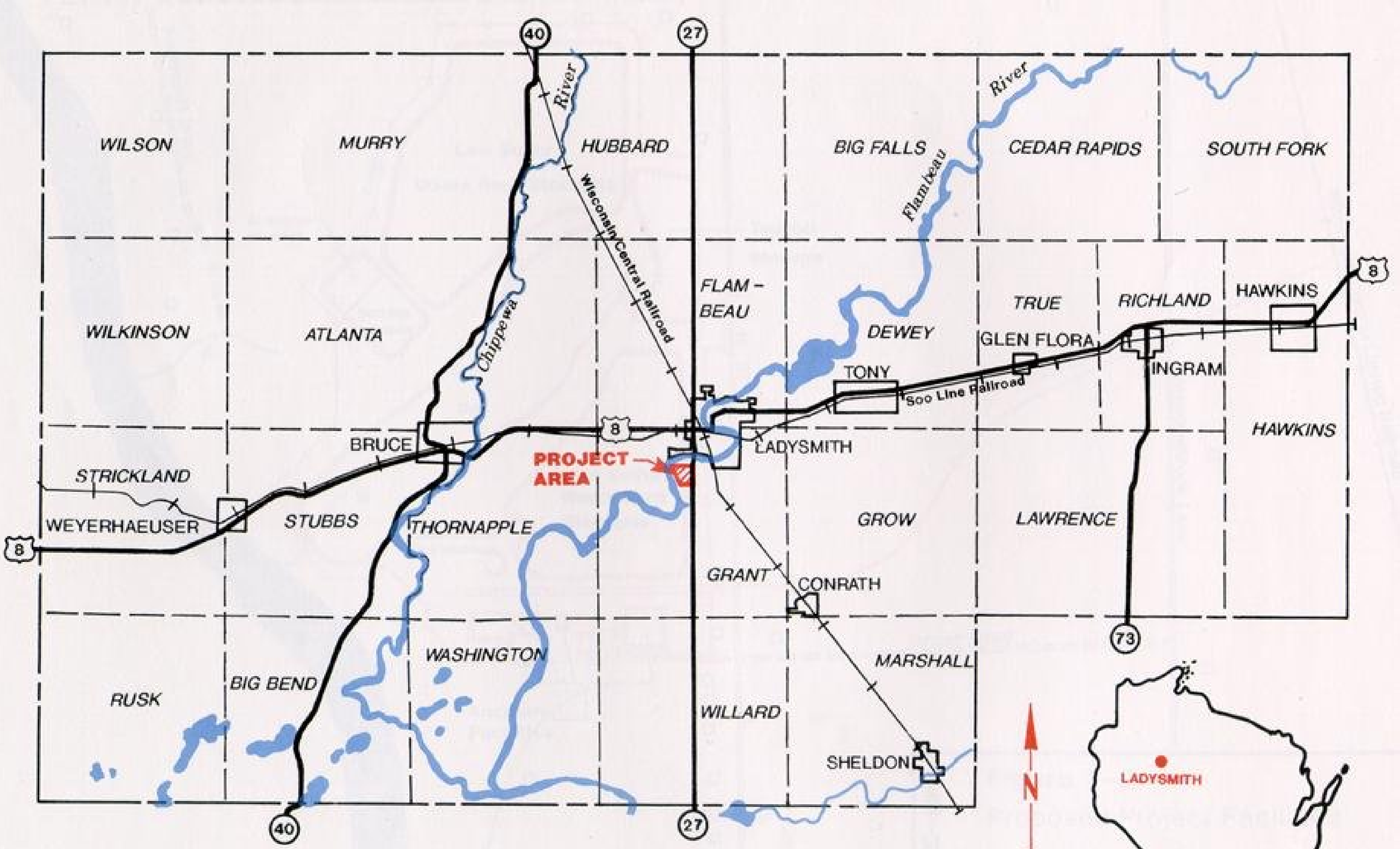


Figure 1–1
Project Location in Rusk County

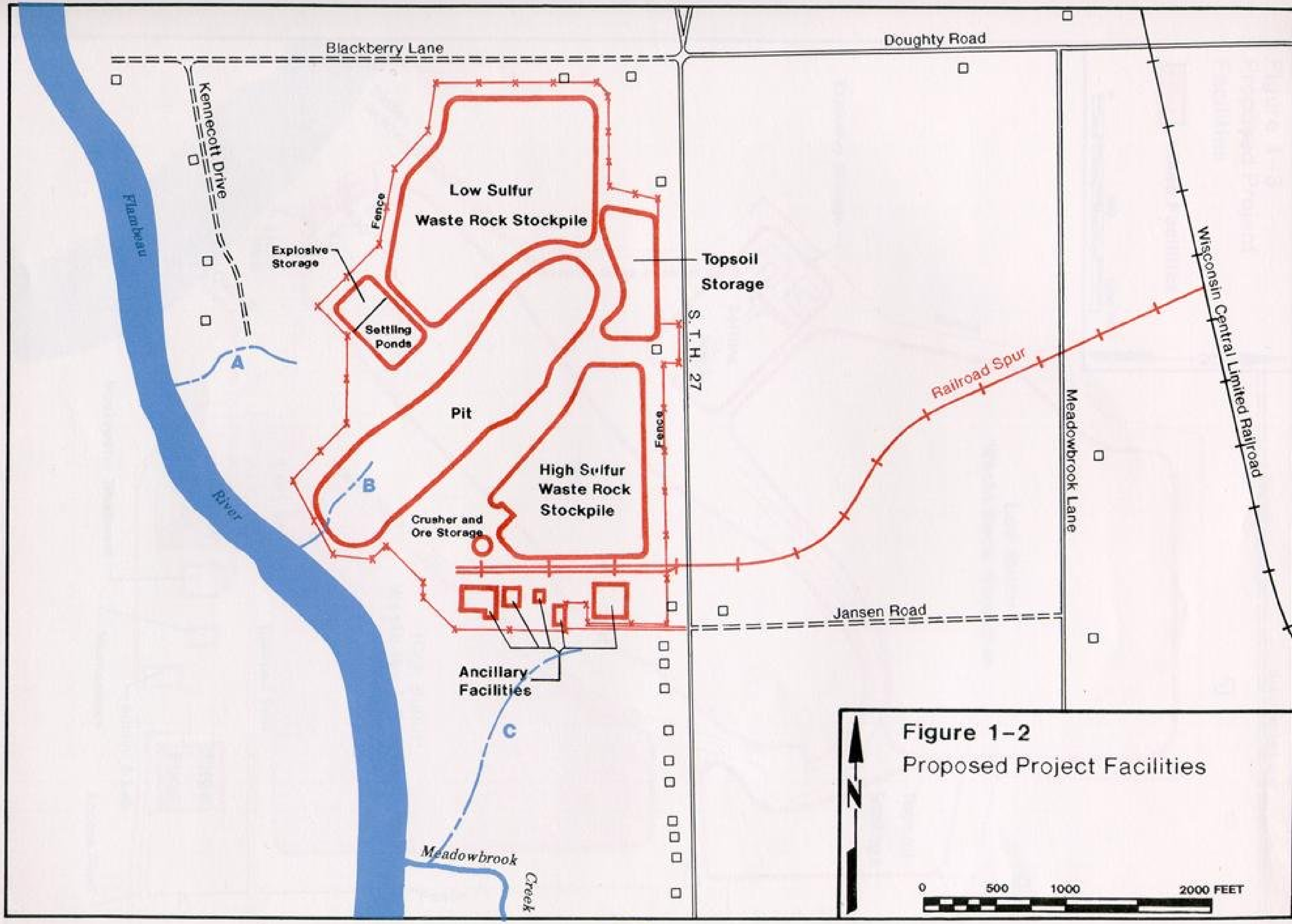
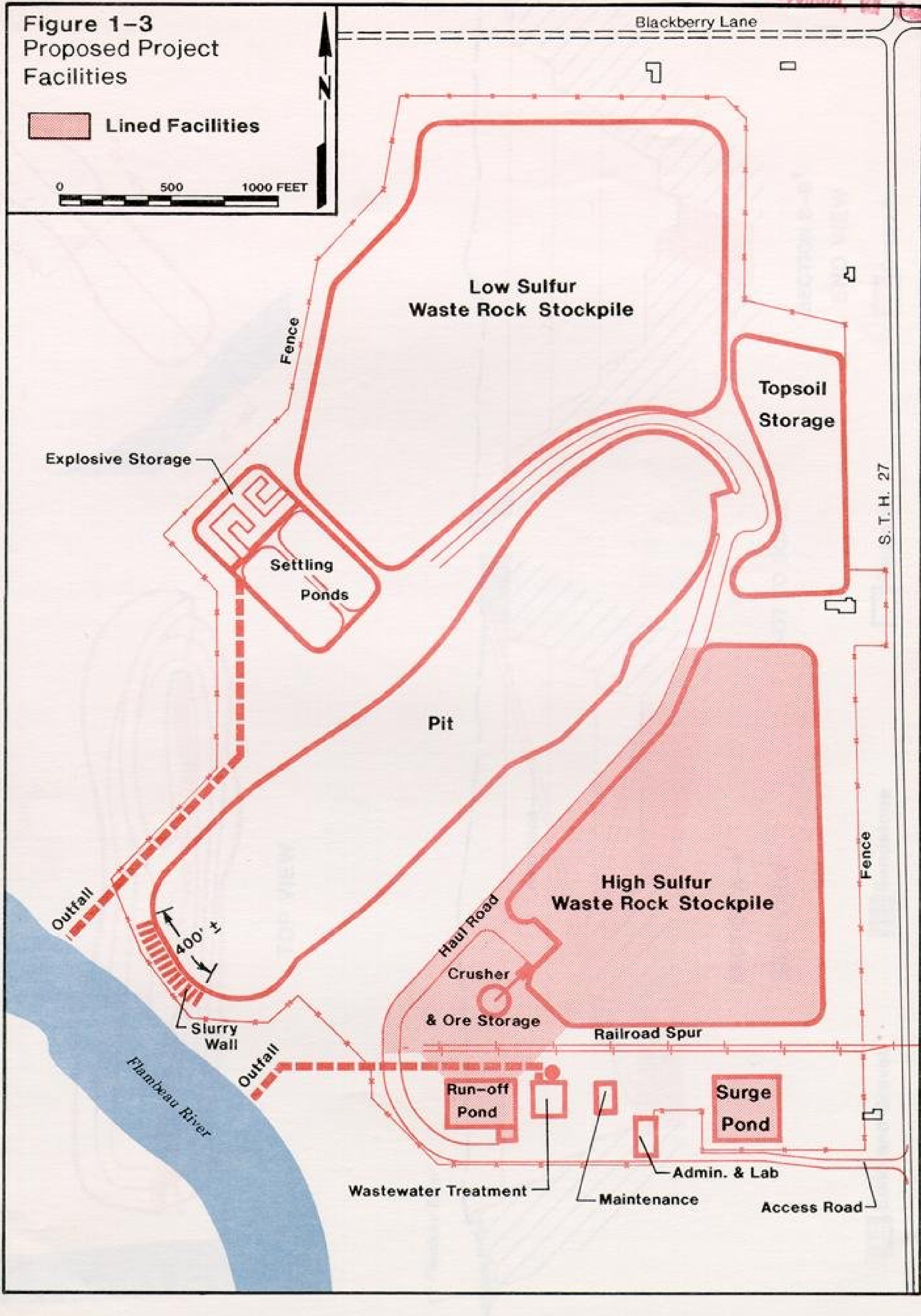


Figure 1–2
Proposed Project Facilities

Figure 1–3
Proposed Project Facilities



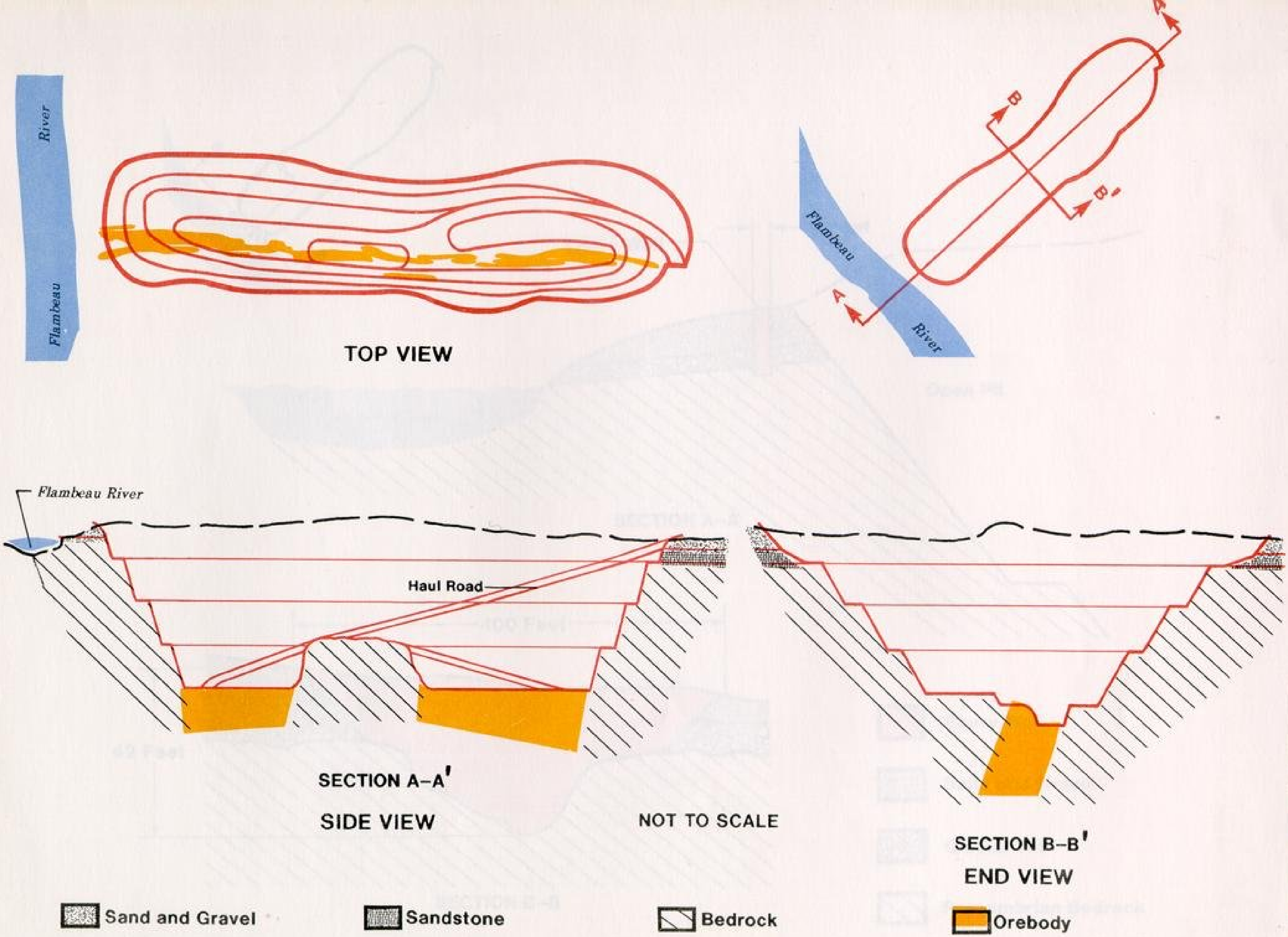


Figure 1–4 Open Pit Cross Sections

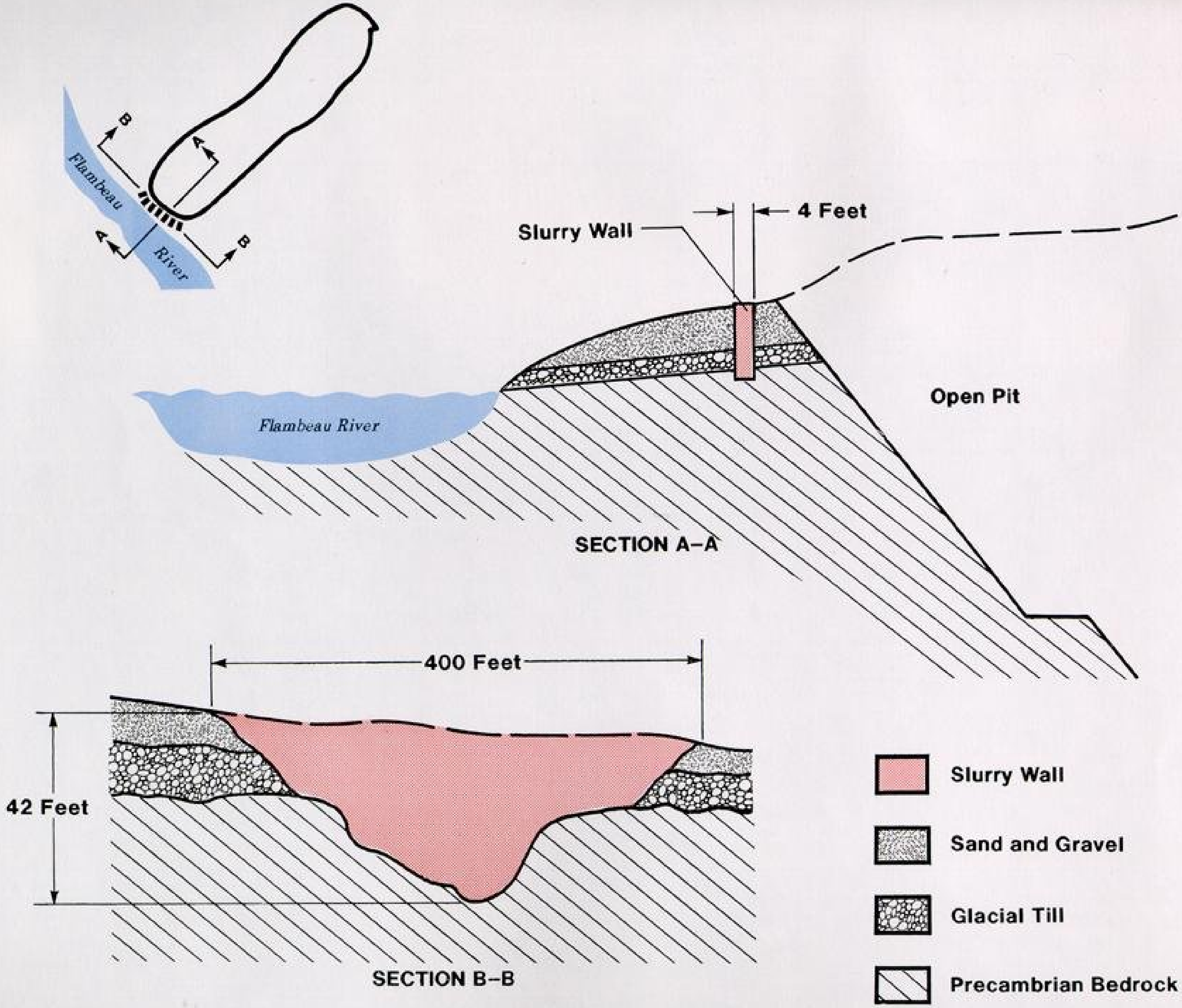


Figure 1–5 Slurry Wall Cross-Section

If the mine operates as anticipated (one shift per day, five days per week, 250 days per year), it will 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 will remain relatively constant until the last year while waste rock removal declines substantially. Total material movement will 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 will be approximately 240,000 tons. Over the life of the mine, approximately 1.9 million tons of ore will be removed from the pit. Total non-ore material removed will total approximately 7.8 million tons. Summary statistics for the project are shown in Table 1-1.

TABLE 1-1

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	139 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
Employment	5 days/week
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.

In accordance with the local agreement, blasting, crushing and rail shipping operations will 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 will be by bulldozers or other mechanical equipment. Blasting will be used where the ore and waste rock is less weathered and cannot be mechanically ripped. The blasting schedule will vary depending on the phase of the project but will vary from one blast/day to one blast/week.

Two four-cubic yard shovels and a seven-cubic yard loader will be used to load the broken ore and other materials into 35-50-ton trucks. Six trucks will be required. The truck fleet will be increased to a maximum of seven trucks as the pit deepens and haul distance increases. A 4,000-gallon water truck will 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 1-2.

TABLE 1-2

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 will be constructed from the entrance of the open pit mine to the waste rock stockpiles and ore crusher (Figure 1-3). The haul road will 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 will 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) will be underlain by a 60 mil HDPE liner to contain potentially contaminated runoff.

Based on anticipated mine operations, approximately 220 round trips will 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 will consist of support operation vehicles for maintenance, supervision, and transporting of employees to mining equipment. Watering will be used to control dust on the haul road.

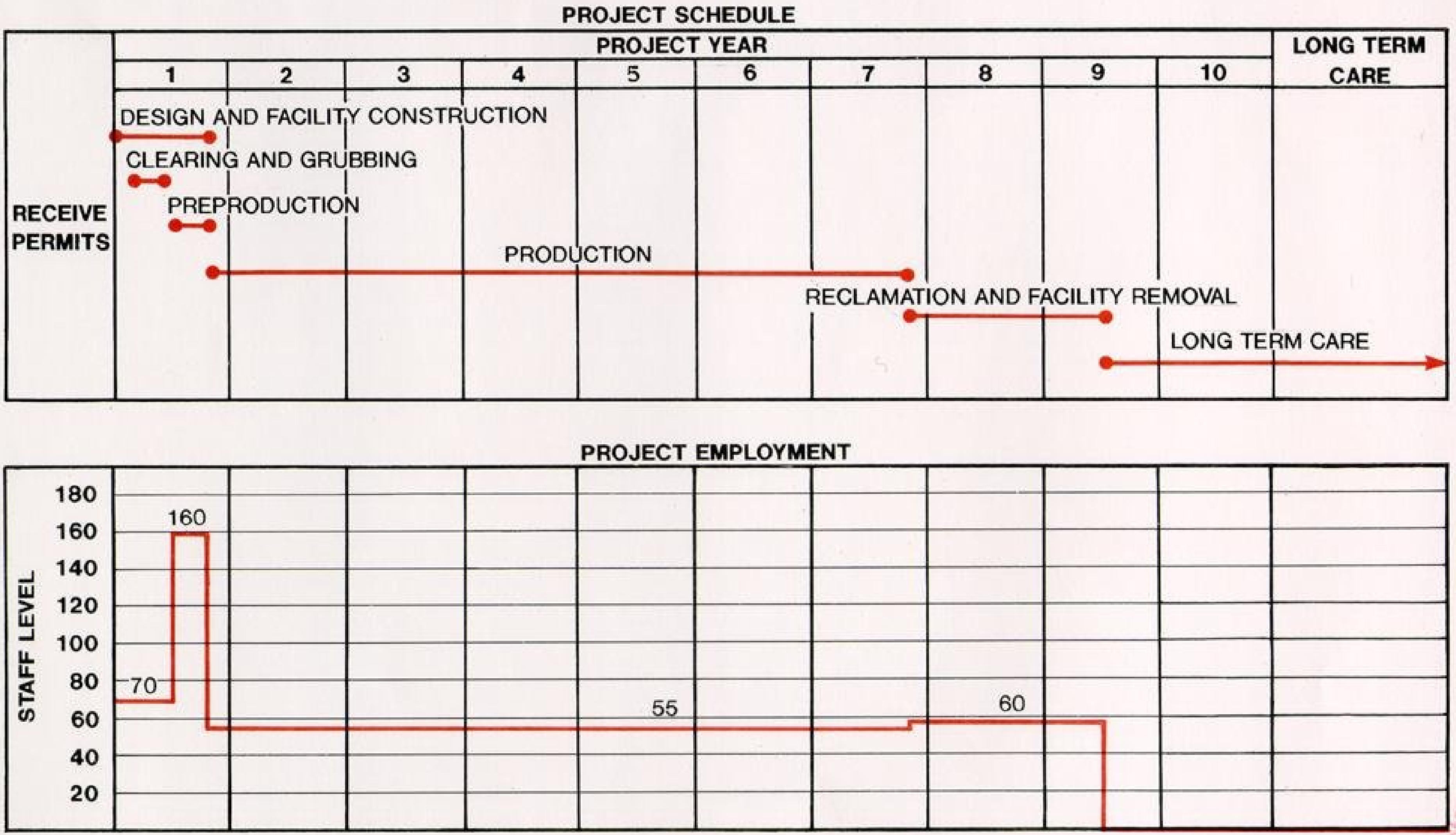


Figure 1–6
Proposed Project Schedule and Employment

ORE CRUSHER AND CRUSHED ORE STOCKPILE

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

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

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

TOPSOIL AND WASTE ROCK STOCKPILES

Three stockpiles will 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 1-3), and high sulfur waste rock (greater than 1% sulfur by weight) (Table 1-4). 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 1-5.

Topsoil Stockpile

Topsoil will 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 160,000 cubic yards of topsoil will be temporarily placed in this stockpile. Some topsoil will be used immediately on berms and landscaped features to be revegetated during site construction and operation activities. Upon reaching its final configuration, the stockpile will be vegetated to reduce erosion.

This stockpile will be constructed in two phases. Phase I will be constructed during initial construction activities and will 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 will 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 will be constructed on or next to this stockpile. Adjacent to the topsoil stockpile will be a parking lot with the capacity to park up to 20 cars and one bus. The parking area will be constructed of crushed stone placed on a subbase of sand and gravel. Access to the parking area will be off Hwy 27.

Low Sulfur Waste Rock Stockpile

The low sulfur waste rock stockpile will contain glacial till, sandstone, saprolite, (highly weathered Precambrian bedrock) and other low sulfur bedrock. This facility will cover approximately 40 acres, will be about 60 feet above existing grades at maximum height and will 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 1-3 shows the relative volume of each of the low sulfur materials to be placed in the stockpile. The stockpile will be surrounded by a vegetated berm to collect runoff from the stockpile and direct it to the settling ponds.

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

The sequence for placement of the low sulfur materials will be as follows. Glacial till will be placed at the base of the pile to provide additional attenuative capacity for metals in percolating rainwater. Sandstone and highly weathered bedrock will then be placed over the till. Finally, low sulfur waste rock will be placed as the top layer of the stockpile. This sequencing or layering will facilitate the return of these materials to the pit in their original sequence during the reclamation phase.

TABLE 1-3

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 proposed facility will 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 will be moving to the pile for storage, followed by approximately 1 year when these materials will be moved from the stockpile to the pit during reclamation. A design capacity of 2,200,000 cubic yards will be available for high sulfur waste materials (bedrock, sandstone, wastewater treatment sludges plus a contingency factor) (Table 1-4).

TABLE 1-4

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		80,000
Saprolite		430,000
Precambrian Waste Rock		1,360,000
	Total Volume	2,045,000

TABLE 1-5

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 will be installed beneath this facility to collect leachate. The liner will 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 will be built in two phases. Phase one, the western half of the stockpile, will be operational for the first 2.5 to 3 years of operation. The eastern portion of the stockpile will remain in its natural state until its development during project year two. Figure 1-7 contains cross sections of the sub-base and base grades, including liner, of this proposed facility.

The base grade will have a ridge and valley pattern to direct leachate to the leachate collection system. This collection system will consist of a series of 6 inch diameter perforated PVC collection pipes located in the valleys as shown in Figure 1-7. The collection pipes will 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 97 to 99+%. The company's estimate of the maximum anticipated leachate head on the liner is 8.9 feet.

SURFACE WATER RUNOFF CONTROL

Storm water runoff control will be provided for all facilities. During construction of project facilities, stormwater runoff will be controlled by temporary siltation basins and straw bale retention checks. The design of all permanent stormwater control facilities, except for those of the high sulfur waste rock stockpile, is based on the 25-year, 24-hour storm event (4.6 inches of rainfall) for the Ladysmith area. In contrast, the ditches and conduits to transport contaminated runoff will have a 100 year, 24 hour storm event design capacity. The open pit will serve as an emergency reservoir for surge pond and runoff pond overflow if a storm exceeding the 25 year, 24 hour standard occurs.

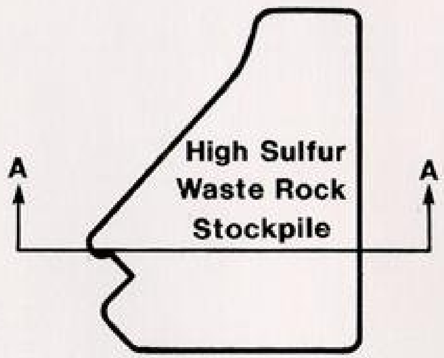
Runoff and Surge Ponds

Water contacting the sulfur rich ore or waste rock from the open pit, high sulfur waste rock stockpile, crushed ore storage area, and haul road will be captured for treatment in the wastewater treatment plant. Runoff will naturally flow (gravity feed) from the high sulfur waste rock stockpile to the surge pond and from the crushed ore stockpile and haul road to the runoff pond. Contact water from the open pit will be pumped to the surge pond.

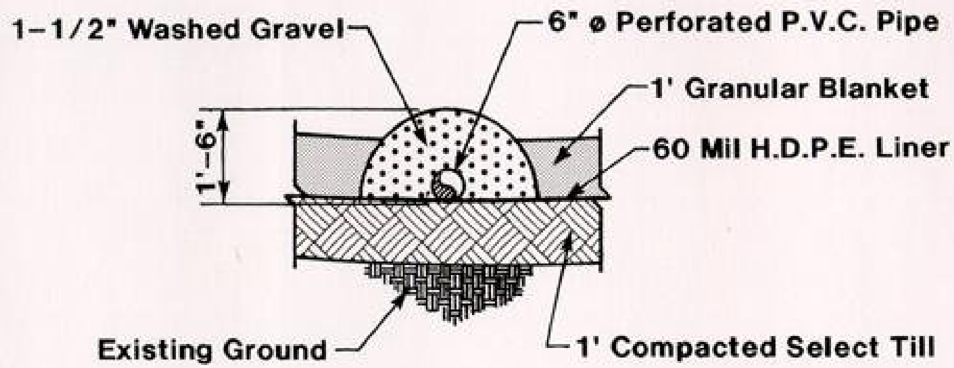
Since a constant delivery rate to the wastewater treatment plant is desirable for optimum performance; water will be stored in the lined runoff pond and the lined surge pond prior to treatment. Contaminated water from these sources is estimated to average about 620 gallons per minute on an annual basis. The wastewater treatment plant will have a maximum design treatment rate of about 800 gallons per minute. Under normal operating conditions, this network is designed to provide sufficient water storage capacity to allow for major maintenance work (plant shutdowns of 1-3 days) of the wastewater treatment equipment.

The surge pond will have a storage capacity of approximately 1.8 million gallons. A 60 mil HDPE liner will be installed beneath the pond to contain the stored water. If a storm in excess of the design capacity (25-year, 24-hour storm) occurs, overflow from the surge pond would go directly to the open pit through a 30 inch diameter buried pipe.

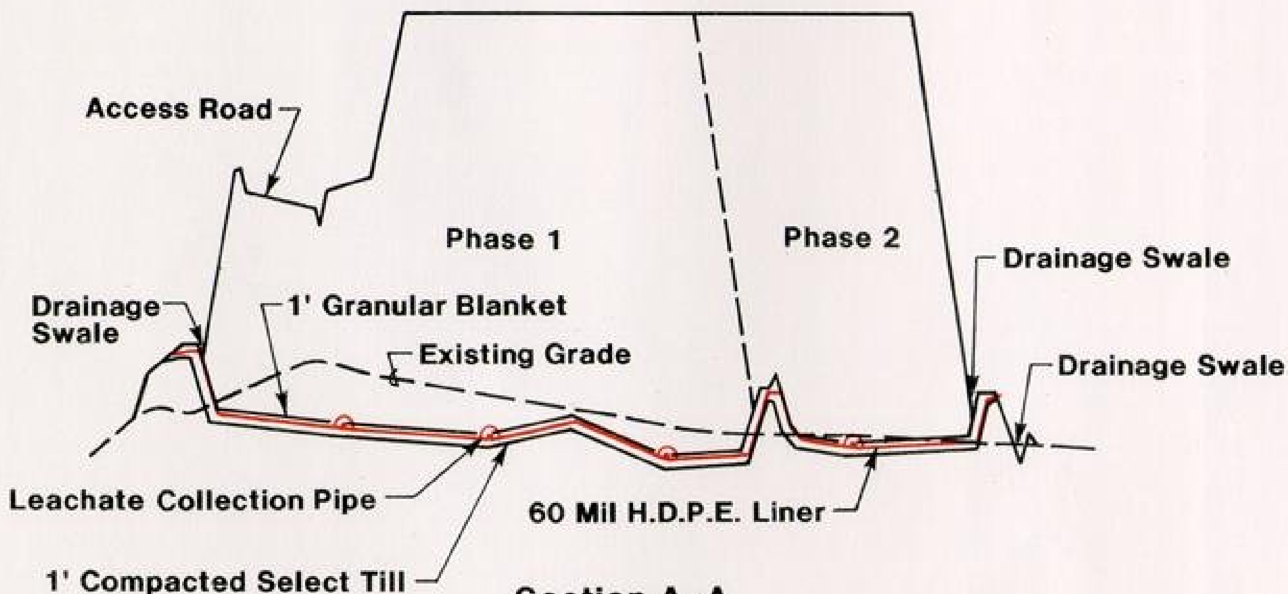
The runoff pond will have a capacity of 640,000 gallons and will be located directly south of the ore crusher, ore stockpile, and rail car loading area. This pond has been designed to store runoff from the crushed ore storage area, haul road and ancillary facilities located south of the rail spur and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



Location Map



Leachate Collection System Detail



Section A-A

Figure 1-7
High Sulfur Waste Rock
Stockpile Cross Section

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

Settling Ponds

Runoff from the low sulfur waste rock stockpile will be collected at the base of the pile in a bermed drainage swale. This runoff will be directed to the two settling ponds located at the southwest end of the stockpile. These two ponds will each have a surface area of 1.4 acres and will be approximately 18 feet deep (Figure 1-8). The bottoms of both settling ponds will be unlined to promote infiltration. The dikes of the ponds will be constructed from overburden excavated from the open pit site.

The settling ponds will 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 will 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 will primarily be achieved by decreasing water velocity while still allowing some flow through during high runoff periods. In the retention mode, the runoff will 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 will be provided for both ponds. A substantial fraction of the runoff water is anticipated to percolate through the bottom of the ponds. Water from the settling ponds will be discharged to either the Flambeau River or an adjacent wetland for mitigation purposes.

Sediment Removal

Periodically, solids from the settling ponds, surge pond, and runoff pond may need to be removed to maintain storage capacity and proper functioning. Cleaning of the settling ponds will be done using on-site mining equipment. Cleaning of the runoff and surge ponds will probably be done annually using a slurry vacuum pump. Material from these ponds will 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 will 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 will be recycled for plant operations, make-up water, wash down, and dust control. The balance will be discharged to the Flambeau River or to adjacent wetlands to mitigate the impacts of the groundwater drawdown.

The plant will be constructed concurrently with the other support facilities during the nine month construction phase and will 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 will operate the plant. The wastewater treatment plant, except for the water clarifier, will be housed in a heated metal building. Reagents such as lime, sodium sulfite, polymers, and sulfuric acid, will be unloaded from delivery trucks to storage bins and tanks located within the plant.

Sludges from the treatment plant will be about 25% solids by weight and will be stored in an 8,000 gallon tank. The sludge will 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 will be 124 tons per day.

WATER BALANCE

The water balance for the project facilities is shown in Figure 1-9. Flambeau Mining Co. anticipates the maximum groundwater inflow to the open pit will be approximately 590 gallons per minute. This is expected to occur early in the overburden excavation phase. Once the maximum rate is reached, inflow should gradually decrease over the period of mining. The pit inflow at estimated steady state conditions is about 300 gallons per minute. Of the steady state inflow, approximately 95 percent (280 gallons per minute) 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 will 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 will be conveyed by an underground pipe to an outfall structure on the river's edge. The treatment plant outfall structure will have a concrete apron with riprap placed between the concrete apron and the river. The settling ponds outlet will be a riprapped drainage channel. The channel will lead to the Flambeau River or to a nearby wetland via a diversion ditch.

Discharges to the Flambeau River will 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 270 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 620 and 800 gallons per minute, respectively. Mitigation discharge to the wetland is expected to average 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 will 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 will cover approximately 8 acres.

Access Road

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

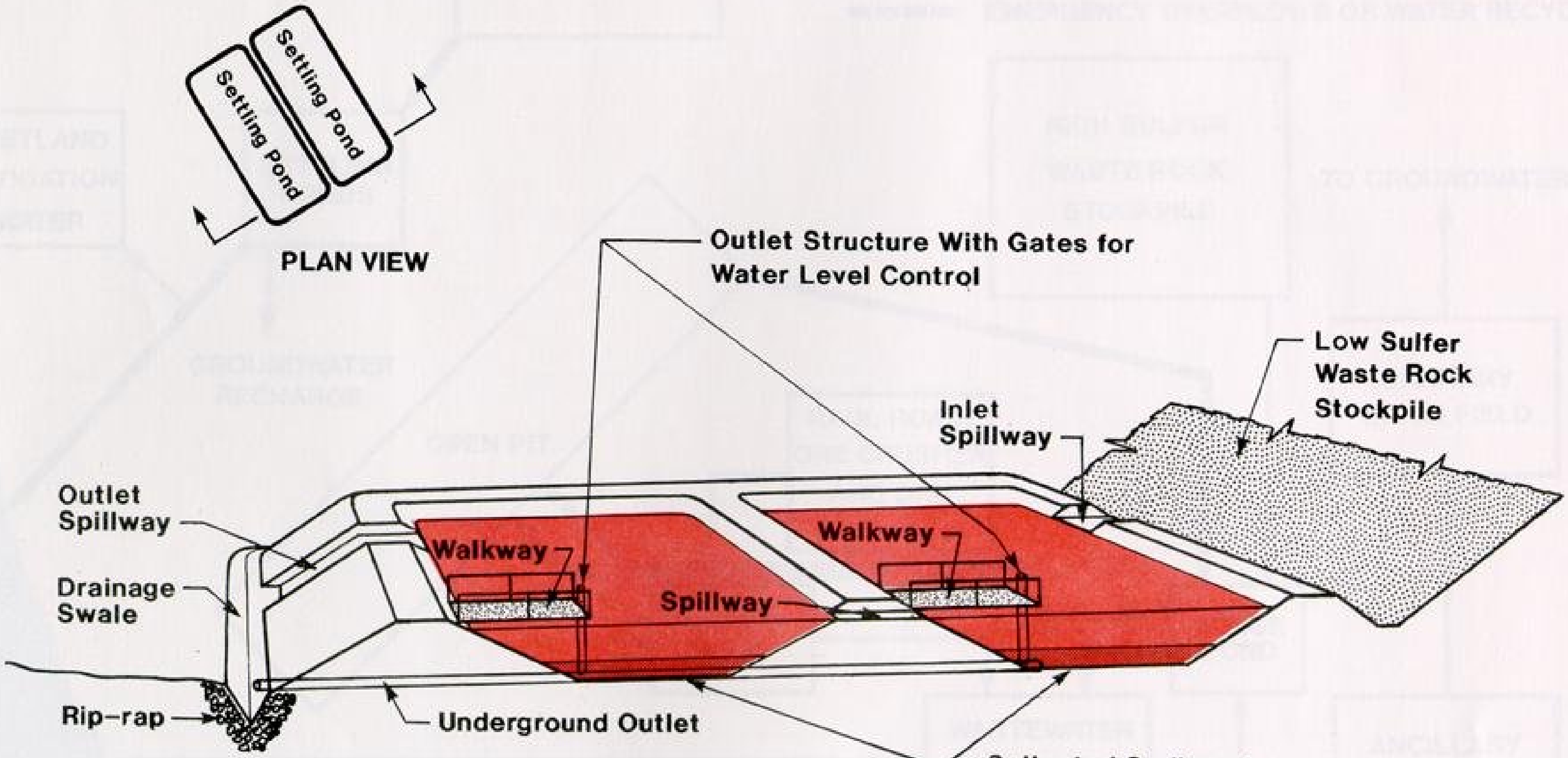


Figure 1 – 8 Settling Pond Cross-Section

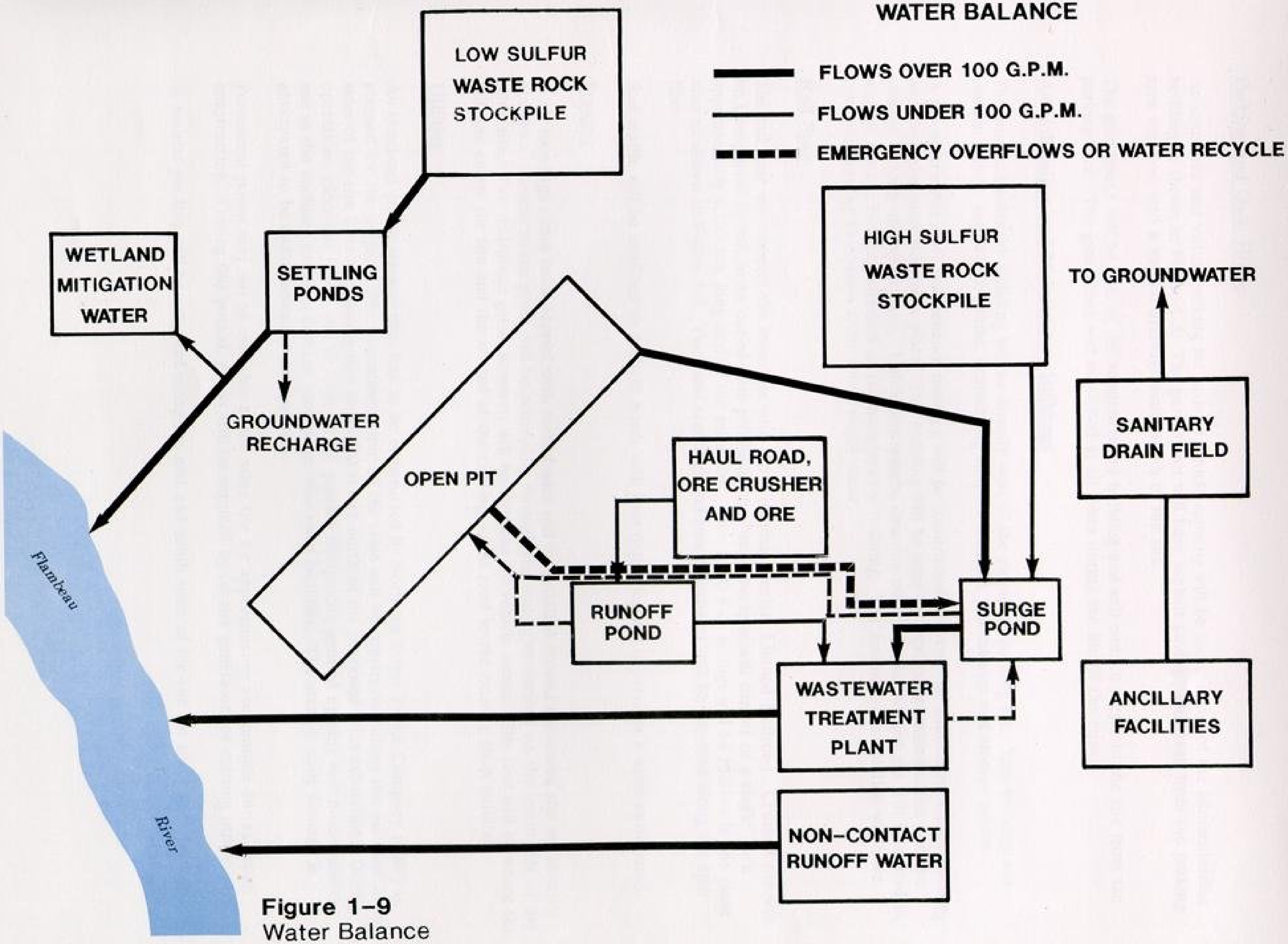


Figure 1-9
Water Balance

Parking and Gate House

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

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

Administration and Maintenance Buildings

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

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

Rail Spur

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

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

Fencing

A six foot high chain fence topped with barbed wire will be installed around the entire site for security purposes. Access to the plant will be principally through the main gate located on the south side of the mine site. Two additional gates, however, will be installed for vehicle access. The first will 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 will 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 will 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 will be supplied by on-site generators or existing utility lines.

A natural gas line will 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 will be trucked to the site. Fuels will 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 will be constructed adjacent to the runoff pond. The fuel tank will be constructed on a concrete foundation and will 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 will 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 will 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, will be located southwest of the low sulfur waste rock stockpile. A blasting cap storage building will also be located in the area. Each storage magazine will be surrounded by 15 foot high earthen berms for safety and protection of the explosive storage areas. The magazines will be constructed and operated in accordance with applicable federal and state safety regulations.

Water Supply

A new potable water well will be constructed near the intersection of the proposed access road with Hwy 27. An existing potable water well, located near the proposed well, will 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 will 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. will use either a drainfield or holding tank to dispose of sewage. Sanitary wastewater will be transported to a holding tank via a buried pipe system and then pumped to a natural subsurface or mound drain field. The proposed drainfield will be north of the employee parking area. If a drainfield is not approvable, a holding tank will be used. In the latter case, the effluent will be taken to a local sewage treatment plant.

The peak flows are anticipated to occur during mine construction. Portable toilets will 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 will be generated per day. A licensed septic tank pumping contractor will 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 will be hauled off-site to an approved disposal area. This refuse will consist of metal, rubber, wood and lubricants as well as daily trash and garbage typical of an industrial work force. Refuse will 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 will consist mostly of worn parts from process or production related equipment. Typically, this material will be collected in a specific location, periodically sorted and sold to scrap metal contractors.

The bulk of the scrap rubber will result from mobile equipment tires and process related equipment such as conveyer belting and air and water hoses. Used tires will be returned to vendors. Waste oil, hydraulic fluids, lubricating oils and other special lubricants will 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 will be approximately 138 tons.

CONSTRUCTION

Construction of the open pit and the surface facilities will 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 1-5) 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 will be the first construction activities undertaken. Clearing and grubbing for other site facilities will be conducted as the overall construction process proceeds and necessary support facilities are completed. Total site disturbance is shown in Table 1-6.

During the clearing process, marketable trees will be salvaged and sold. Other trees will be chipped, with the chips saved for soil stabilization use during construction and operation. The remaining trees, wood, and brush will be burned on-site.

TABLE 1-6

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	7
Railroad spur within fenced area	2
Railroad spur east of fenced area	3
Observation Parking and Access	1.5
Total	138.5

Temporary Facilities

Some temporary structures will be required during initial site construction activities. These facilities will 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 will be required at the site until the permanent buildings are constructed.

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

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

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

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

Flambeau Mining Co. or the project contractor will 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 will be used for site construction to minimize the need for off-site materials.

During the preproduction period, the open pit will 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 will 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 will be performed in two stages:

A. Initially, the open pit, stockpiles and plant facilities sites will 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 will be seeded and silt fences will be placed to control erosion and runoff.

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

Erosion control during rough grading will 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 will be determined during construction on a site-by-site basis. Mulches and soil surface stabilizers will be applied as needed.

CLOSURE AND RECLAMATION

The intent of reclamation will be to return the mine site to a state that provides long-term environmental stability. Reclamation will consist of the removal of surface facilities, backfilling the pit, and returning the site to its approximate original contour. The entire area will be graded and planted to create the landforms and plant communities associated with upland hardwood forests, lowland hardwood forests, wetlands, and early successional grasslands (Figure 1-10).

Upon completion of mining, the pit will be sequentially backfilled with the stockpiled waste materials. The sequence of backfilling will begin with the placement of high sulfur waste rock in the bottom of the pit. Lime will be added to reduce the formation of acid and groundwater contamination. This will 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 will 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. The 160,000 yd^3 of off-site material imported to the site will offset the 2,000 yd^3 deficit. The remaining excess material will be distributed over the project area.

As noted above, approximately 160,000 yd^3 of construction material will be imported for use as road base and as a drainage blanket for the high sulfur waste rock stockpile liner. Of this 160,000 yd^3, about 130,000 yd^3 will need to be backfilled with the high sulfur waste rock material because of potential contamination by the high sulfur ore and waste rock.

BACKFILLING SCHEDULE

The backfilling operation is scheduled for three 8-hour shifts per day, five days per week, for 250 days per year. Backfilling will require approximately 1.5 years to complete. The rate will 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 will be placed in layers approximately three feet thick. The operating procedure will be for the trucks to dump onto sloping benches. The load will 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 will be placed in the pit with the high sulfur waste rock material. Base material from the ore haul road will 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 will 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 will be accomplished in a similar fashion to that described for the high sulfur waste rock material. Some construction debris such as wood, metal, masonry, concrete, rip rap, the sanitary wastewater tank and asphalt also will be disposed of with the low sulfur wasterock. Lime will not be added to these materials since they are not acid producing.

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

Sandstone will then be placed on top of the compact weathered bedrock layer followed by glacial till and some construction debris. When backfilling approaches the approximate original contours, soil will be dumped and graded as needed to achieve the desired final contours. Glacial soils will be mounded over most of the pit to allow for settling. The western 500 feet of the pit will be allowed to settle to recreate a 5-acre wetland. About 10 to 12 inches of topsoil will be replaced over the mound to facilitate plant restoration efforts.

FACILITY DEMOLITION

Flambeau Mining Co. will reclaim the mine site to provide long-term environmental stability. If an approved alternate use is demonstrated, 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 will be dismantled and removed from the mine site. During the removal of the ancillary facilities, building materials such as wood, metal, etc., will

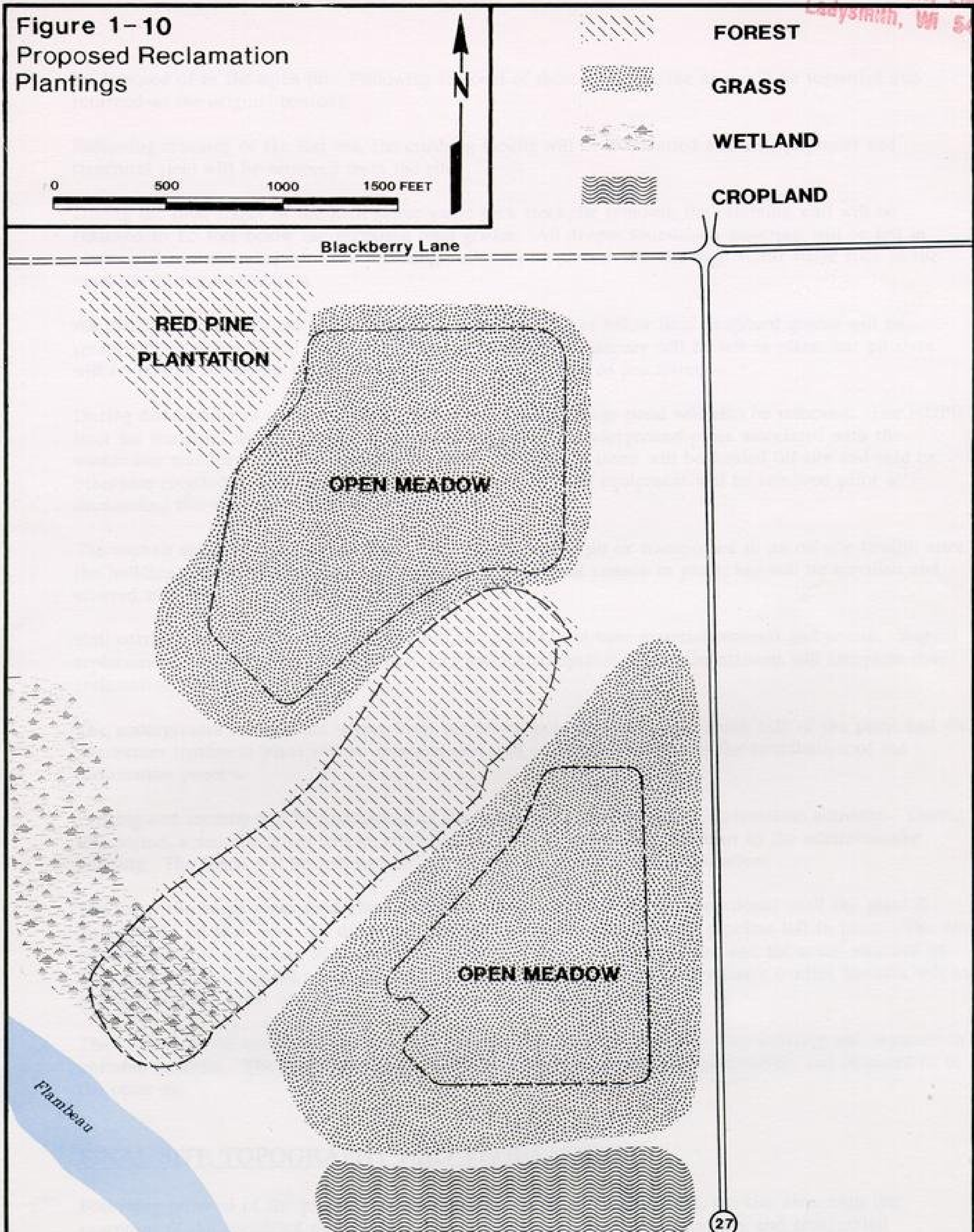


Figure 1-10
Proposed Reclamation Plantings
N
0
500
1000
1500 FEET
FOREST
GRASS
WETLAND
CROPLAND
Blackberry Lane
RED PINE PLANTATION
OPEN MEADOW
OPEN MEADOW
Flambeau River
27

be disposed of in the open pit. Following removal of these facilities, the area will be topsoiled and returned to the original contour.

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

During the final stages of the high sulfur waste rock stockpile removal, the retaining wall will be removed to 1.5 feet below the proposed final grades. All deeper foundation materials will be left in place. All contaminated concrete retaining walls will be placed with the high sulfur waste rock in the open pit during reclamation.

All masonry structures and concrete to approximately 1.5 feet below final proposed grades will be removed and placed in the open pit. Deeper concrete and masonry will be left in place, but all slabs will be broken up before being covered to permit infiltration of precipitation.

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

The asphalt surface of the access road will be buried in the pit or transported to an off-site landfill after the building sites are reclaimed. The road bed material will remain in place, but will be scarified and covered with topsoil and then revegetated.

Rail corridor reclamation will consist of rail, tie, ballast, and base material removal and re-use. Topsoil replacement, regrading, and revegetation with species acceptable to the Department will complete the reclamation process.

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

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

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

The sanitary waste system will be removed concurrently with the administration building and replaced by portable facilities. The materials for the drain field or holding tank will 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, will be graded to approximate original contours and revegetated (Figure 1-10). With the exception of the western 500 feet, the open pit area will be backfilled to slightly above original grade to compensate for anticipated settlement. The western 500 feet of the open pit will be backfilled to its approximate original grades to allow settlement to assist in the development of a planned 5 acre wetland area.

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

The plant species selected for the proposed reclamation plan reflect the ultimate goal of creating self-sustaining natural plant communities on the appropriate land forms. Four major plant community types in the project area include: upland hardwoods, lowland hardwoods, open meadow, and wetland. Each of the four plant communities are represented on the final planting plan. In addition to the four major plant community types previously listed, the portion of the mine site presently devoted to agricultural crop rotations is proposed to be returned to a condition suitable for use in farming.

LONG-TERM CARE

Under the long-term care provisions of the mining regulations, Flambeau Mining Co. will be responsible for monitoring and maintaining the former open pit for 30 years and the remainder of the mine site for a period of 20 years following reclamation. The total annual cost of long-term monitoring is anticipated to be $11,000/year.

Flambeau will inspect the reclaimed site twice per year for the first four years after reclamation is complete and once per year thereafter. The semi-annual inspections will occur in the spring and fall. The annual inspection will occur in the late summer. The inspections will evaluate conditions associated with erosion, vegetation growth, settling, and monitoring device integrity.

Plant communities will be maintained on an as needed basis to ensure that they develop in a manner consistent with naturally occurring plant communities. Volunteer native species will be encouraged wherever possible.

If a plant community is under stress, Flambeau will add additional plant materials or will take other action as deemed necessary.

Groundwater monitoring during the long-term care period will include three well nests. Two well nests are located downgradient of the backfilled pit. One well nest is upgradient for background water quality data purposes.

Sampling will be performed quarterly (March, June, September, and December). Analyses or measurements will be performed for the following parameters.

Water levels	Total dissolved solids	Iron
Specific conductance (field)	Alkalinity	Manganese
pH (field)	Hardness	Copper

MONITORING

The purpose of the monitoring program is to provide appropriate data for evaluating the performance of the environmental protection facilities, in particular, and the mining operation in general.

Baseline groundwater monitoring was conducted at the site in 1987 and 1988. Interim monitoring is currently on-going. If permits are issued, construction and operation monitoring will be conducted. During the background baseline studies 25 piezometers and 10 combination monitoring well/piezometers were sampled in the study area. The locations of these piezometers and wells are shown in Figure 1-11. Chemical analysis of the groundwater has been conducted for parameters including: pH, specific conductivity, alkalinity, hardness, cadmium, iron, zinc, and copper.

Four of the baseline monitoring well nests will be sampled throughout construction and operation. Two well nests are located downgradient of the pit. One is located downgradient of the low sulfur waste rock stockpile, and the last is located upgradient of the site.

Water levels in selected on-site wells will be monitored to document the drawdown due to the mine excavation. After the pit is backfilled, water levels will be monitored until groundwater levels stabilize.

The company has not proposed monitoring of the Flambeau River above and below the proposed outfalls. It has indicated all surface water monitoring techniques and parameters will conform to standards prescribed by the Department.

Monitoring for potential noise and air quality impacts during mine operations has not been proposed. Blast monitoring sites are shown on Figure 1-12.

Ecological monitoring of vegetation has not been proposed but will also be required.

MITIGATION MEASURES

The mitigation measures proposed by the company include the slurry wall to impede groundwater movement into the open pit (see Figure 1-5), the flood control dike at the west end of 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) will be placed between the southwest end of the pit and the river. This slurry wall will be 4 feet wide, about 400 feet long and will extend from the surface to firm bedrock (12 to 46 feet deep). A small flood control dike will 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 1-13). 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 shall immediately test all active wells within the well guarantee area and remedy any mine-related violations.

COST OF PROPOSED FACILITIES

The anticipated total value of the proposed mine site with improvements is approximately $20 million. The total project payroll by phase is estimated as follows: construction phase ($2 million), operation phase ($7.5 million), and reclamation phase ($2 million). Supplies purchased by the mine operator over the nine year life of the project would amount to $500,000 during the construction phase, $5.8 million over the operation phase, and $1.2 million over the reclamation phase. Overall anticipated costs during the reclamation phase are $6 million.

WORK FORCE CHARACTERISTICS

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

The mine will 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 Hwy 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 Hwy 27 for a short period during the preproduction period. During mine operation, the maximum employment level of 57 persons would increase traffic on Hwy 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 Hwy 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 will occur on Hwy 27. The biggest increase will occur in project month one when project truck traffic will reach 84 trucks/day. This level will diminish substantially to 8-14 trucks/day during project months 2 and 3. Project traffic will 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 will 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 1-7

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

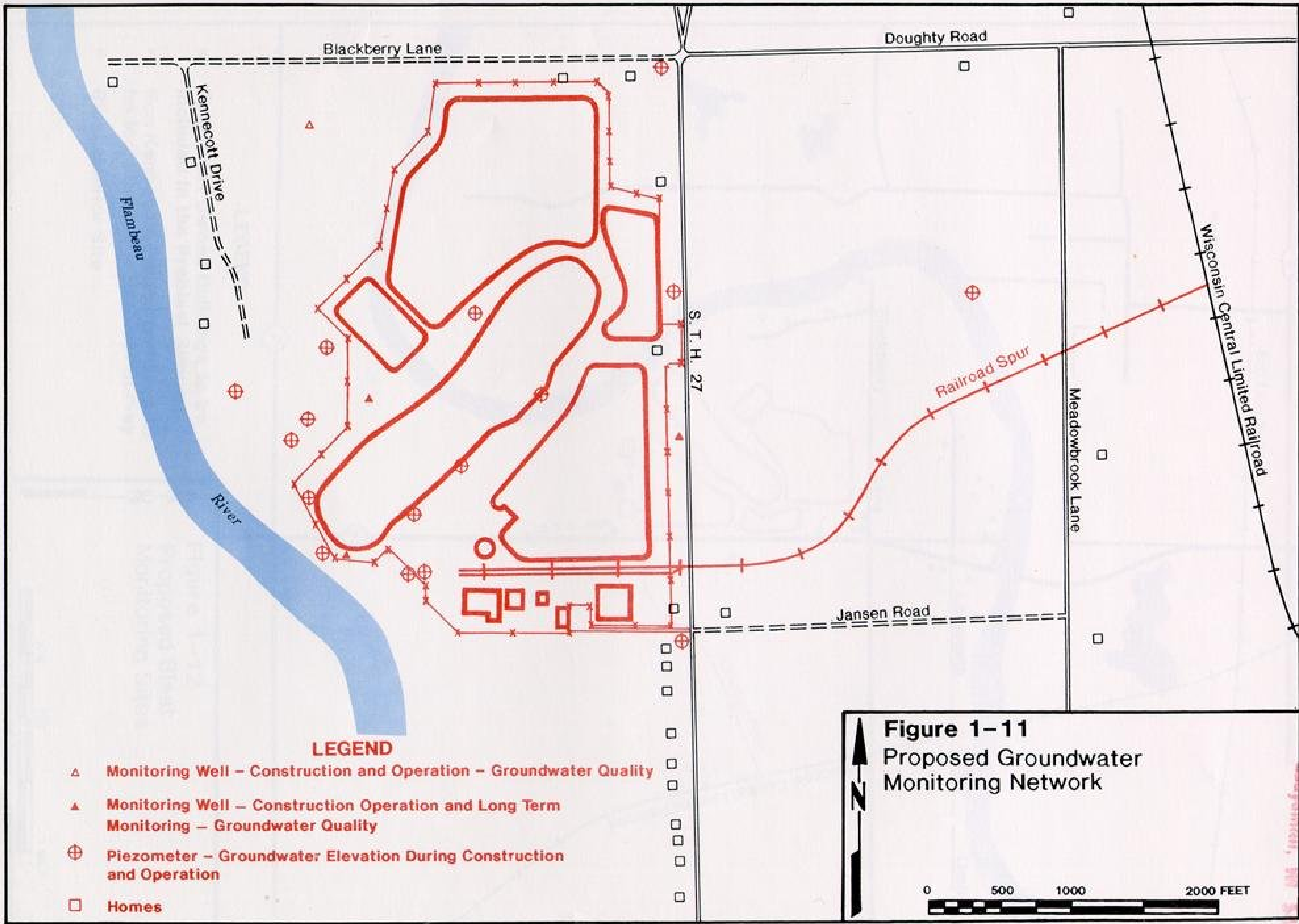
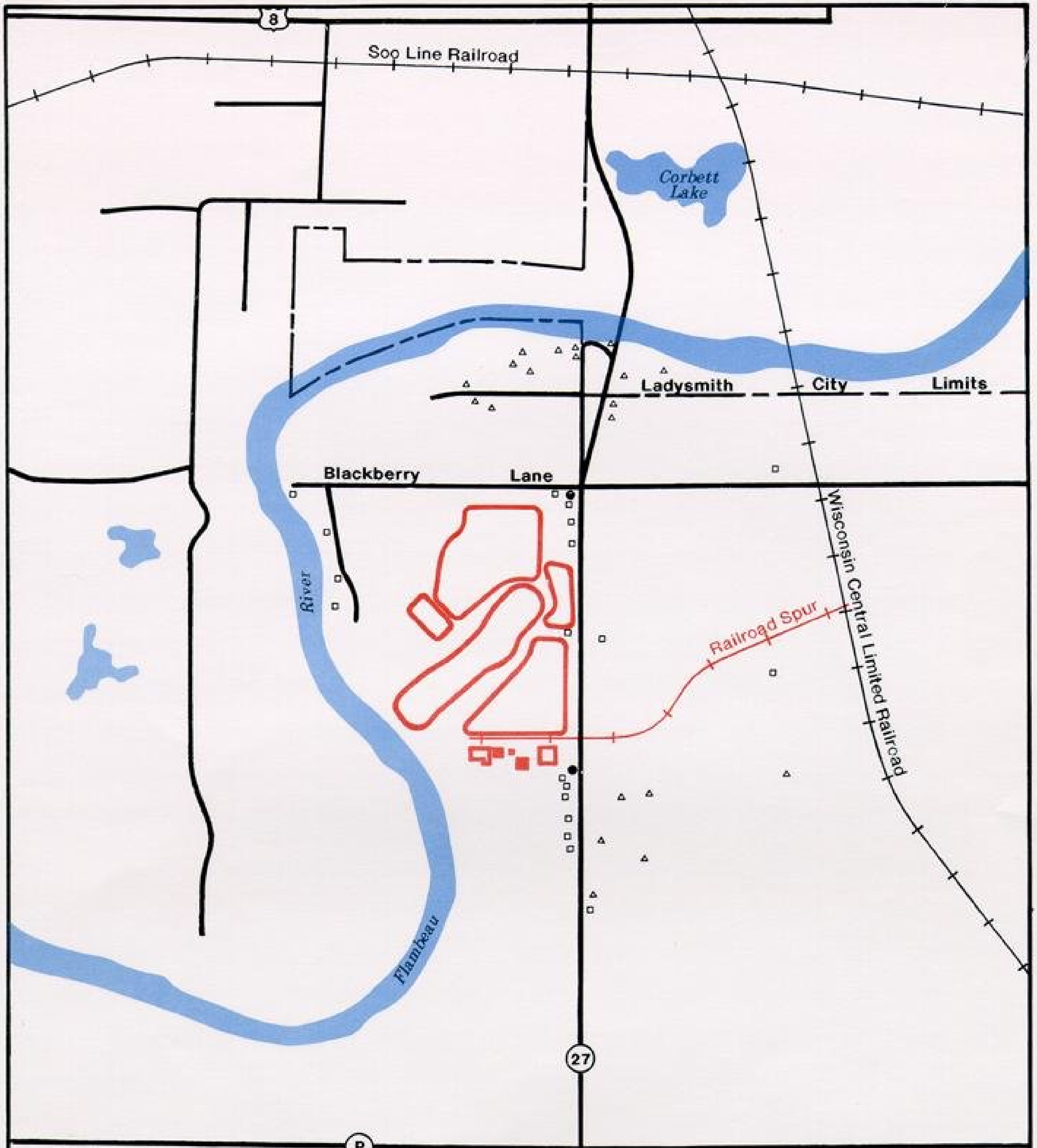


Figure 1–11
Proposed Groundwater Monitoring Network



LEGEND

- □ Kennecott Owned Buildings to be Included in the Preblast Survey
- △ Non Kennecott Owned Buildings to be Included in the Preblast Survey
- ● Blast Monitor Site

N

Figure 1-12
Proposed Blast Monitoring Sites

0 1/4 1/2 1 MILF

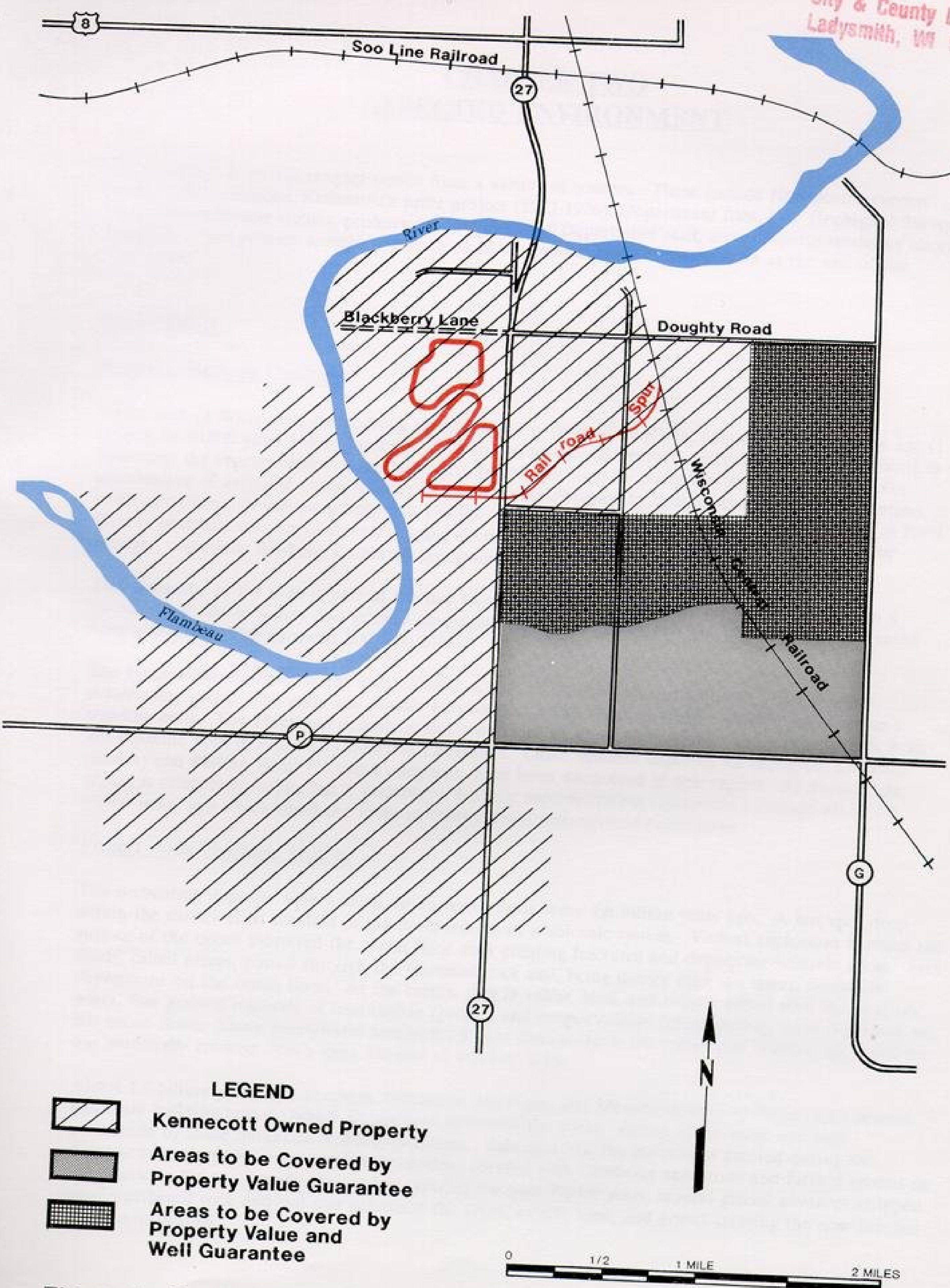


Figure 1–13 Property Ownership and Well / Property Value Guarantee Area

CHAPTER TWO
AFFECTED ENVIRONMENT

The information in this chapter comes from a variety of sources. These include Kennecott's current (1987-1988) 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 primary 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 part of the late Cambrian Mt. Simon Formation which grades from a pebbly sandstone to a very fine grained sandstone. In Rusk County, the Mt. Simon Formation 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 early and 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) about 1.6 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 some 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.

About 1.6 billion years ago, 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. Subsequently, 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 silty sand glacial till and well to poorly sorted glacial outwash. The soils at the ground surface vary from brown or red-brown silt to silty fine sand and were primarily deposited by the wind. 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 of the Mount Simon Formation. The sandstone of this formation 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 the supergene process 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, bornite and chalcopyrite 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 Highway 27.

The upper surface 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 super gene 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 containing minerals are not present in the ore or bedrock.

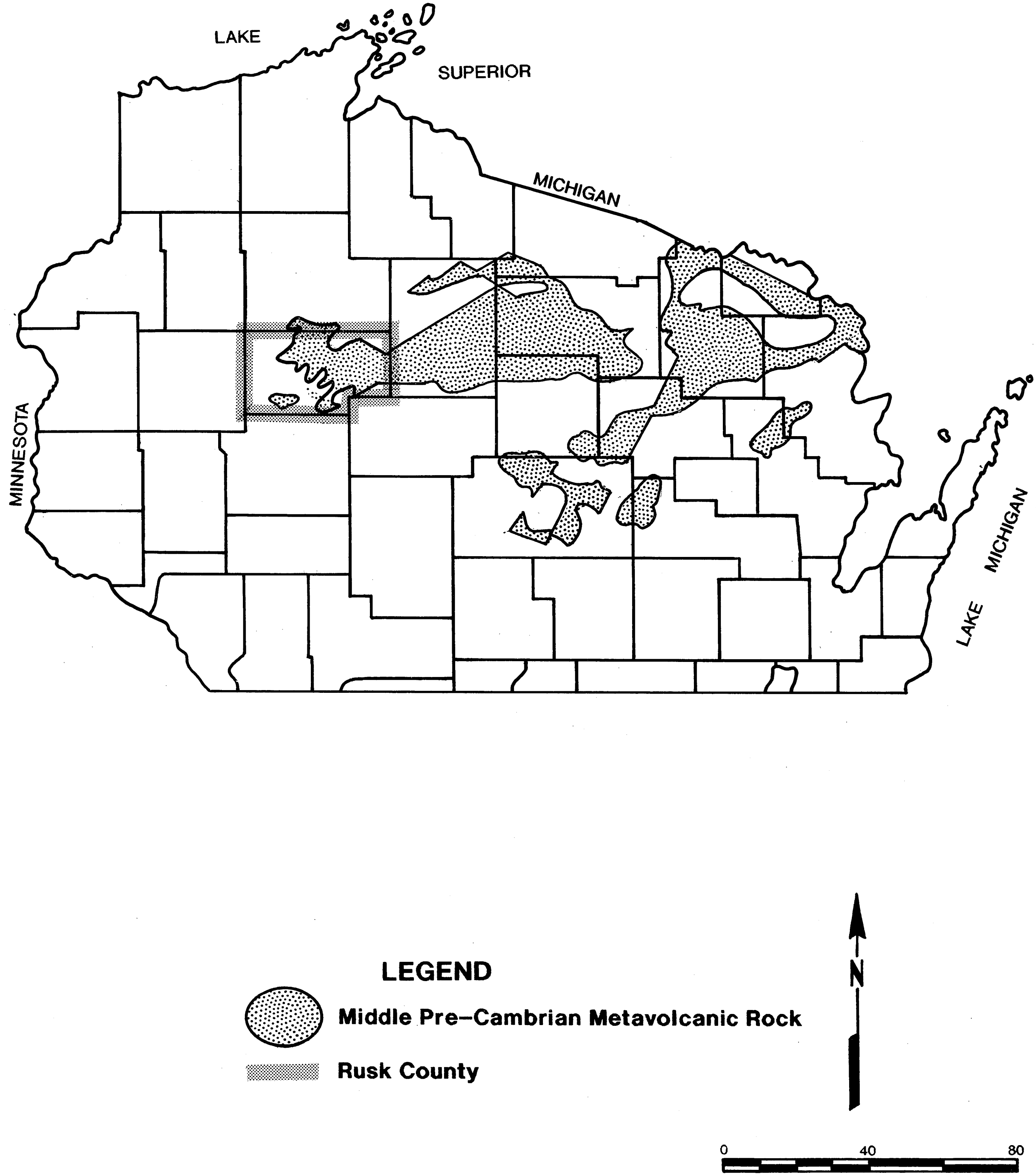


Figure 2–1

Distribution of Middle Pre–Cambrian Metavolcanic Rocks in Northern Wisconsin

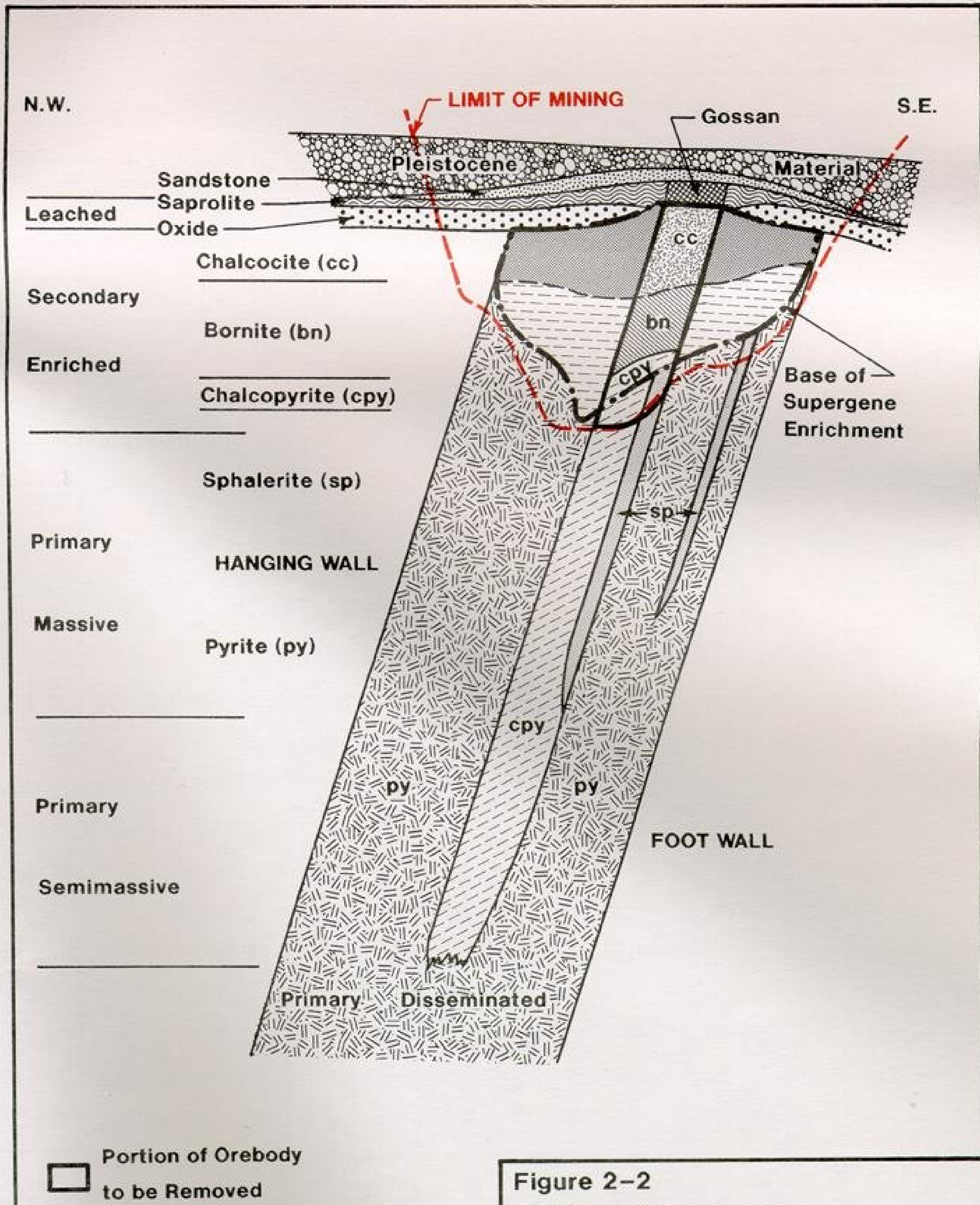


Figure 2-2
Idealized Cross Section
of the Flambeau Deposit

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 and 1,160 feet. The uplands are underlain by a layer of silty sand till 30 to 40 feet thick.

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 silty-sand glacial 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.

The last 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 watertable 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 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.

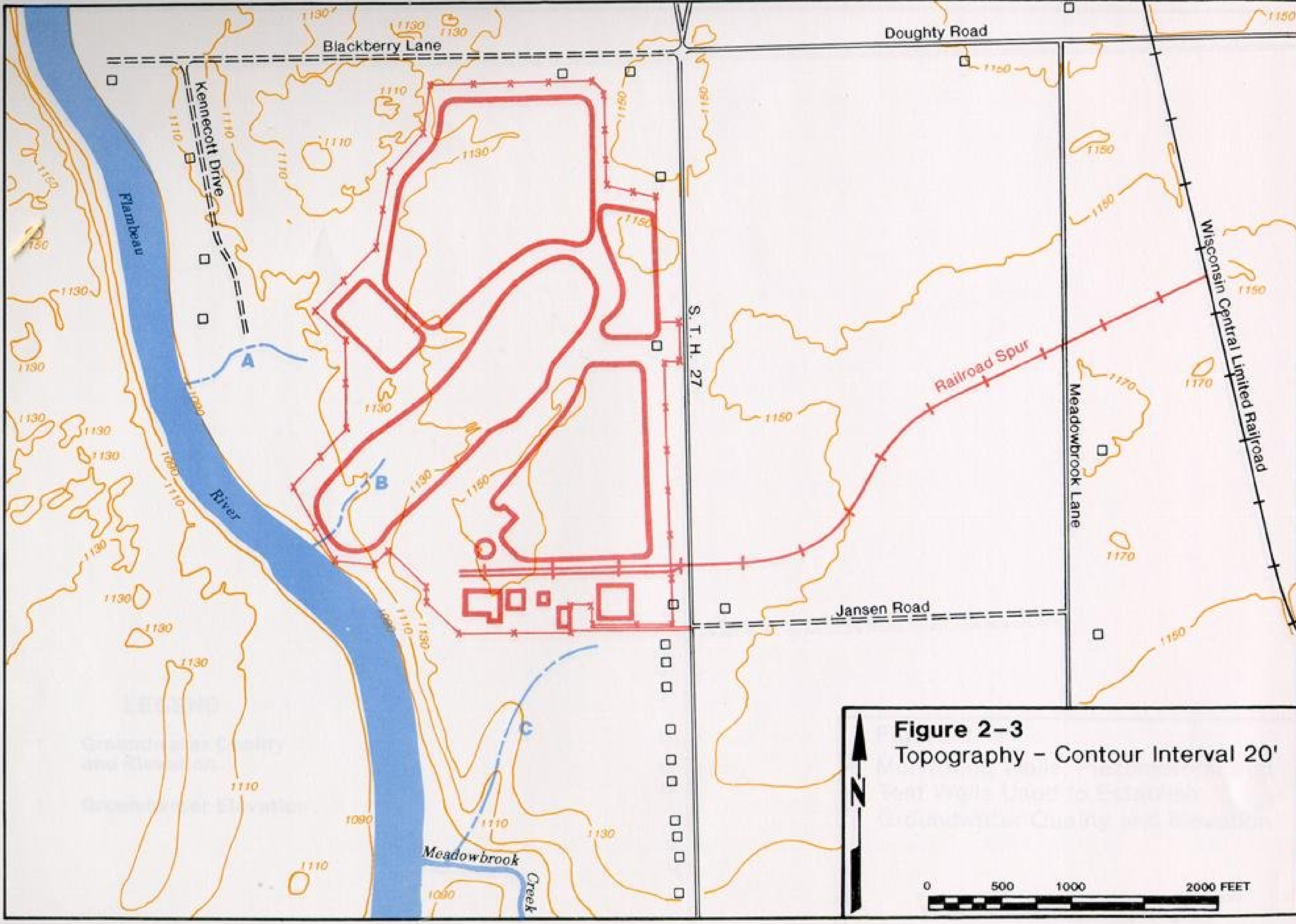


Figure 2-3
Topography - Contour Interval 20'

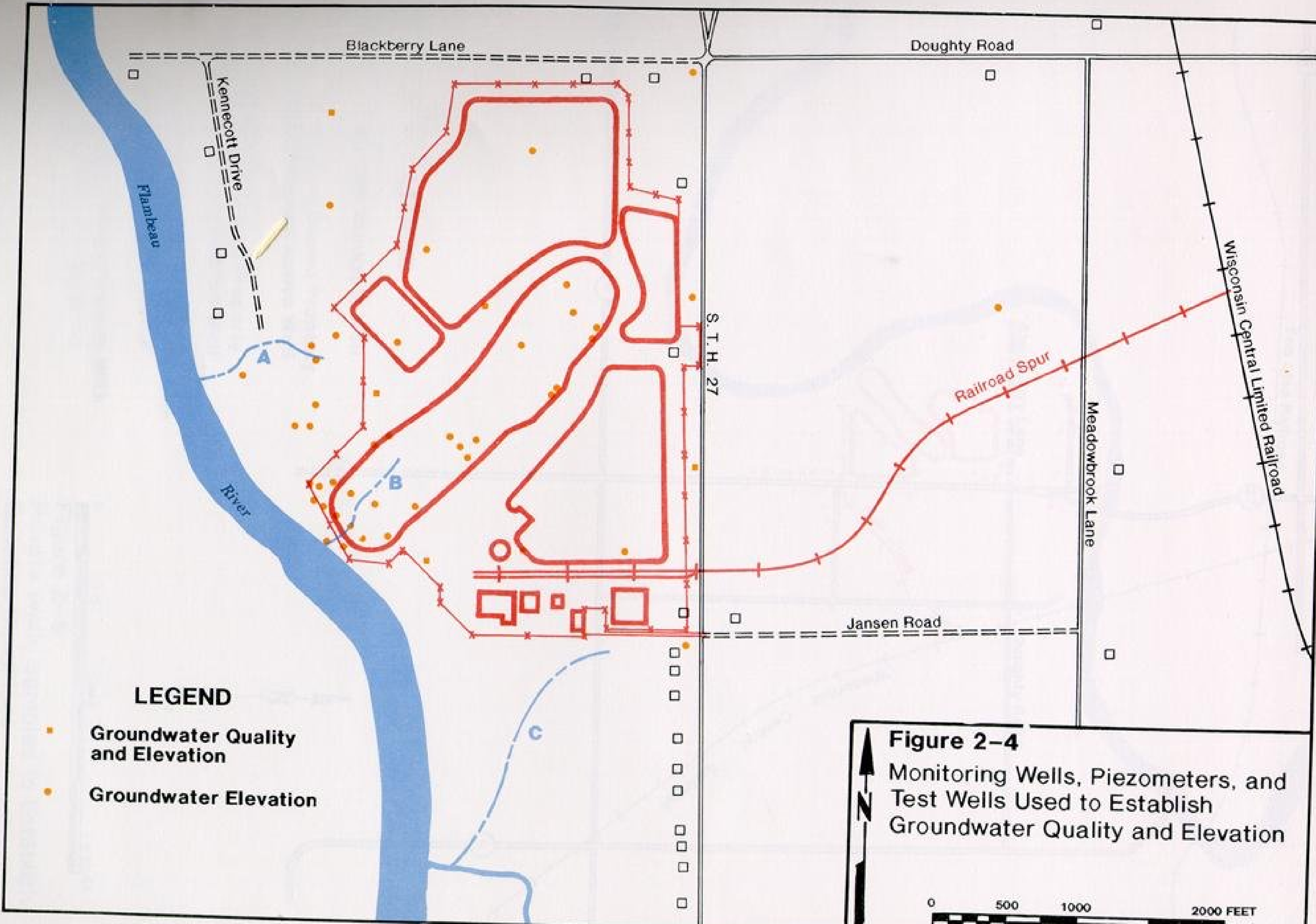


Figure 2–4
Monitoring Wells, Piezometers, and Test Wells Used to Establish Groundwater Quality and Elevation

Figure 2–5
Private Wells Sampled to Establish Baseline Conditions

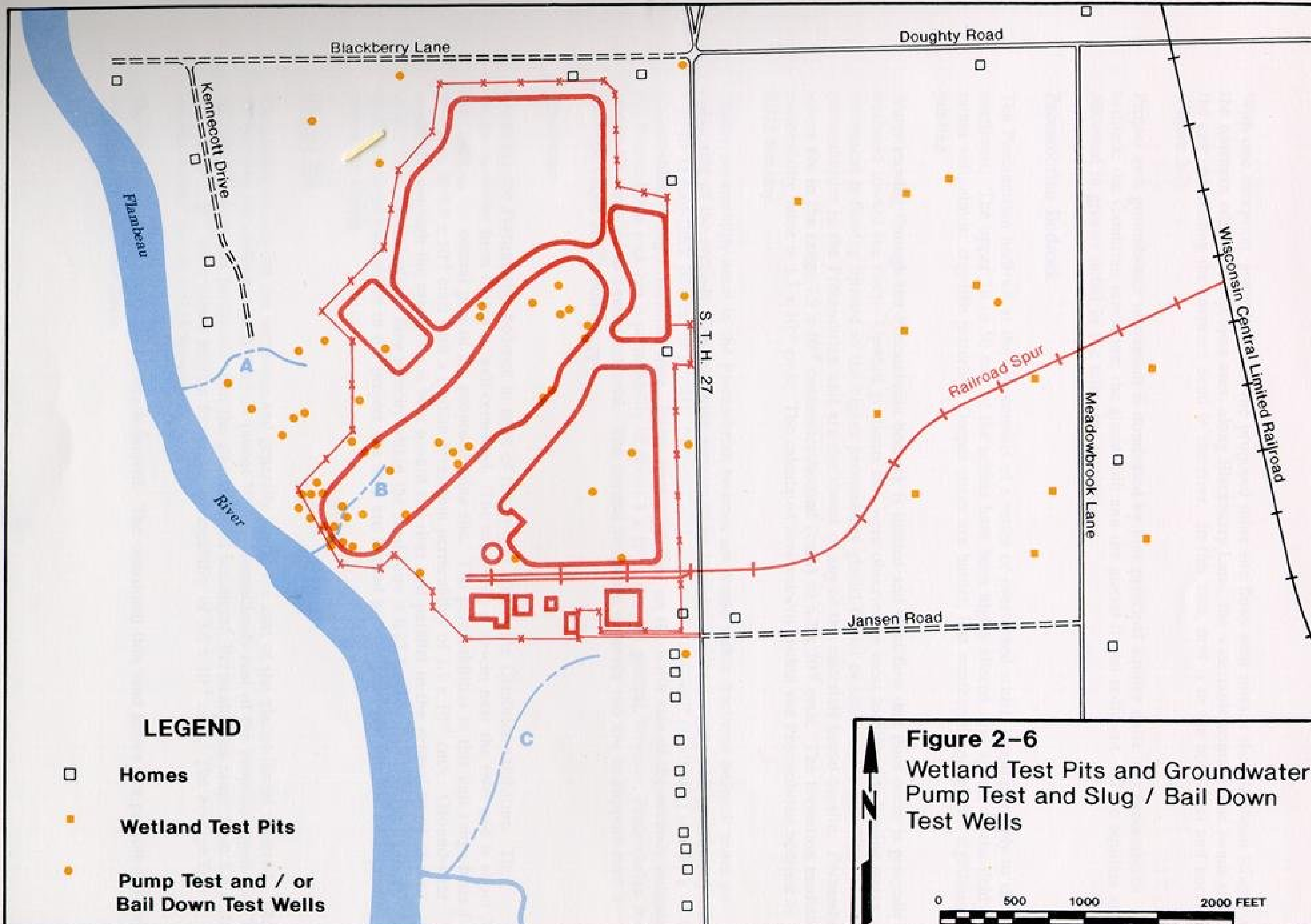


Figure 2-6
Wetland Test Pits and Groundwater Pump Test and Slug / Bail Down Test Wells

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 watertable 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 glacial-fluvial sediment. These aquifers are discussed in greater detail in the following sections.

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 flow velocity within the Precambrian bedrock is 0.022 feet/day.

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 cannot be classified 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 1.0×10^{-4} cm/s to 1.8×10^{-3} cm/s with a median formation permeability of 1.1×10^{-3} cm/s. Groundwater movement through the sandstone is west toward the river and parallel to the general trend of the watertable. The calculated flow velocity within the sandstone is 0.17 feet/day. 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 glacial-fluvial 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 glacial-fluvial sediment. Permeabilities range from 1.4×10^{-5} cm/s to 5.5×10^{-3} cm/s with a median formation permeability of 3.6×10^{-4} cm/s. The average flow velocity within the till is 0.19 feet/day.

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

Glacial-Fluvial Sediments

The glacial-fluvial 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. It is occasionally 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 1.0×10^{-5} cm/s to 1.7×10^{-1} cm/s. The formation median permeability value is 2.6×10^{-3} cm/s and the calculated flow velocity is estimated to be 0.60 feet/day. 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 glacial-fluvial 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.

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 watertable 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).

The other upland wetlands are hydraulically isolated and are perched above the watertable.

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.

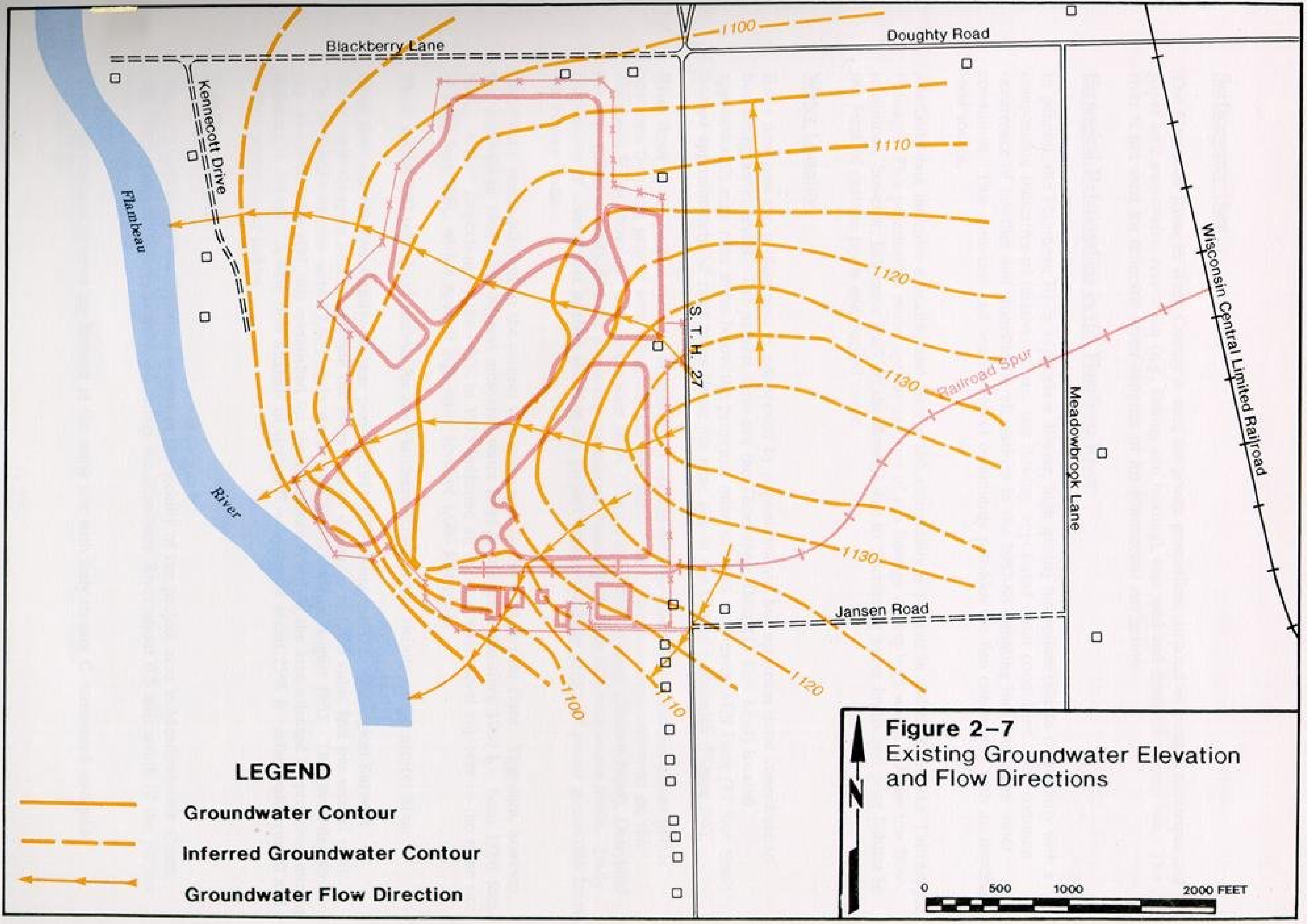


Figure 2–7
Existing Groundwater Elevation and Flow Directions

Surfacewater 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.

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 surfacewater 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 mine site with only stream C considered navigable (Figure 2-9).

Surfacewater 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 are contained in Appendix A.

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 2-1). 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.

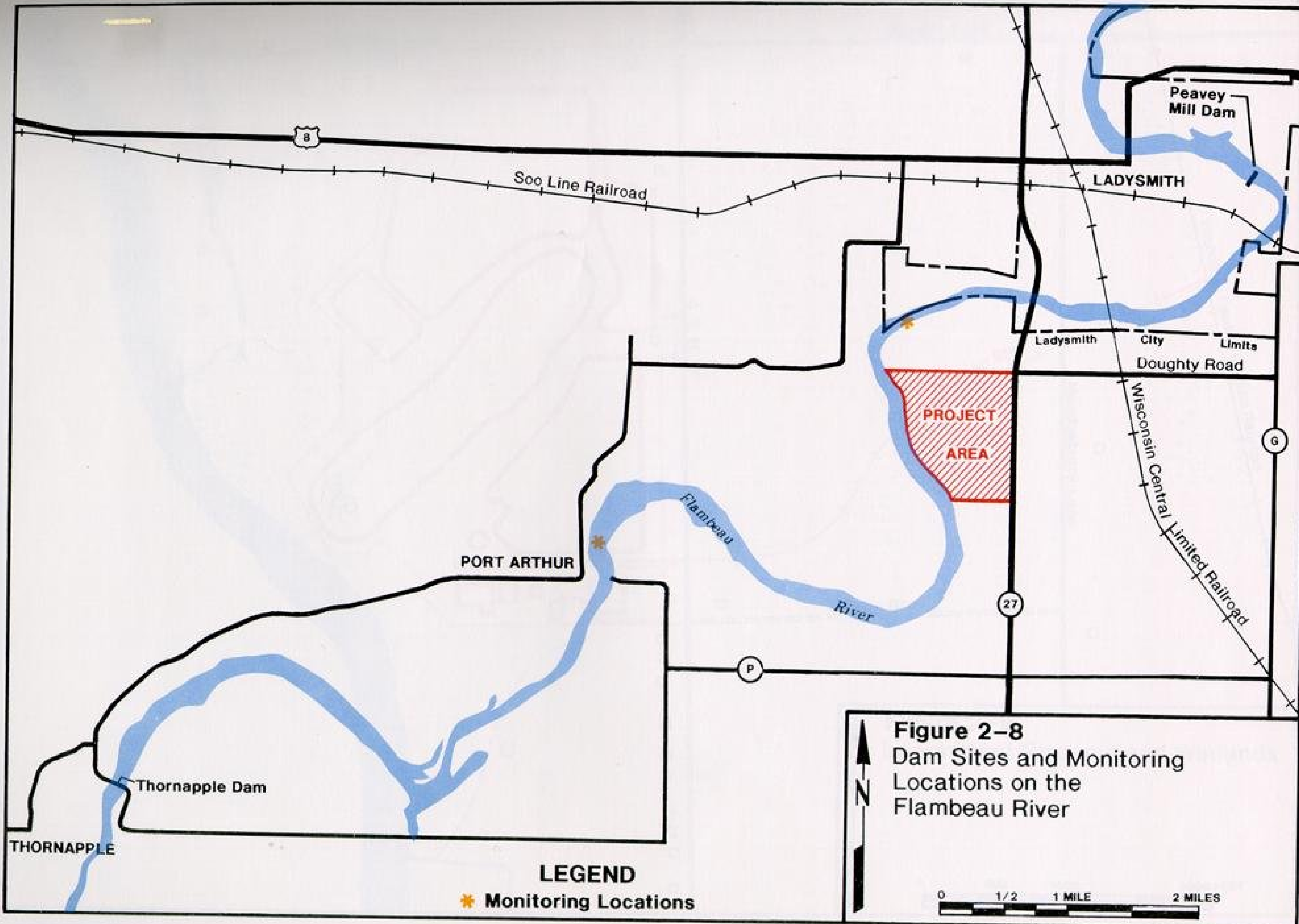


Figure 2–8
Dam Sites and Monitoring Locations on the Flambeau River

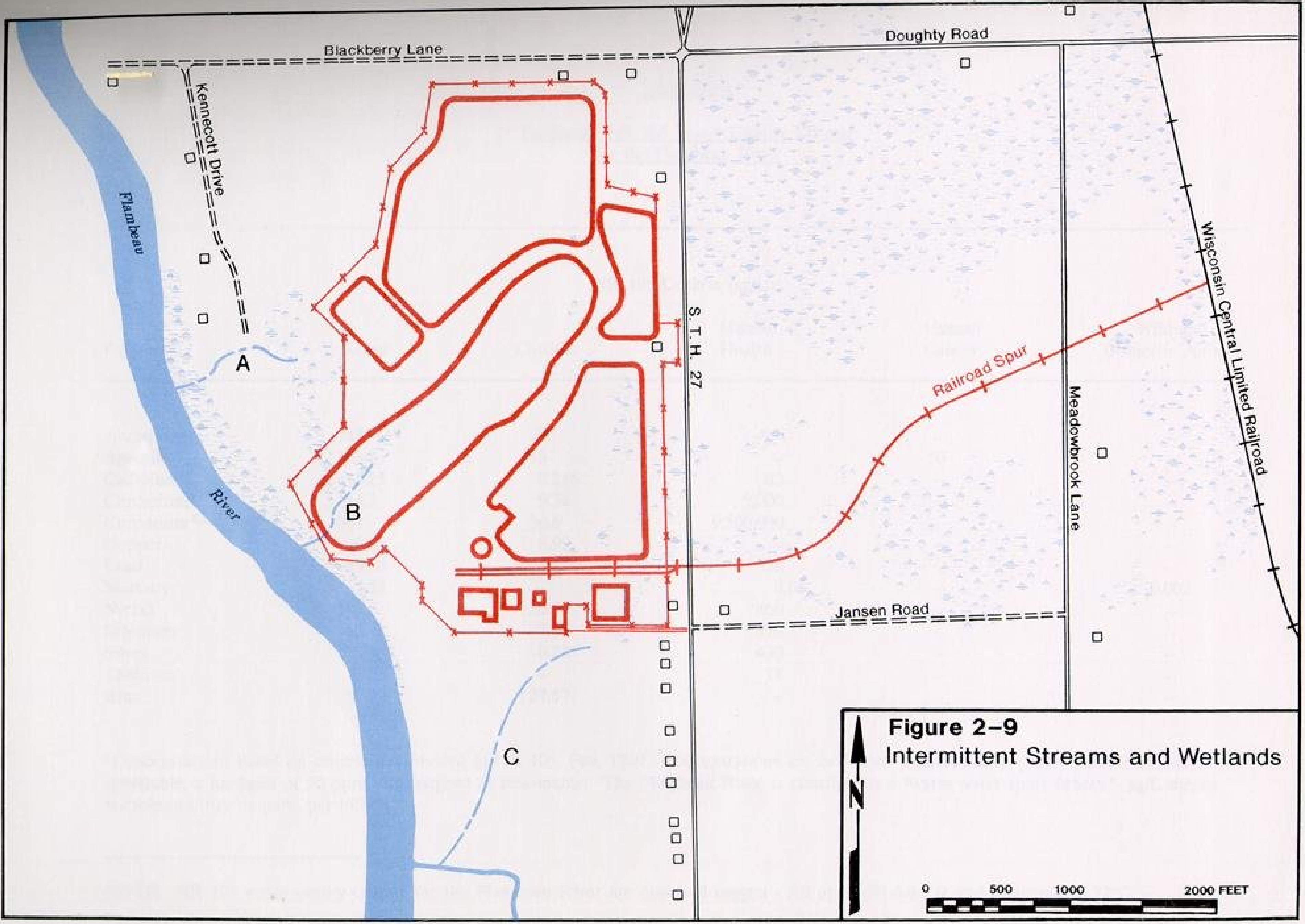


Figure 2–9
Intermittent Streams and Wetlands

TABLE 2-1

Estimated NR 105 Water Quality Criteria
for the Flambeau River

	NR 105 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. 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 surfacewater 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 papermill.

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 Hwy. 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 and is influenced by seasonal flooding from the river, and has been historically inundated by the former flowage caused by the Port Arthur dam.

VEGETATION

Terrestrial Vegetation

The project area supports a combination of natural communities and recently 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 recently 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, 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 big-tooth 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, big-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 Hwy. 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 ruffed grouse 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 gamebirds commonly observed in the area.

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, is probable in Rusk County, but has not been observed at the mine site. Habitat suitable for wood turtles exists near the mine site.

There are two active bald eagle nests located 1.0 to 1.7 miles downstream from the project area. 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 Highway 27, and the Ladysmith 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 Highway 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 Hwy 27, the principle noise source in the vicinity. Noise levels adjacent to Hwy 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 Hwy 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 April 1989 Mining Permit Application to the Department of Natural Resources.

Excerpts from the local agreement also were published in the Ladysmith newspaper. 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 devastating 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 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.

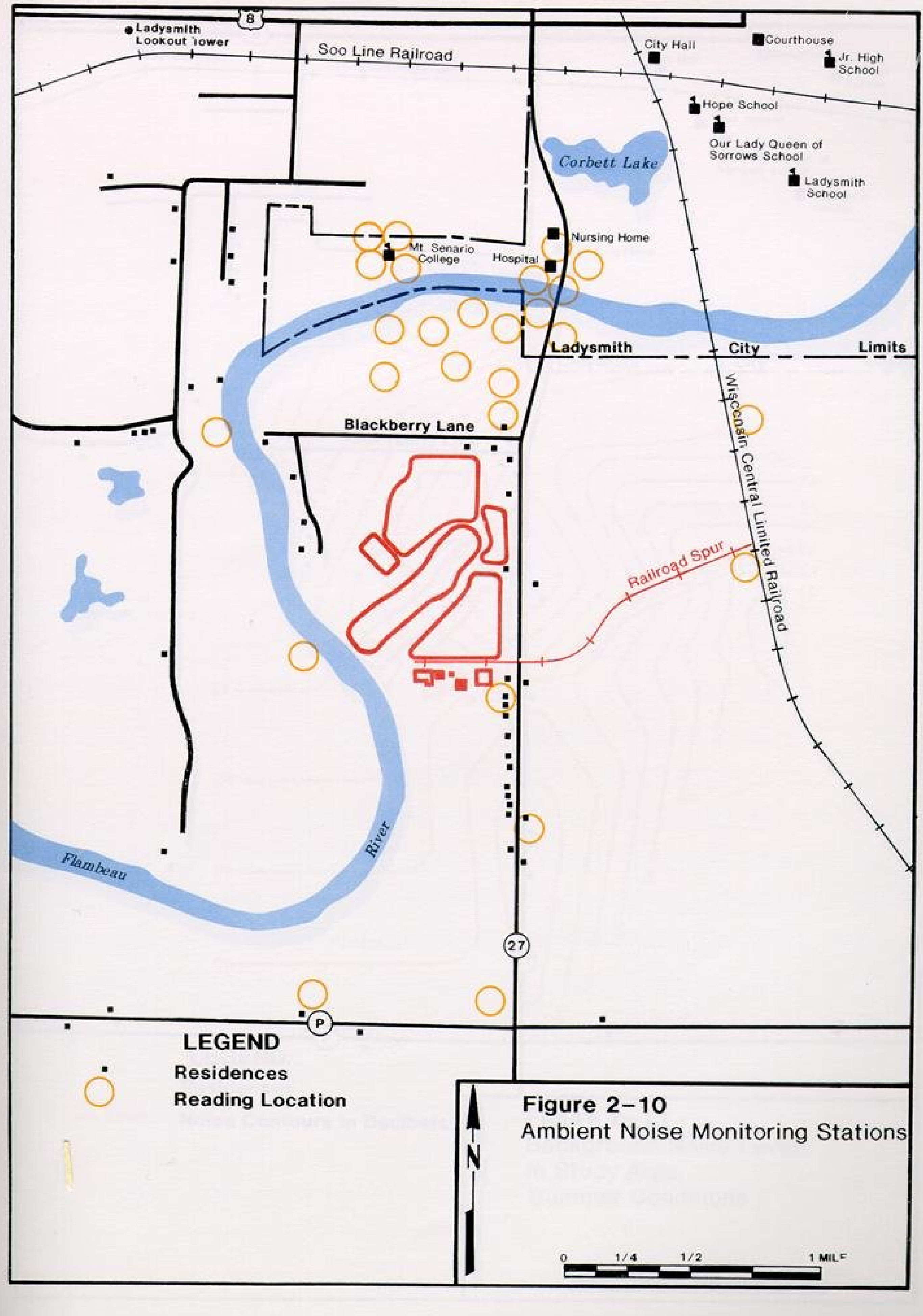
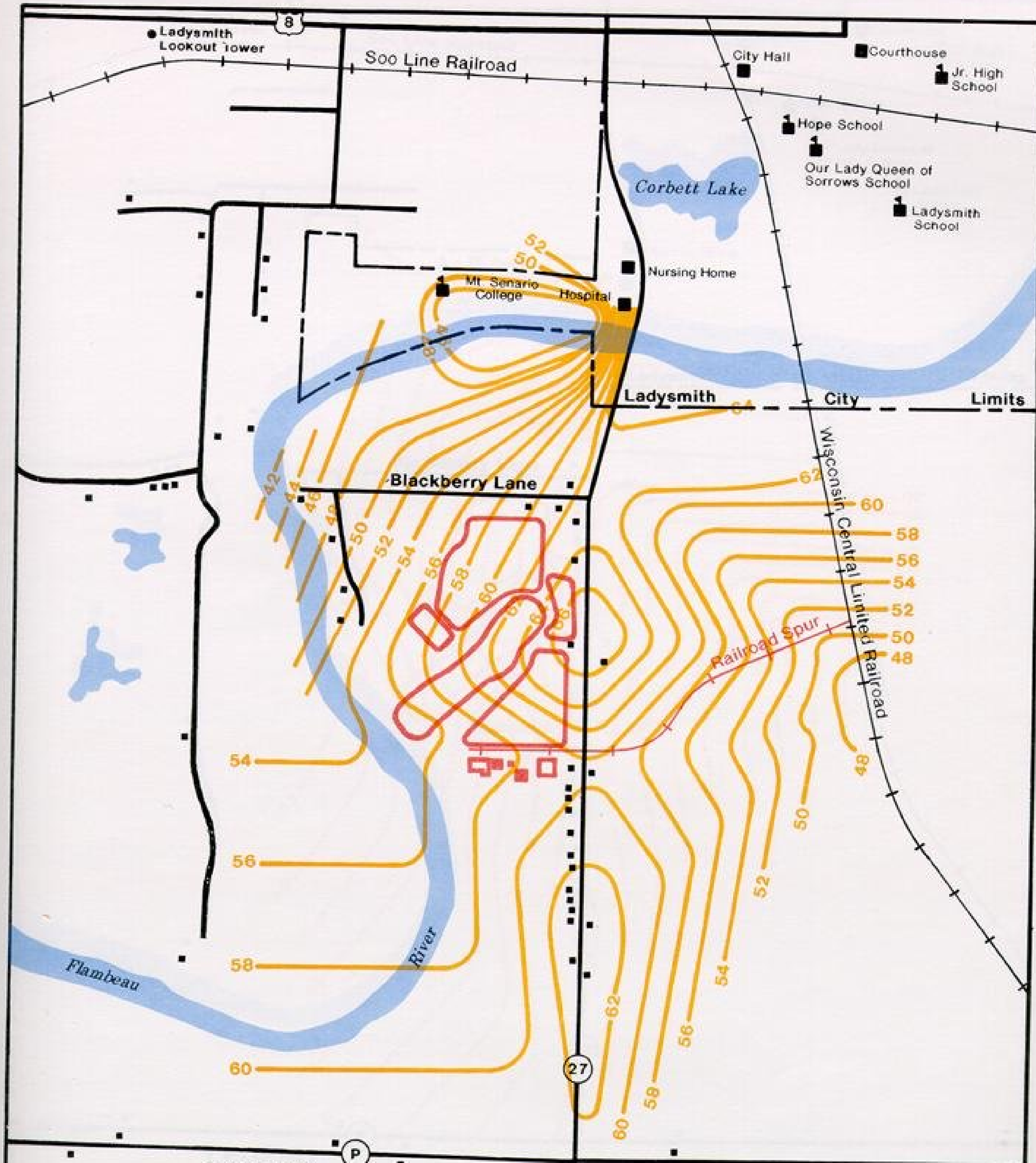


Figure 2–10
Ambient Noise Monitoring Stations



LEGEND

Residences

Noise Contours in Decibels

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

0 1/4 1/2 1 MILE

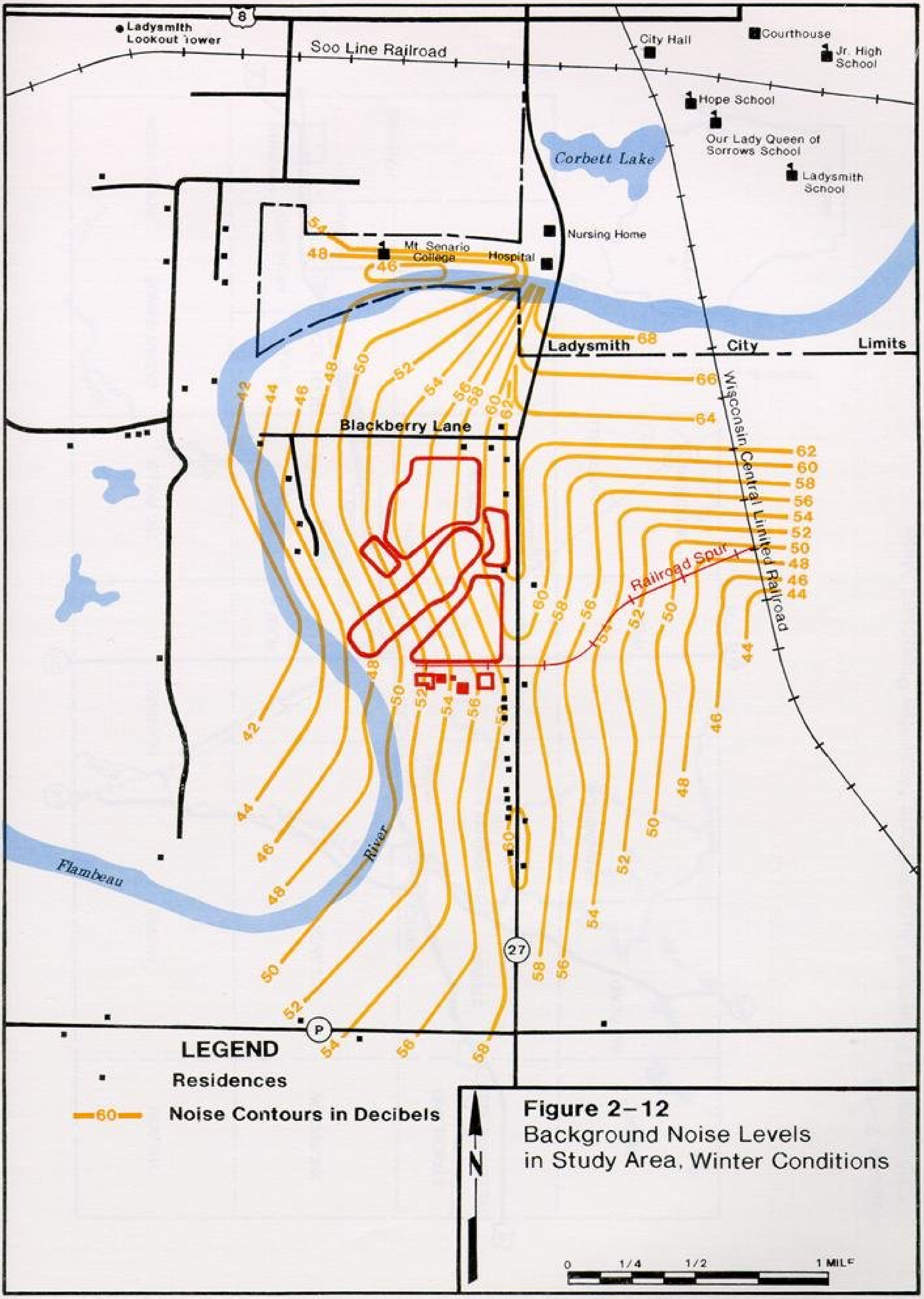


Figure 2–12
Background Noise Levels
in Study Area, Winter Conditions

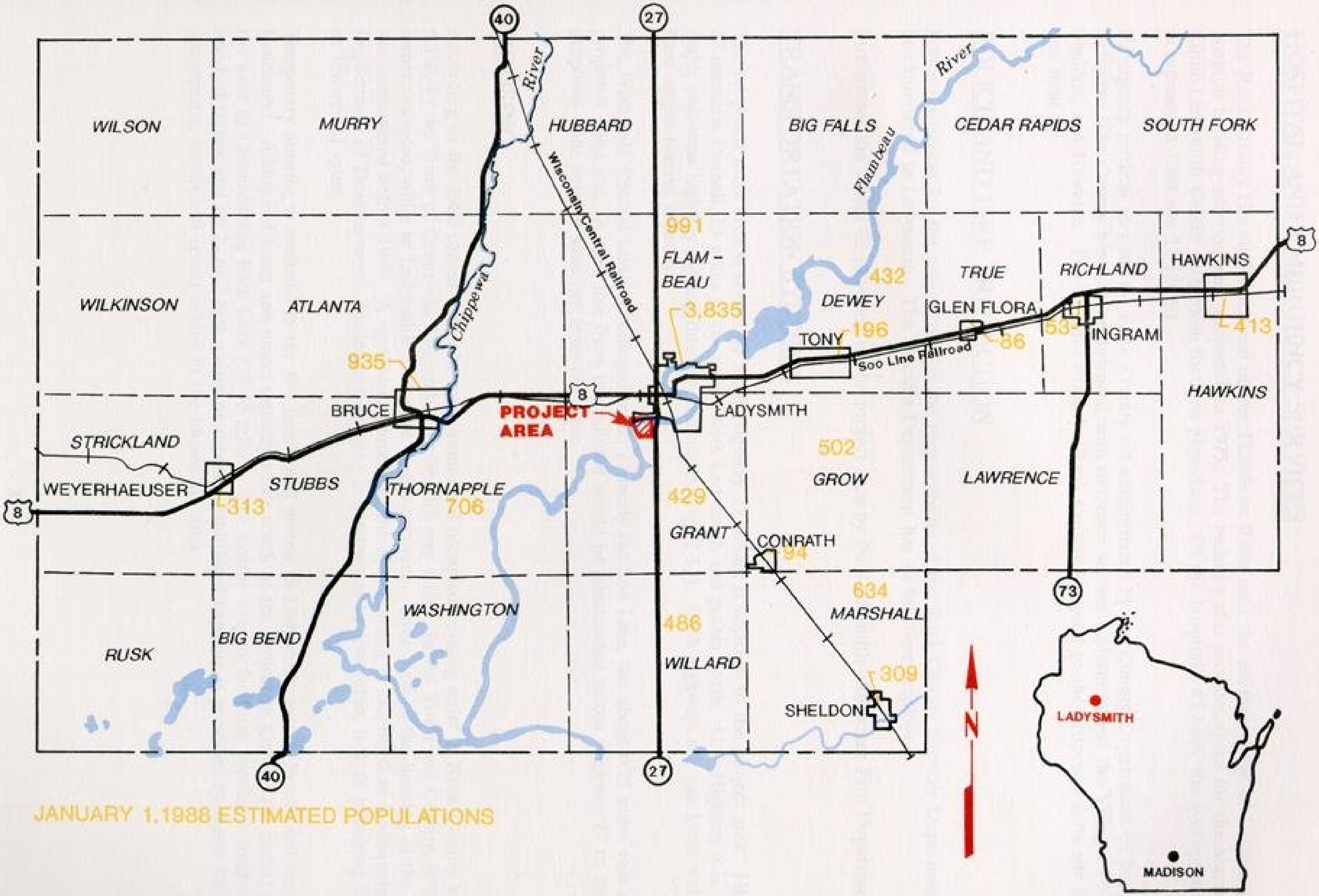


Figure 2–13
Populations of Selected Jurisdictions Near the Proposed Mine

HOSPITAL AND EMERGENCY SERVICES

The Rusk County Hospital is located on 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 State Highway 27, which is adjacent to the project area. Highway 27 connects Cornell, 23 miles to the south, with Ladysmith and points north. U.S. Highway 8 is the major east-west highway passing through Ladysmith (Fig. 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 Highway 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 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 2-2 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 2-2

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 Flambeau Mining Co. 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 2-3 indicates the 1988 property taxes levied on Flambeau's property.

TABLE 2-3

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 2-4) 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. That information was not available. The assumptions used for the calculations are explained below.

Recoverable quantities of copper, gold, and silver are contained in the estimated 1.9 million ton orebody. Published newspaper reports have characterized the orebody as containing 10% copper. The 1976 final environmental impact statement prepared by the Department of Natural Resources on the initial mining proposal indicated the rates of gold and silver production from the original orebody. From those quantities it was calculated that the orebody contains an average of 0.05 ounces of gold per ton of ore and 0.5 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 ounce and silver at $5.60 per 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. The minimum gross value of the orebody is about $362 million in 1989 dollars.

TABLE 2-4

Minimum Gross Value of Orebody

		Gross Value (Millions)
Copper:	1,900,000 tons x 10% metal x 2,000 lbs/ton x $0.85 =	$323.0
Gold:	1,900,000 tons x 0.05 oz/ton x $.350 =	$33.3
Silver:	1,900,000 tons x 0.5 oz/ton x $5.60 =	$5.3
		$361.6

The value of the orebody at current prices is about $511 million as shown below:

TABLE 2-5

Value of Orebody at Current Prices
(July 1989)

		Gross Value (Millions)
Copper:	1,900,000 tons x 10% x 2,000 lbs/ton x $1.24 =	$471.2
Gold:	1,900,000 tons x 0.05 oz/ton x $368 =	$35.0
Silver:	1,900,000 tons x 0.5 oz/ton x $5.12 =	$4.9
		$511.1

A maximum gross value of the orebody calculated at 10% above current prices is $562 million. Therefore, the gross value of the Flambeau orebody ranges from $362-$562 million based on the above assumptions. Gross value does not reflect the cost of mining the orebody, transporting, concentrating and refining the metals or reclaiming the mine site. 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 active and abandoned farm fields, second growth forests, single family residences, wetlands, and a 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 the three following areas (Rusk County (590,295 total acres); Grant Township (23,013 total acres); 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 executed between Rusk County, the Town of Grant, City of Ladysmith and Kennecott on August 1, 1988, 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.

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 land use and immediately adjacent lands have only a very small percentage of land available for active development, unless adequate wastewater treatment facilities are provided because of soil limitations for on-site sewerage systems. In addition, only 20 acres of developable land are not under Kennecott ownership.

RECREATION

Leisure activities in the Ladysmith area consist of both outdoor and indoor 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 Zoning

Some incidental hunting and berry picking may occur in the project area and canoeists use the Flambeau River adjacent to the project area. In general, the project area is not a significant recreation resource.

UTILITIES

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 Hwy 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.

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 either.

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 to the land surface. 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 will 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 appropriate 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 250 feet and cover approximately 40 acres. The majority of the pit would initially be backfilled to approximately three feet above the original land surface of the site.

The western 500 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 near the original contours on the eastern part of the pit and about three feet lower than 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 topography at the abandoned gravel pit north of the mine would also be altered by the project reclamation. The gravel pit would be used to either obtain additional fill material for the mine pit, or to dispose of excess fill, depending on the actual needs at the time of reclamation. In either case, Flambeau Mining Co. proposes to grade the gravel pit upon completion of the project. While no specific plans for the grading are available, grading should enhance the topography at the gravel pit by reducing slope gradients thereby making the land more suitable for other land uses.

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 138.5 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.

About two million tons of till subsoils would be excavated from the pit and stockpiled on the land surface. These soils would also be mixed and compacted and, without restoration of the soil structure, productivity of the till soils would be substantially reduced.

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 necessary 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. 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). 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

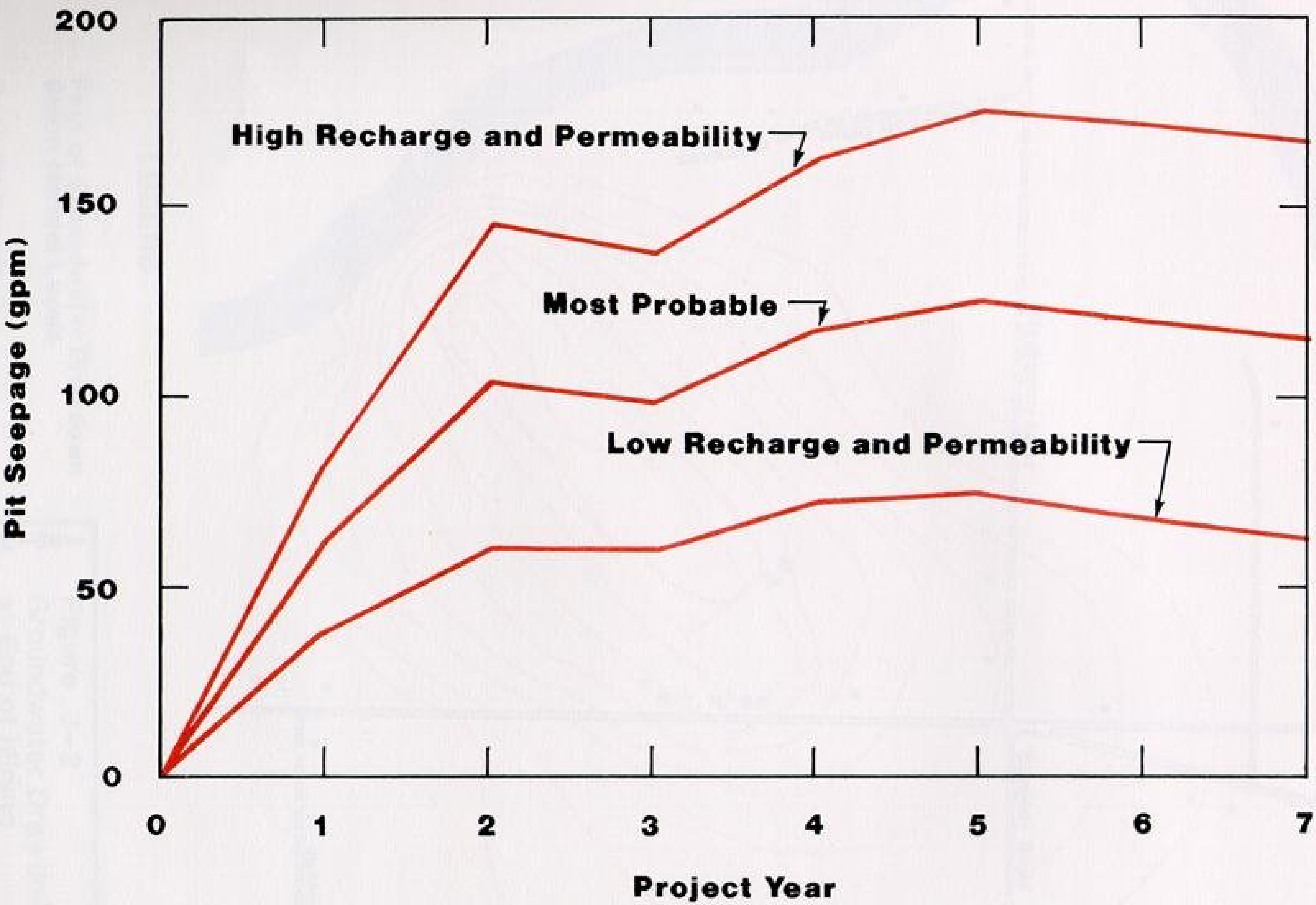


Figure 3–1 Potential Rates of Groundwater Flow into the Pit

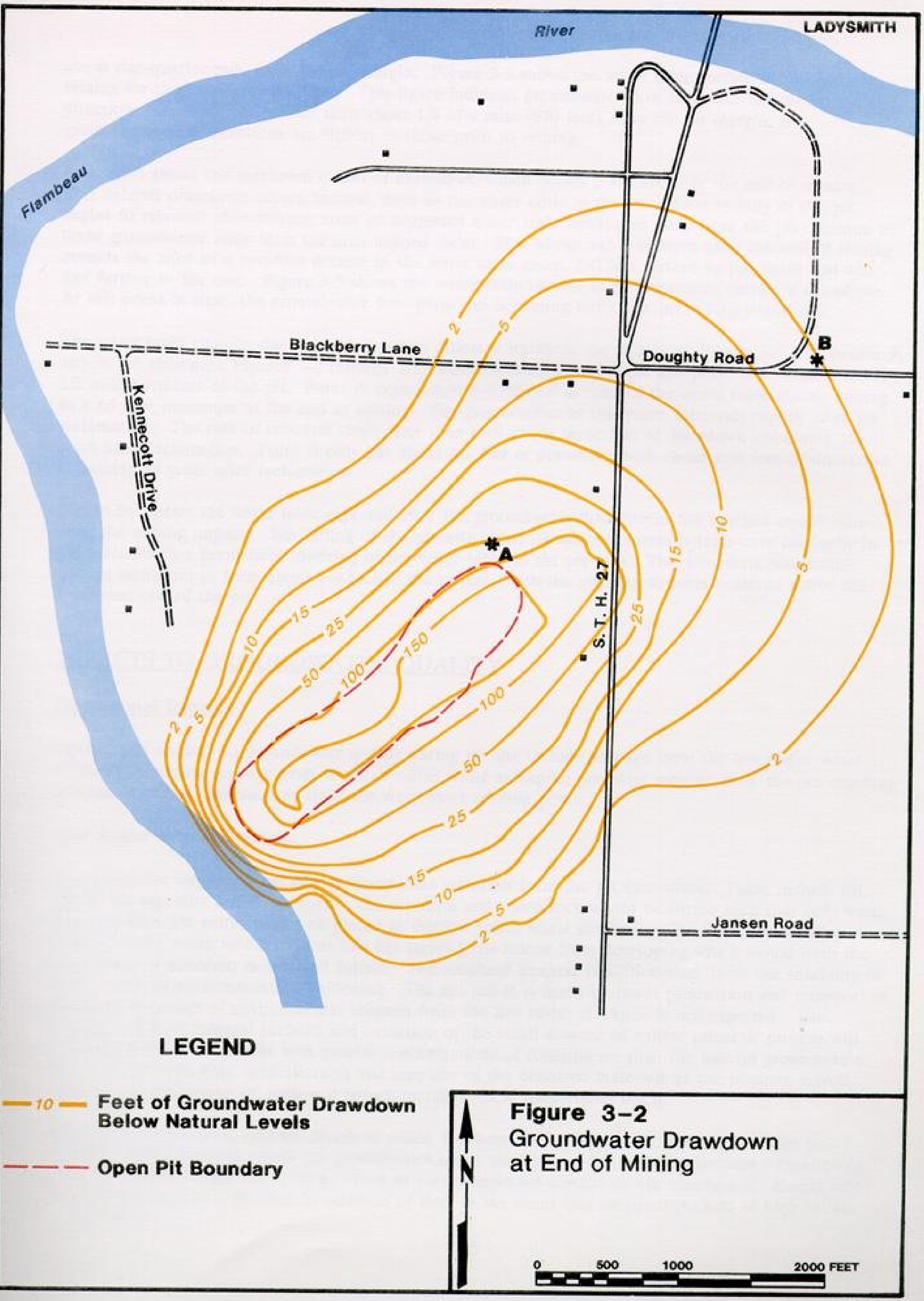


Figure 3-2
Groundwater Drawdown at End of Mining

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 the mining impacts. 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 is 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. Monitoring devices under the waste could be provided to ensure expected conditions are maintained. Excess acid production could be controlled by addition of lime in the event that localized pockets of high sulfide wastes were inadvertently placed in the pile. 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.

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 abandonment 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 5-6,000 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 not only can dissolve metals of environmental concern but allows their transport due to conditions of increased solubility. 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. 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. 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

LEGEND

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

— — Open Pit Boundary

Figure 3–3
Predicted Water Table
at End of Mining

N

0 500 1000 2000 FEET

LEGEND

—10— Feet of Groundwater Drawdown Below Natural Levels

– – – Open Pit Boundary

N

0 500 1000 2000 FEET

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

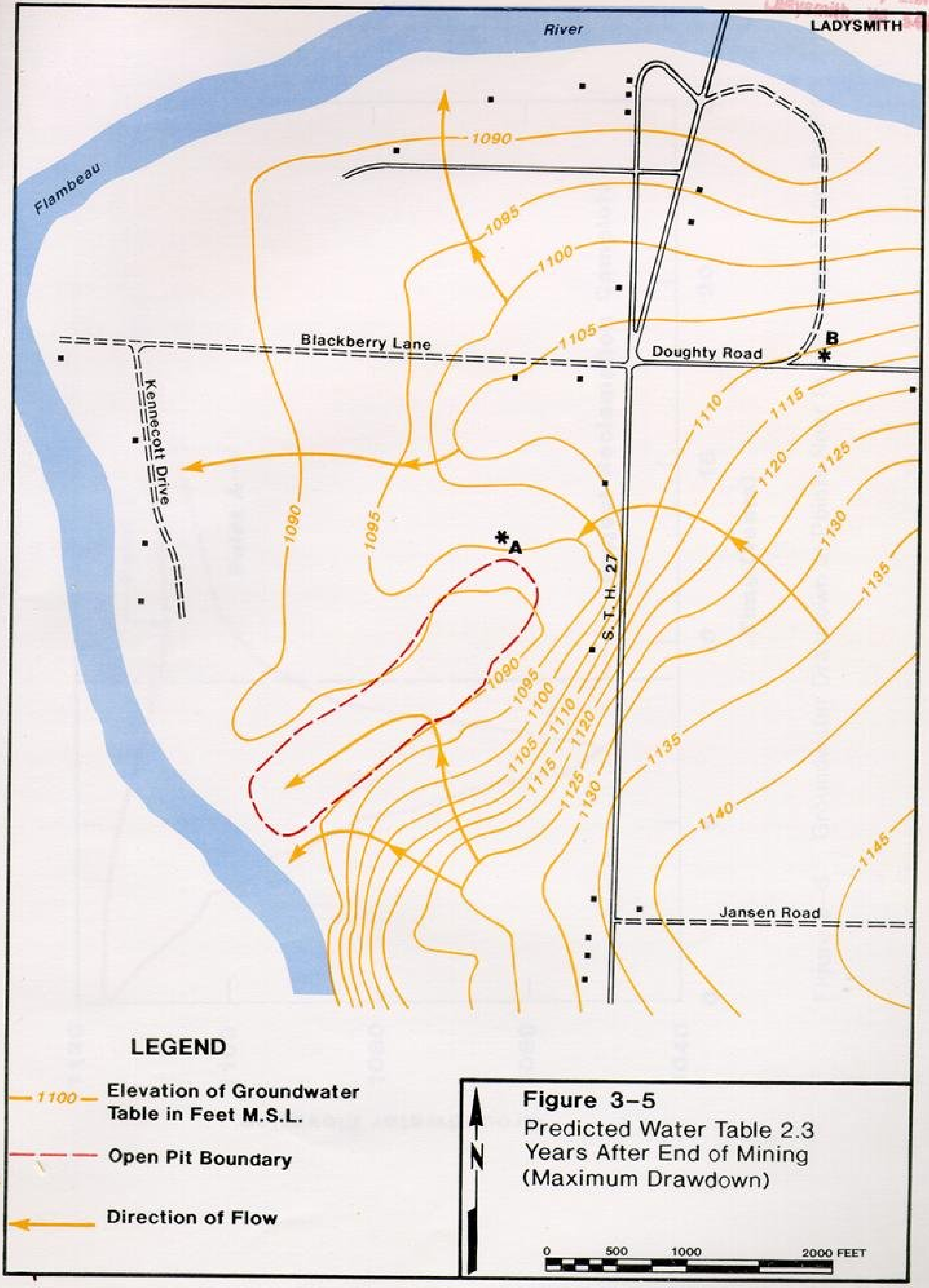


Figure 3–5
Predicted Water Table 2.3 Years After End of Mining (Maximum Drawdown)

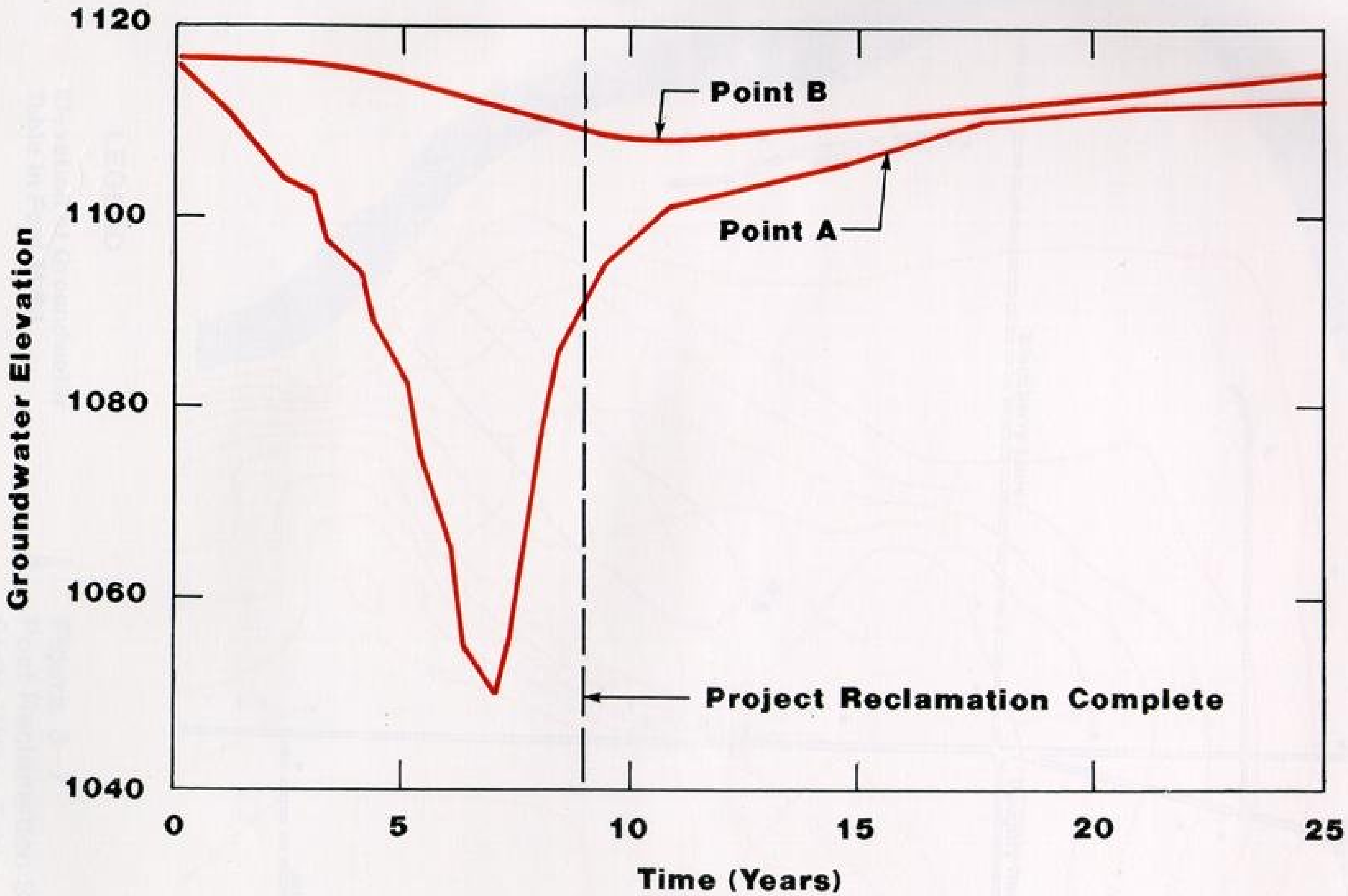


Figure 3–6 Groundwater Drawdown at Points Near to and Distant From the Pit

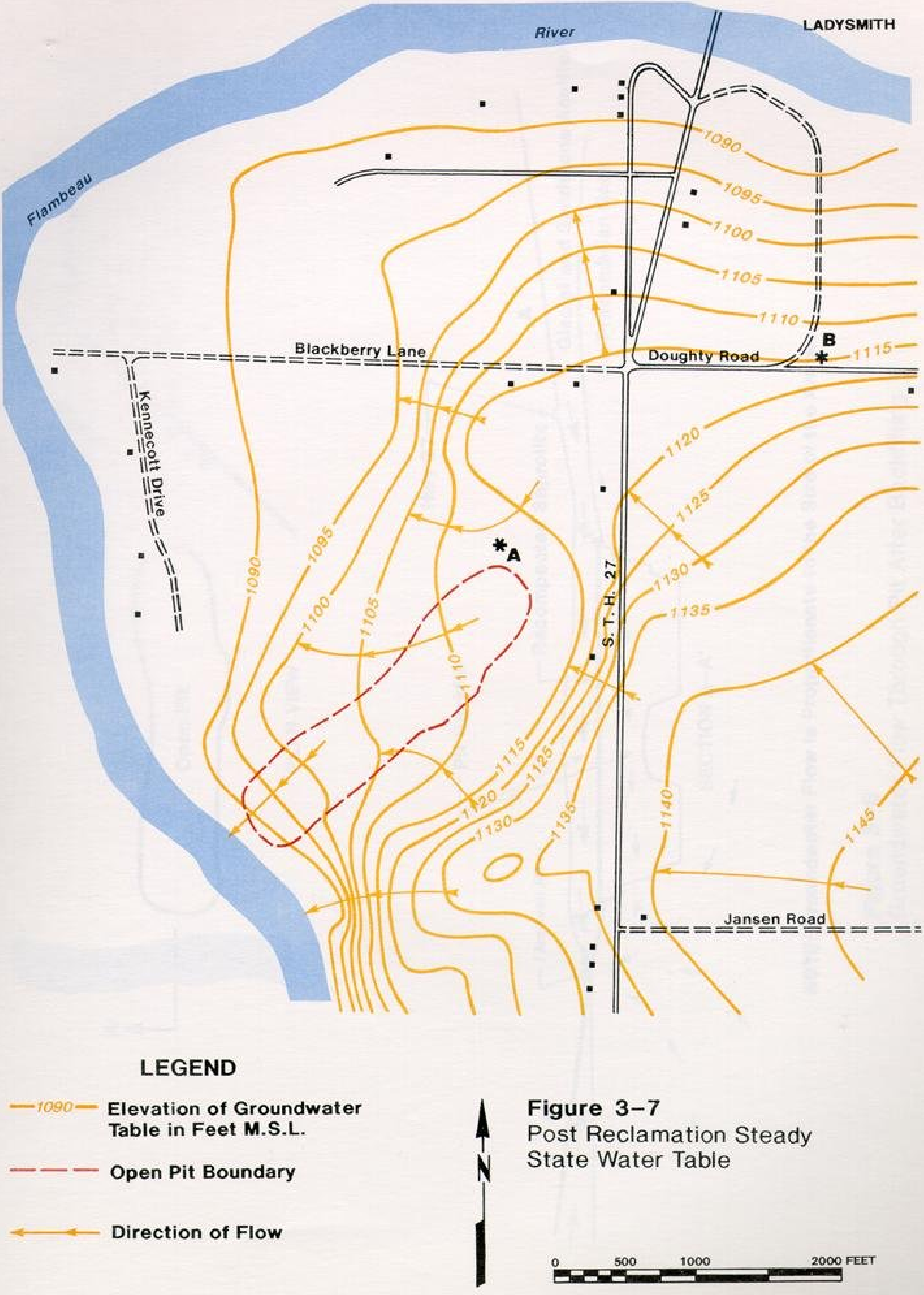
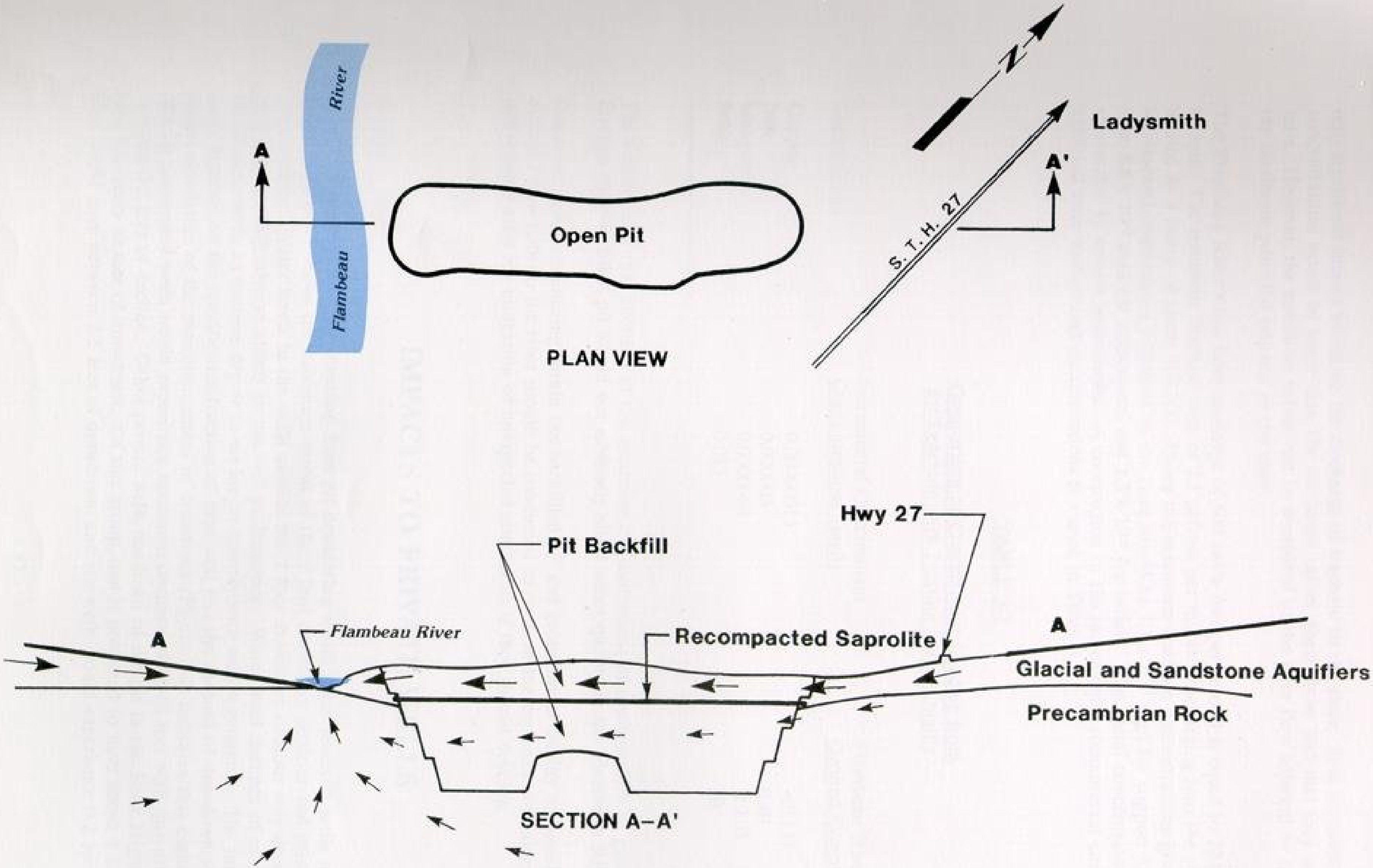


Figure 3–7
Post Reclamation Steady State Water Table



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

Figure 3–8
Groundwater Flow Through Pit After Backfilling

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 river to evaluate the maximum potential impacts to the river.

The Flambeau River's low flow discharge of 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 1.3×10^{-7} mg/l for copper, 3.0×10^{-6} mg/l for iron, 6.8×10^{-6} mg/l for manganese, and 1.3×10^{-2} for sulfate. The 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.

Leachate quality monitoring within the backfilled pit and groundwater quality monitoring along the expected flow path to the river should be conducted to confirm the expected conditions and provide early opportunity for mitigation of unexpected conditions if they should develop.

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 State Highway 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 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. 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. Both discharges would require a WPDES (Wisconsin Pollutant Discharge Elimination System) permit from the DNR.

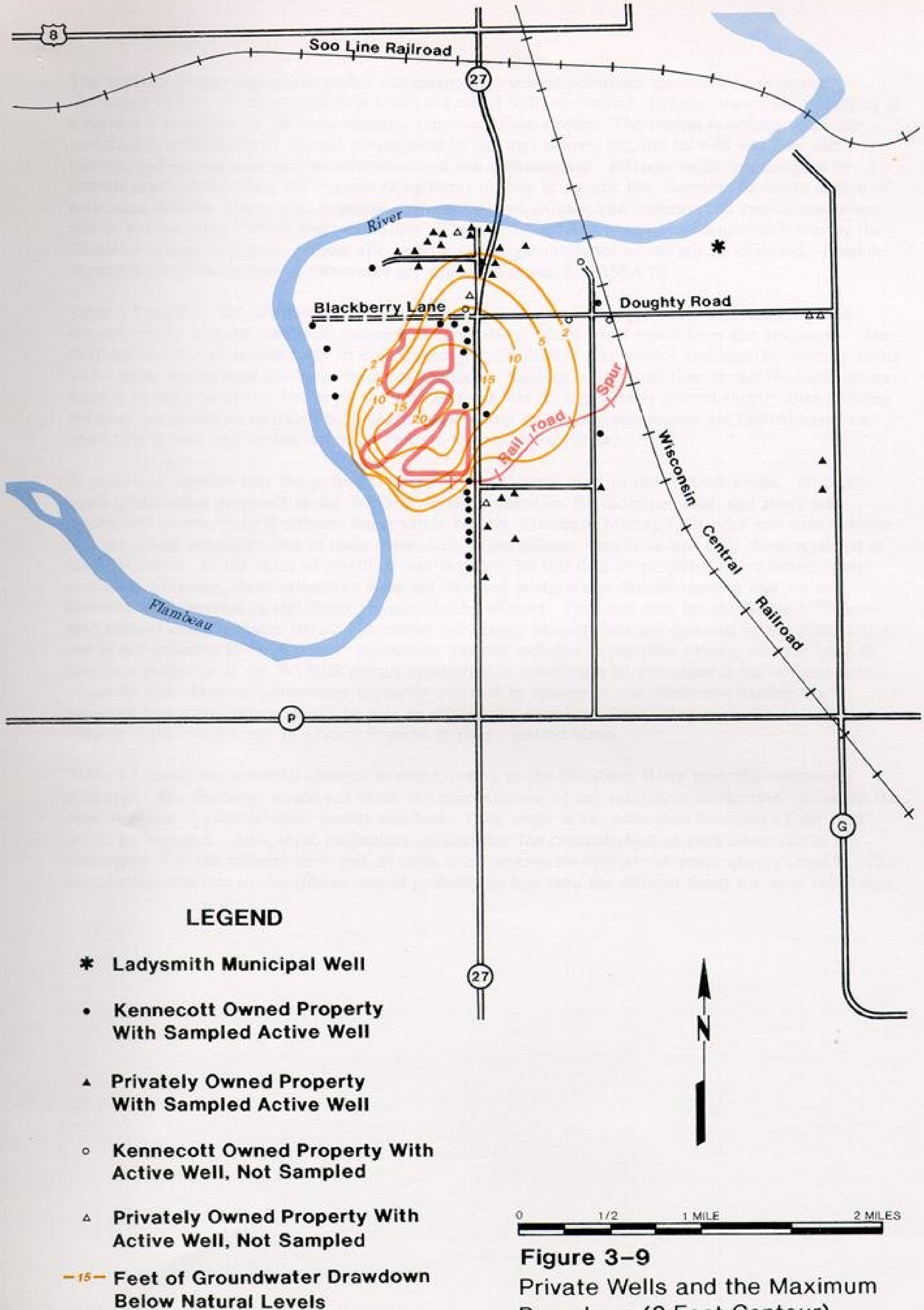


Figure 3–9
Private Wells and the Maximum Drawdown (2 Foot Contour)

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 functions 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 prevent acute (short-term) and chronic (long-term) toxicity to aquatic life, excessive bioaccumulation of substances, adverse effects (i.e., impaired reproduction) to animals and humans, and reduce the cancer risk to humans from surface water exposures. 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 and the maximum instream concentrations which could result from the discharges. The daily maximum limit would apply to each discharge individually. The weekly and monthly average limits would apply to the total discharge from both outfalls. 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, about half of the parameters are limited based on acute toxicity and half limited based on chronic toxicity and other factors.

In general, it appears that the proposed discharge would meet most of the effluent limits. While the levels of detection proposed in the WPDES permit application for cadmium, lead, and silver are insufficient to determine if effluent limits would be met, Flambeau Mining Co.'s pilot test data indicate that the actual concentrations of these substances in the effluent should be less than those reported in the application. In the cases of beryllium and thallium, no test data or projected concentrations are available. However, these substances were not detected in the waste characterization and are not expected to be present in significant amounts in the effluent. Pilot test data for chromium $^{(+6)}$ show that effluent concentrations should not exceed the limits. Mercury was not detected in the pilot testing and is not expected in the effluent. Aluminum was not included in the pilot testing, and the level of detection projected in the WPDES permit application is insufficient to determine if the effluent limit would be met. However, aluminum is readily removed by treatment, and Flambeau Mining Co.'s proposed treatment system should be able to achieve the aluminum limit. Any exceedances of the effluent limits could result in adverse impacts to river - related biota.

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. 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 probably be less than the effluent limits for most substances.

TABLE 3-2

Effluent Limits and Projected Effluent Quality For the Flambeau Mining Discharge[1]

Parameter	Preliminary[2] Effluent Limits: Monthly Average	Weekly Average	Daily Maximum	Projected Effluent Quality[3]	Pilot Plant Test Results
Arsenic			728	5	< 3
Beryllium	103			no data	no data
Cadmium	50*	7.1	94.9	< 5	< 0.3
Chromium (total)		981	5360	< 50	< 2
Chromium (+6)			28.4	no data	< 2
Copper	150*		50.1	< 20	< 10
Lead	300*	136	591	< 100	< 2
Mercury	0.34		2.0*	< 0.5	< 0.5
Nickel		1170	3120	< 40	< 30
Selenium			116	20	3
Silver			6.6	< 10	< 0.4
Thallium			1410	no data	no data
Zinc	750*		299	< 30	< 30
Aluminum		822	1500	< 5000	no data
TSS	20,000		30,000	20,000	
pH		- (6-9 range) -			

1 All values in μg/l (parts per billion)

2 Monthly average limits are based on human cancer, human threshold, and wild and domestic animal criteria, or 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:
- $Q_{7,10}$ (for weekly average) = 435 cfs
- $Q_{7,2}$ (for weekly average) = 710 cfs
- Mean annual (for monthly average) = 1855 cfs
- Effluent flow = 542 gpm = 1.21 cfs

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

3 From WPDES application (Kennecott, 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	1.4	50.0
Beryllium	<1.0	0.2	0.2
Cadmium	<1.0	0.01	0.23
Chromium (total)	<5.0	1.9	31.6
Chromium (+6)	<50.0	0.06	9.7
Copper	3.7	3.8	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	0.23	7.07
Silver	<0.4	0.01	0.93
Thallium	<5.0	2.76	11.0
Zinc	5.1	5.69	28.5
Aluminum	62.5	64.11	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 1.21 cfs. Assumes each substance in the discharge is at the effluent limit (e.g. maximum concentration).

Table 3-2 shows that substantial differences exist between the results of the pilot tests and the effluent quality projected by Flambeau Mining Co. in its WPDES permit application. The reasons for these differences are not clear. The discussion above assumes that Flambeau Mining Co. conservatively estimated high concentrations for the WPDES permit application, and that the proposed treatment system will result in an effluent cleaner than that indicated in the application. If this assumption is not valid, the wastewater treatment proposal may need to be refined or redesigned to meet the effluent limits.

Heavy Metals

Maximum concentrations of heavy metals in the Flambeau River from the discharge are shown in Table 3-3. 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; 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 toxicity is present in the discharge.

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 metal concentrations 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 excessive levels of metals in aquatic organisms. 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 synergestic 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. has not conducted bioassay testing on synthesized wastewater. Bioassays will be required after the discharge begins. Based on past experience with similar discharges, it is possible that Flambeau Mining Co.'s discharge will fail the bioassay 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 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 No. 1. Since the mine would occupy part of the Stream A watershed and would disrupt the groundwater flow into Wetland No. 1, flows in Stream A would be reduced. Flambeau Mining Co., however, plans to maintain the water level in Wetland No. 1 with wastewater. To the extent that Wetland No. 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 No. 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 the site reclamation. Specific plans for the Stream B re-creation have not been provided, and the long-term impact of the project on Stream B flows is unknown.

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 3-4 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 or vegetation of wetlands) this analysis may slightly overstate the actual acreage involved in direct wetland impacts.

During pit construction a portion of Wetland No. 2 (2½ acres) would be excavated, including intermittent Stream B which drains part of the area over the pit. The remaining portion of Wetland No. 2 would be dewatered from the groundwater drawdown. 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 No. 2 also serves a moderately important hydrologic function by retaining groundwater discharge and surface runoff from a 65 acre watershed.

TABLE 3-4

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 No. 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

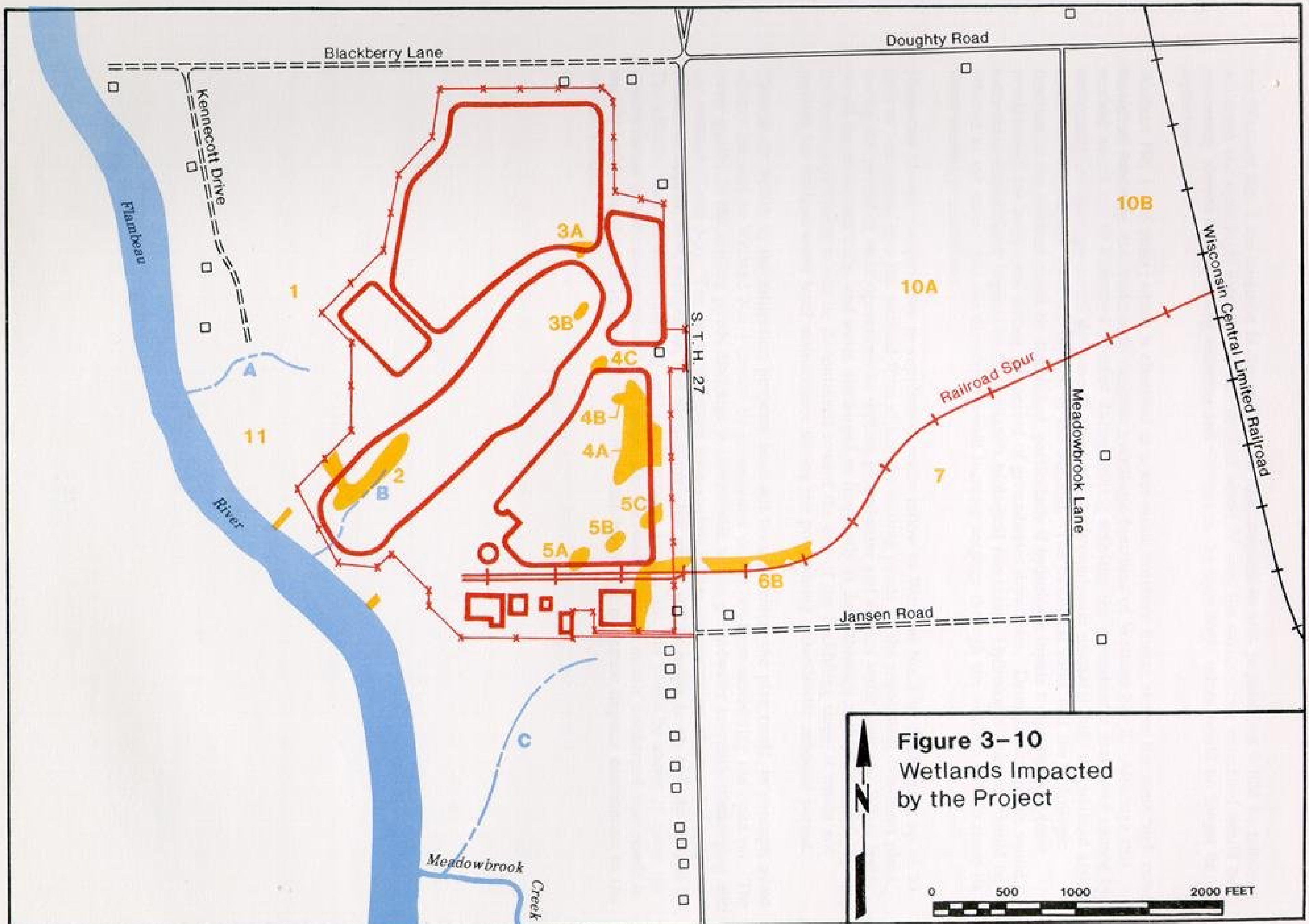


Figure 3–10
Wetlands Impacted by the Project

use Wetland No. 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 No. 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 No. 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 No. 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.

Though the details of the mitigation proposal have not been provided, the plan could, in concept, avoid adverse impacts to Wetland No. 1 caused by groundwater drawdown from dewatering the open pit. The water quality of the settling ponds discharge is comparable to the groundwater currently discharging into the wetland (Table 3-5). 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 effluent limit for aluminum (822 $\mu g/l$) would protect aquatic life, but would be about 21 times the concentration in the existing groundwater seep. 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 3-5

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	< 0.5	2
Selenium	< 5	20	10
Silver	< 5	< 10	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	< 5,000[4]	

1 Values in μg/l.
2 From a single sample by Flambeau Mining Co. on 11/5/87.
3 From WPDES Permit Application, Discharge 002 (Kennecott, 1989).
4 The preliminary effluent limit for aluminum is 822 μg/l.

Wetlands No. 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 No. 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 of less value than the eastern portion. About 4.1 acres of the western part of Wetland No. 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 No. 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 No. 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 No. 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 No. 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 No. 6c may experience 3-4 feet of water table decline. Since there are no groundwater monitor wells in the area of Wetland No. 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 No. 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.

Wetlands Nos. 7, 8 and 9 are well outside of the area of mining induced groundwater drawdowns and so will not be effected.

Maximum groundwater drawdown under Wetland No. 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 produced.

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 five-acre wetland at the west end of the pit during the site reclamation. Creation of this wetland, a function of reestablishing the necessary wetland hydrology and vegetation, could restore most or all of the long-term wetland losses from the project. If reestablishing the wetland is unsuccessful, the area would provide only minor wetland functions, and the wetland losses described for the construction and operation would be sustained, long-term impacts. The details of the wetland reestablishment proposal are insufficient to assess the probability of success.

A key element to restoring wetlands at the project site and avoiding long-term impacts, especially to Wetland No. 1, would be the restoration of adequate water inflow and outflow to each wetland. Flambeau Mining Co.'s reclamation plan relies on the groundwater seep, which currently supplies Wetland No. 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 Wetland No. 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 No. 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. Wetlands No. 1 and 2 would not receive groundwater discharge for several to many years after the site reclamation was completed. It's possible that the groundwater seep may never reappear and that Wetland No. 1 and the Wetland No. 2 remnant would be permanently lost.

Flambeau Mining Co.'s reclamation plan is unclear as to whether the other wetlands (No. 3, 4, 5, and 6) impacted during the project would be restored. Restoration of these wetlands could help to ensure that the project would not result in a net long-term loss in wetland acreage and functions.

IMPACTS TO TERRESTRIAL RESOURCES

About 135 acres of the plant and animal communities within the 173 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 3-6 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.

TABLE 3-6

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
Area within fenced boundaries	65.0	45.2	51.1	1.5	.9		2.0	0.4	4.2	170.7
Railroad spur east of fence	.9	1.5	.1			.1	.4		.2	3.2

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

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 progress. Some of the plant species proposed for reclamation are not native to the area and may limit the success of restoration to natural vegetation and wildlife communities. Similarly, 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**.

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 reliably predict the synergistic toxicity of Flambeau Mining Co.'s effluents. Based on past experience, however, it's possible that the effluent will be toxic.

If the effluent is toxic, Flambeau Mining Co. would be required to undergo a process to identify and eliminate the reasons for the toxicity. Flambeau Mining Co. would probably be allowed to continue discharging wastewater during this process. Thus 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 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 No. 4, which would be filled by the project. However, this species is not expected to inhabit this type of ecological environment and was probably a misidentified specimen.

The two active bald eagle nest located 1-1.5 miles southwest of the site would probably not 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.

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 an overburden; or crushing; or 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 3-7). 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 3-7

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 Highway 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. No significant levels of toxic materials would be included with the dust.

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 3-8 presents guidelines developed by the International Organization for Standards to assess community responses to noise increases.

TABLE 3-8

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 3-9 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 phase of the project, the major sources of noise would be from equipment at the stockpiles and the open pit. Flambeau Mining Co. predicts the following 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, noise at Highway 27 east of the high sulfur waste rock stockpile would be about 72 dB or an increase of 11-16 dB in the winter and 5-11 dB in the summer. East of the low sulfur waste rock pile, noise levels at Highway 27 would be about 68 dB or an increase of 6-12 dB over existing summer levels and 11-16 dB over winter levels. 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. Most of these noise level increases would be considered moderate although winter-time noise increases would occasionally be categorized as significant. 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. This noise level is considered normally unacceptable for single family residents without air conditioning (Table 3-9). Figure 3-11 shows the approximate boundary of the 65 dB noise level resulting from equipment operations on the stockpiles and the pit.

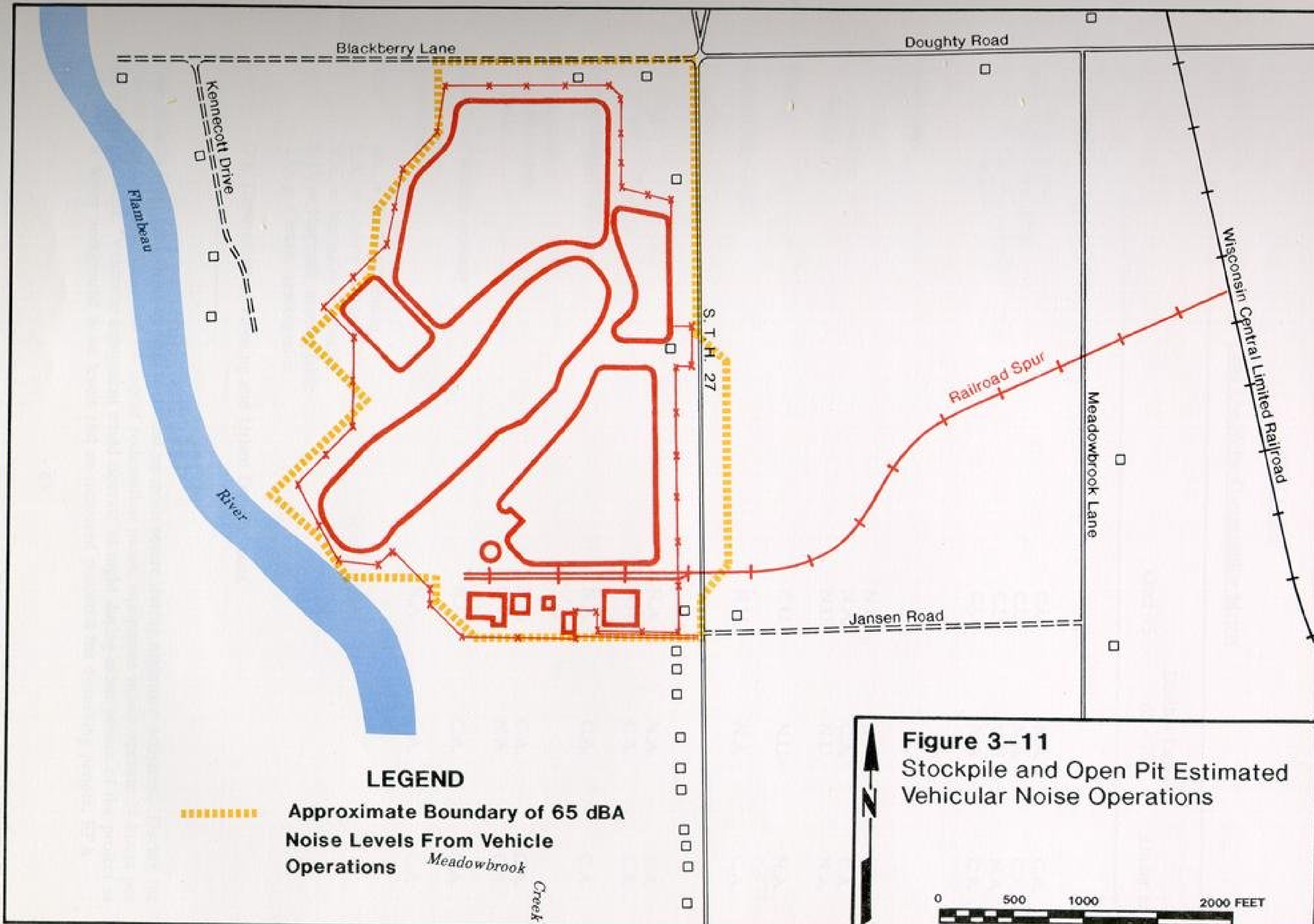


Figure 3–11
Stockpile and Open Pit Estimated Vehicular Noise Operations

TABLE 3-9

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.

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. Thus, a point 200 feet from the low sulfur waste rock stockpile, which would receive 72 dB over a 24-hour period, would actually be exposed to a day/night weighted equivalent noise level of about 78 dB.

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.

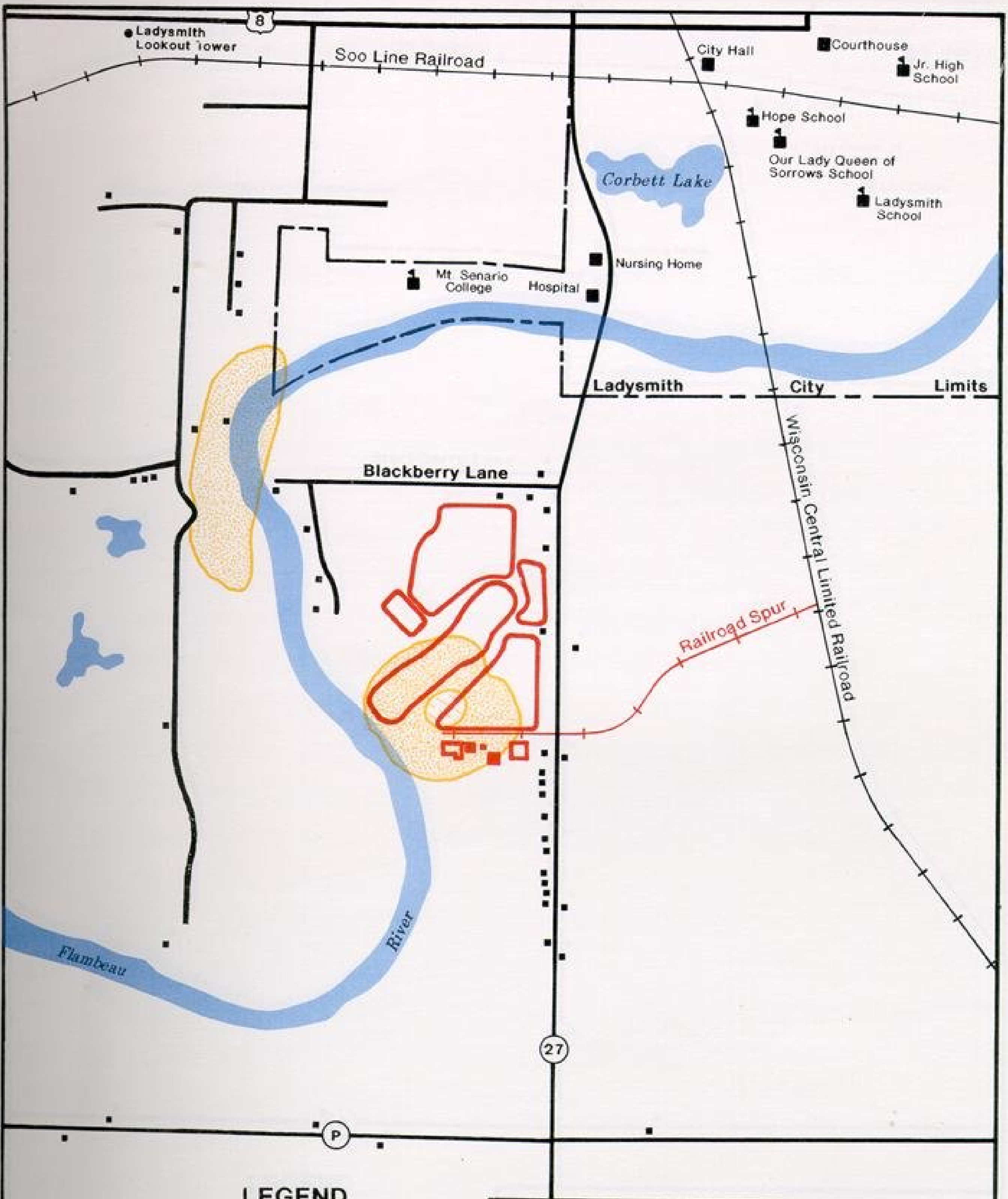
BLASTING

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 affect of delays disappears at 1,500 feet, the estimated noise levels are as follows:



LEGEND

Noise Increase Greater Than 15 dBA

Noise Increase Greater Than 6 dBA

N

0 1/4 1/2 1 MILE

Figure 3–12
Estimated Crusher Noise Levels, Summer Conditions

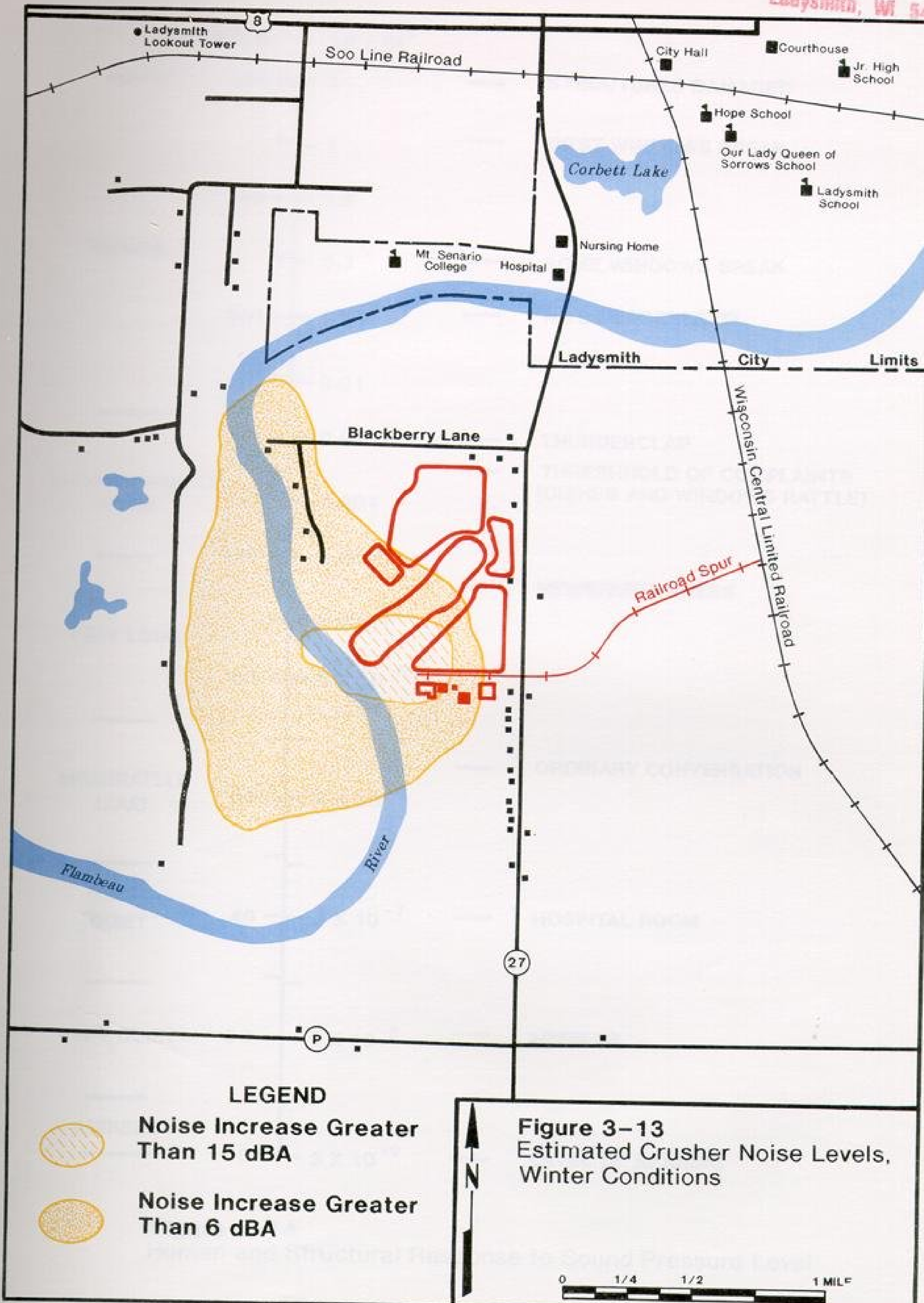


Figure 3–13
Estimated Crusher Noise Levels,
Winter Conditions

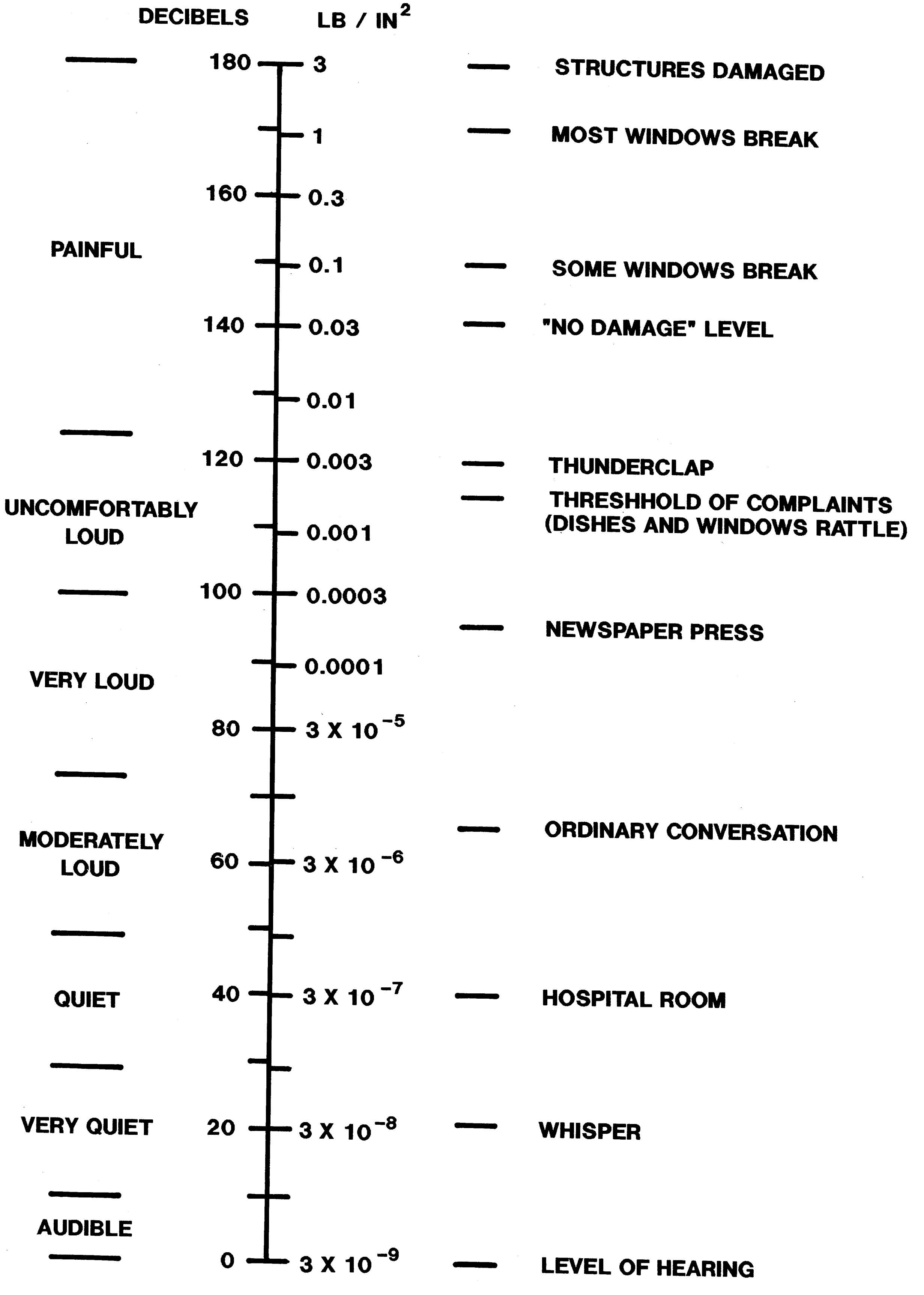


Figure 3–14
Human and Structural Response to Sound Pressure Level

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. Current peak noise levels at these sites are about 118 dB. Therefore, the blasting noise will represent a regular but instantaneous noise of slightly less intensity than the currently existing peak noise sources.

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 Highway 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 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, 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.

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 Highway 27 east of the pit. Vibration levels at homes approximately 1,000 feet from the pit such as those at Highway 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 3-10 summarizes U.S. Bureau of Mines data on human responses and possible damage from various levels of vibration.

TABLE 3-10

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. 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.

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 Highway 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 Highway 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 Highway 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 Highway 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 Highway 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 Highway 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. 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.

Flambeau Mining Co.'s reclamation plan, which is described in Chapter 1, is intended to provide details on how the site will be restored to premining conditions. Aspects of the plan, however, are not sufficiently detailed to determine the probability that this will actually occur.

LAND USE AND REVEGETATION

Flambeau Mining Co.'s reclamation plan does not propose a specific land use for much of the site. The plan specifies that about 50 acres of land currently being cropped would be reclaimed to cropland, but doesn't describe the standards or techniques which would ensure that the soil productivity is restored to pre-project levels. With proper soil management and fertilization, premining cropland productivity could be restored. If the appropriate reclamation techniques are not applied, the resulting cropland could be substantially less productive.

A 5-acre wetland would be created over the west end of the pit by allowing the backfill to settle about 3 feet below the adjoining terrain. As discussed under **WETLANDS**, the plan for creating this wetland does not provide enough detail to assess the probability of success. If the reclamation effort can maintain a relatively consistent level of water in the wetland, many of the natural wetland functions could be restored. If water levels fluctuate dramatically, the wetland would perform fewer traditional functions. In either case, the proposed reestablishment of trees in the wetland would require specialized techniques and management to insure their survival.

No specific land use is proposed for the remainder of the mine site. As a result, the ability of the proposed revegetation to support a designated land use cannot be assessed. About 43 acres of land would be planted to hardwood forests and about 42 acres would be seeded with grass. The apparent intended land use for this property is abandoned land.

The plant species proposed for permanent revegetation include several species which are not native to Wisconsin. Although, the state law allows the use of non-native species for the purpose of temporary erosion control, it specifies that mine site revegetation must have the objective of reestablishing indigenous plant species. Use of non-native plant species would, over the short term, create an unnatural plant community and would inhibit the reestablishment of indigenous vegetation. Over the long term, it is uncertain whether competition from native species would prevail over exotic plant species. Non-native species could become dominate on the site and escape and propagate off-site.

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 3 feet above the original elevation and allowed to settle. As previously described, the western 500 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 some fashion. The details of recreating this drainage have not been provided. Surface water runoff from the stream B watershed would probably drain into the created wetland on the west end of the pit. No outlet from this area would exist, since the natural stream B outlet would be filled with the flood control dike. Excess water would probably flow overland, eventually eroding a new outlet from the area.

The abandoned gravel pit north of the mine would be either the source of additional fill or the disposal site for excess fill during the final backfilling of the pit. Reclamation grading and contouring of the abandoned gravel pit would improve the site stability and suitability for other land uses.

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. Materials would be disposed in both the high and low sulfur waste rock layers and in the overburden. Waste disposed of in the overburden could include building demolition wastes, rip rap, the septic tank, and asphalt. Placing these materials in the overburden over the pit would contribute to uneven settling of the land surface over the pit and may interfere with monitoring of the groundwater impacts from the backfilled pit. Disposing of these wastes in portions of the overburden which would eventually become saturated would also encourage leaching of any contaminants in the waste into the groundwater. However, these types of wastes normally do not have high levels of contaminants and excessive groundwater contamination from wastes in the overburden is not expected.

Other wastes disposed of in the waste rock layers would include liners, drainage blanket materials, pipes, filter material from the wastewater treatment plant, and sludge. these materials could add contaminants to the backfilled pit and could complicate monitoring of the groundwater impacts from the pit. Due to the minimal groundwater flows through the pit, impacts to groundwater quality from these wastes should be minor.

MONITORING IMPACTS

In general, the proposed monitoring plan would not assure that any significant releases of pollutants to the environment would be detected. No monitoring of surface water, air quality, or terrestrial or aquatic ecology is proposed. Without monitoring, releases of pollutants to these environmental components may not be detected.

The monitoring plan for groundwater quality includes 4 locations during the mine operation and 3 locations during the long-term care period. No monitoring under the waste rock stockpiles or within the backfilled pit is proposed. Also, no monitoring of seepage is proposed under the settling ponds. This density of sampling points may not detect unexpected problems with facilities' performance or migration of contaminants into the groundwater.

The density and distribution of wells for monitoring the groundwater drawdown may not be sufficient to completely determine the extent of the mine dewatering impact on the groundwater. The maximum, extent of the cone of depression (Figure 3-4) extends well beyond the northeastern most monitoring well. Substantial areas within the expected drawdown cone would not be monitored. Although the proposed monitoring scheme would probably be adequate to provide general information on the drawdown, a detailed understanding of the development and eventual extent of the cone of depression would not be possible without additional monitoring points.

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 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.

The analyses do not focus on ethnic impacts, tourism or recreational 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 3-11 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 inmigrant 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 3-11

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 State Highway 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 Highway 27 is 790 vph for Level of Service B. The American Association of State Highway and Transportation Officials and Wisconsin Department of Transportation both have minimum design standards of Level of Service B for rural highways. 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 State Highway 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 State Highway 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 Hwy. 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 State Highway 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 phase 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 State Highway 27 and Meadowbrook Road for a few days when the surface crossing would be constructed. The State Highway 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 State Highway 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.

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 Hwy. 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, the abandoned gravel pit on-site or the active pit north of Blackberry Lane. If this is correct, the amount of truck traffic could be reduced by more than 50%. If this is not correct there could be road damage resulting from repeated trips by loaded gravel trucks. Much more extensive damage might result from truck traffic in the spring, although highway weight limits during spring thaw are designed to minimize road damage then.

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 road damage, if any.

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.

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 employees 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. Inmigration 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 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 profits.

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 underlying 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% copper, 0.05 troy ounces of gold per ton and 0.50 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 Flambeau Mining Co.'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 ounce and $6.00 per 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 mining duration.

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. Flambeau Mining Co.'s materials 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 for both transportation cost scenarios are shown on Tables 3-12 and 3-13. Adjusting for unrecoverable metal, the total potential revenue for the life of the mine ranges from $240.9 million in the low-price scenario to $562.3 million in the high-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 $247.1 million in the low-price scenario to $324.8 million in the high-price scenario. Under the low transportation cost case, total expenditures range from $184.3 million in the low-price scenario to $262.0 million in the high-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 a negative $3.7 million in the low-price scenario (implying Flambeau Mining Co. will receive a refund or have credits of equal amount for use on other projects) to a positive $54.1 million in the high-price scenario. State income taxes range from zero in the low-price scenario (implying Flambeau Mining Co. is unable to use profits elsewhere to offset its loss in Wisconsin) to $18.3 million in the high-price scenario (a construction period payment not offset by future credits) to $13.1 million in the high-price scenario.

Under the low transportation cost case, federal income taxes range from $10.3 million in the low-price scenario to $68.7 million in the high-price scenario. State income taxes range from $5.0 million in the low-price scenario to $22.8 million in the high-price scenario. The net proceeds tax ranges from $1.5 million in the low-price scenario to $18.9 million in the high-price scenario.

Tables 3-14 and 3-15 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 $1.5-18.9 million over the life of the project depending on metals prices. Considering the middle metals price scenario, which is about equivalent to current metals prices, approximately $8.3 million would be collected in net proceeds tax. 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 3-16 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. This amount is 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 only in the first two years of mining. In the final four years of mining, Rusk County would 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, all money deposited in the investment and local impact fund would be disbursed to the municipalities. Therefore, the fund would not have money available for discretionary use. Under higher metals prices, however, or lower costs for mining, there would likely be discretionary money available in the fund. In addition, there would be approximately $3.2 million deposited in the Badger Fund during the mining project.

TABLE 3-12

Results of the Mining Tax Model for the High 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%	10%	10%	10%	10%
Gold (troy oz/ton)	0.05	0.05	0.05	0.05	0.05
Silver (troy oz/ton)	0.50	0.50	0.50	0.50	0.50
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	$591.1	$506.6	$422.2	$337.7	$253.2
Gold	52.9	45.3	37.8	40.2	22.7
Silver	7.7	6.6	5.5	4.4	3.3
Unrecoverable metal	(89.4)	(76.6)	(63.9)	(51.1)	(38.3)
Total Potential Revenue	$562.3	$481.9	$401.6	$321.2	$240.9
Estimated expenditures ($ 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	136.0	116.6	97.2	77.7	58.3
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	$324.8	$305.4	$286.0	$266.5	$247.1
Net cash flow ($ millions):					
Before taxes	$237.5	$176.5	$115.6	$ 54.7	$ (6.2)
Federal income tax	54.1	39.7	24.9	9.8	(3.7)
State income tax	18.3	13.9	9.4	4.8	0
Net proceeds tax(*)	13.1	8.2	4.3	1.5	0.3
After taxes	$152.0	$114.8	$ 77.1	$ 38.7	$ (2.8)

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

TABLE 3-13

Results of the Mining Tax Model for the Low 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%	10%	10%	10%	10%
Gold (troy oz/ton)	0.05	0.05	0.05	0.05	0.05
Silver (troy oz/ton)	0.50	0.50	0.50	0.50	0.50
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	$591.1	$506.6	$422.2	$337.7	$253.2
Gold	52.9	45.3	37.8	40.2	22.7
Silver	7.7	6.6	5.5	4.4	3.3
Unrecoverable metal	(89.4)	(76.6)	(63.9)	(51.1)	(38.3)
Total Potential Revenue	$562.3	$481.9	$401.6	$321.2	$240.9
Estimated expenditures ($ 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	136.0	116.6	97.2	77.7	58.3
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	$262.0	$242.6	$223.2	$203.7	$184.3
Net cash flow ($ millions):					
Before taxes	$300.3	$239.3	$178.4	$117.5	$ 56.6
Federal income tax	68.7	54.6	40.2	25.4	10.3
State income tax	22.8	18.5	14.0	9.6	5.0
Net proceeds tax(*)	18.9	13.2	8.3	4.4	1.5
After taxes	$189.9	$153.0	$116.0	$ 78.2	$ 39.9

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

TABLE 3-14

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	2.422	1.481	0.705	0.115	0
1993	2.325	1.436	0.744	0.263	0
1994	2.248	1.395	0.728	0.247	0
1995	2.095	1.299	0.674	0.221	0
1996	1.879	1.157	0.589	0.192	0
1997	1.780	1.024	0.554	0.185	0
Total	$13.050	$ 8.153	$ 4.295	$ 1.523	$ 0.300

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

TABLE 3-15

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	3.336	2.330	1.396	0.640	0.063
1993	3.253	2.281	1.402	0.721	0.240
1994	3.207	2.248	1.396	0.728	0.247
1995	3.082	2.144	1.336	0.700	0.232
1996	2.895	1.979	1.232	0.642	0.214
1997	2.824	1.908	1.201	0.634	0.219
Total	$18.897	$13.190	$ 8.264	$ 4.365	$ 1.515

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

TABLE 3-16

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

Year	Amount Needed for First Dollar Payments	Maximum Amount to County	Total	Transfer to MILIF[2]
1992	.445	.371	.816	.838
1993	.467	.389	.856	.842
1994	.490	.409	.899	.838
1995	.515	.429	.944	.802
1996	.541	.450	.991	.739
1997	.568	.473	1.041	.721

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 are low transportation costs.

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 most or 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 $1.12/pound in July, 1989):

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 3-17

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 3-18 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 3-18

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 $14 million including fringe benefits. Fringe benefits typically comprise about 30% of wage costs. Therefore, if the estimated $10.8 million wages received by Flambeau Mining Co. employees and contractors were taxed at 4%, the total income tax received by the state would be approximately $432,000 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 $10.8 million wages received by Flambeau Mining Co. employees and contractors, $1.26 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 $57,000 to the State of Wisconsin. The 0.5% sales tax collected by Rusk County, using the same assumptions, would amount to about $6,000.

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 sales tax revenues generated from purchases would be $240,000 during the project. Total sales tax revenues from all sources, therefore, would be approximately $293,000.

Corporate Income Tax

The State of Wisconsin would receive income tax revenue estimated at $9.4-14.0 million based on income from project mining under the middle metals price scenarios. This estimate was made by the Department or 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 million. Of this total, about $10 million would be wages and salary (excluding fringe benefits), and about $6.5 million would be disposable income. Not all of the disposable income would be spent locally within Rusk County. If 65% were spent locally, about $4.2 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. 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 Highway 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.

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 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.. During these periods, it is possible, although unlikely, that some sectors and governmental entities could be impacted with greater costs than revenues. It is more likely there would be greater revenues than costs.

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 income tax and sales tax, which indirectly benefit the local area, 5) costs to municipalities and school districts to provide necessary services, and 6) Mining Impact Board or Flambeau Mining Co. payments to municipalities and net proceeds taxes paid to the state.

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

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

Approximately 38,000 pounds of sulfuric acid will be used annually. It will 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 will be used annually. It will be delivered to the plant in bulk by truck, and stored in a 46-ton silo next to the treatment plant. The silo will be covered and sealed, and will 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 will be designed to prevent leaks and spills. As required by state and federal law, contingency plans will be provided for the use of each chemical. These plans will be developed prior to operation and will 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. Professional judgment suggests that low truck speeds, and low traffic densities within the project boundary would further reduce the probability of truck accidents.

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

In conclusion, spills probably would be minor, discrete, short-term, reversible events, 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 will arise. The probability of a major on-site spill is low and appropriate 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. 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 will be shut down periodically for equipment maintenance, or for unplanned events which could interrupt operations. Preventive maintenance for the wastewater treatment plant will 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 when operations are restored.

There is little probability of failure of the surface water discharge pipeline. It will not be exposed to corrosive materials or extremes in internal or external pressures which could result in pipe failure. The water discharge pipeline will 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 waste water 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 will 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 is constructed to specification, the potential for significant leaks developing will 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 will not be allowed to accumulate in the stockpile surge pond, or runoff pond for extended periods (i.e., water will 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 potential air emission sources will have pollution controls where appropriate and necessary. A complete discussion of air pollutant emissions is presented in the Air Quality section.

Transfer and storage of fuels will occur primarily at the 15,000-gallon bulk fuel storage tank located at the southern boundary of the plant. A vapor balance system will be used during storage tank loading to minimize hydrocarbon emissions. A dust collection baghouse will 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 will 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 will sound and personnel will evacuate the treatment plant building immediately and will not return until H_2S generation ceases. The cause of the problem will then be corrected. 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 will be used during all phases of the project. During the construction and reclamation phases, diesel fuel will be required for earth moving equipment and will be dispensed from the tanker truck used for delivery. Other vehicles and equipment will 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 will be dispensed from tanker trucks within a temporary berm. Soil absorption will 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 because the contaminated soil will be removed following a spill.

During mine operation, diesel fuel and gasoline will be stored in an above ground 15,000-gallon diesel fuel storage tank and a 1,000-gallon gasoline storage tanks, respectively. Diesel fuel will be dispensed from the storage tank to a tanker truck which will fuel equipment in the field during the beginning and end of shifts and during break times. Small spills will 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. They will be developed before the start of construction and will 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 some minor 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 will be designed to comply with applicable codes, standards, and regulations. To 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 will help reduce the risk. Design features, which are required for the surface storage of explosives by federal and state regulations, will 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) will be followed throughout the duration of the project.

Blasting

The initial surface excavation will be ripped rather than blasted. Blasting will first occur on the first full bench, located below 40-60 feet original surface topography. The steep dip of the ore and the proposed mining technique will 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 will also be taken on the Flambeau River when blasting in the extreme west end of the pit.

Ground vibration, air impact and noise impact will 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 very low.

CONTINGENCY MEASURES FOR GROUNDWATER POLLUTION

A spill prevention, control, and countermeasures plan, as required by federal law, will be available before site operations begin, if permits are issued. 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. 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 contamination 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. 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.

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 will be used on the mine site, fires which do occur on-site should be brief and localized. Fire protection for all temporary construction buildings will 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 will supply hose stations at the water treatment building and maintenance shop. Hand-operated fire extinguishers will be provided by the various contractors. In addition, the Ladysmith Volunteer Fire Department and the Department of Natural Resources will 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. Because of the fire prevention standards and detection systems that will be employed at the project, the actual probability and duration should be less than those presented here. 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) will be minimal because the large cleared area and roads around the mine site will serve as fire breaks. During the construction phase, controlled burning may be used to eliminate waste wood from clearing and grubbing activities. Measures specified on the WDNR burning permit would be followed to prevent forest fires.

The potential for fires starting along the power line and rail corridor will be low. Undesirable vegetation in these corridors will be controlled through cutting or the use of EPA-approved herbicides. During project operation the railroad spur will receive limited use (approximately three or four round trips per week). These conditions will 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 a 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 will be maintained for safety considerations. These 27-foot wide benches will be left at 60-foot vertical intervals on the pit walls below the bedrock contact. The benches will 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.

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

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.

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 will 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 will be fenced and all gates will 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 will 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 will 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 Mining Co. Flambeau site is in a region of very low seismic risk. The appropriate 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 is assumed to 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 will settle out and free iron will 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 toxicity effects are highly unlikely in this situation.

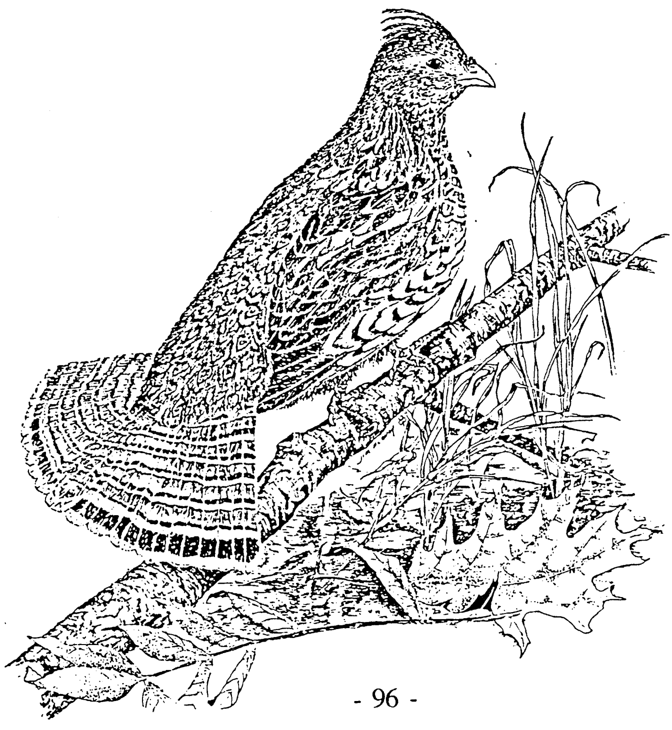
If a major storm threatens to overtop the surge pond and runoff pond, the water would overflow into the mine via an emergency overflow pipe, so the risk of overtopping of the ponds would be low.

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.



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. does not have any employees in Wisconsin but would probably maintain its present 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 will 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, 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 were 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 pre-production 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 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 the preferred alternative. 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 east 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.

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 Highway 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

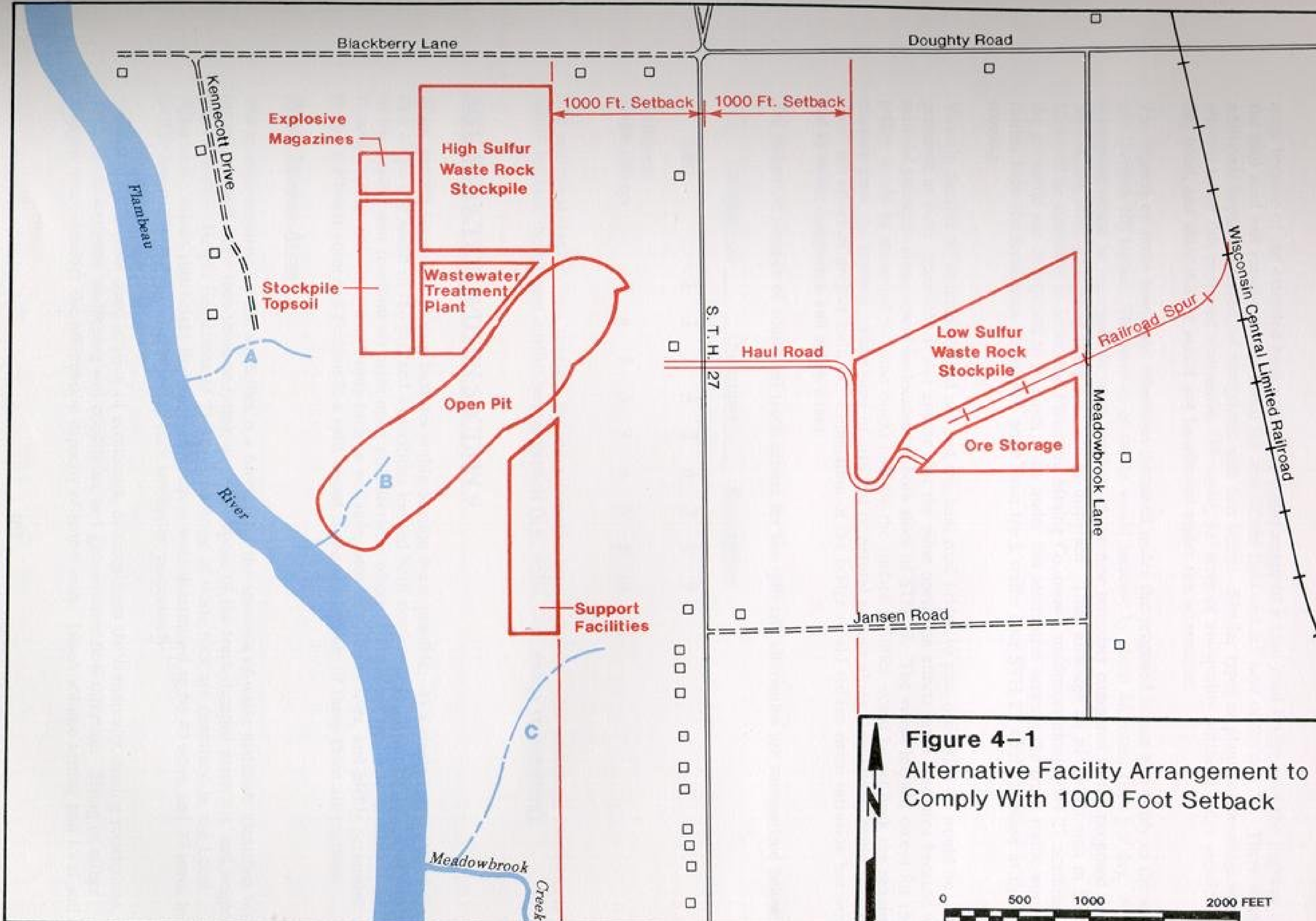


Figure 4–1
Alternative Facility Arrangement to Comply With 1000 Foot Setback

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 drivers 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 drivers 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 is 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 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 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 haulage 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 No. 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 haulage 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. Since truck traffic would be frequent, a bridge would be required over the highway. This presents 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.

In-pit storage would eliminate the need for a variance to the 1,000 foot setback requirement. Variances, however, would be required for the stockpiles and the east end of the open pit.

During construction the aesthetic impacts of the in-pit storage of waste rock will differ slightly from the proposed design. The high-sulfur waste rock stockpile will be located in the pit and will 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. The in pit stockpile would be partially within the 1,000-foot setback from STH 27. 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 haulage and surface crushing is 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 haulage 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 would 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 would permanently restrict the land use of a small parcel of land.

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.

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.

GROUNDWATER MONITORING

Groundwater monitoring could be enhanced by adding at least 1-2 well nests for monitoring groundwater quality during both the operation and long-term care periods. Additional well nests would help ensure that any groundwater contamination from the project would be detected and that actions to evaluate and correct the source of contamination could be implemented.

Additional monitoring wells would also be useful in defining the groundwater drawdown. Additional wells would provide the data necessary to determine if the cone-of-depression was developing as expected and to predict and document the ultimate extent of the drawdown. Additional data would also help to more accurately predict impacts to private wells.

Monitoring at project facilities would 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 low sulfur wasterock stockpile to determine if seepage through the stockpile was producing more contaminants than expected. Similarly, lysimeters could be used under the high sulfur wasterock 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.

Monitoring wells could also be installed directly into the backfilled pit. Monitoring within the backfill would provide data on the chemical reactions within the pit and on the flow of groundwater over and through the backfill. This information may be necessary to determine if any unexpected releases of contaminants from the pit are occurring.

SURFACE WATER MONITORING

Alternatives for monitoring surface waters include monitoring water quality, sampling fish tissue and sediments, conducting bioassay tests, and monitoring water levels in wetlands.

Water quality monitoring could be conducted to determine the quality of the wastewater and the impact of the wastewater on the receiving water. Water quality monitoring on the Flambeau River could include sampling sites upstream and downstream from the discharge location. Fish tissue and sediment sampling could be conducted to detect any accumulation of methods from the project discharges Bioassay testing could be done on the wastewater immediately upon commencement of the discharge to evaluate the toxicity of the effluent to fish and aquatic life.

Wetlands surrounding the site could be monitored to determine if the groundwater drawdown was causing a drop in wetland water levels. Level monitoring in Wetland No. 1 would be necessary to determine the required amounts of supplemental water during operations and to detect long-term impacts to the wetland after closure. Monitoring of water levels in other wetlands which might be affected by the drawdown would detect any impacts and would enable mitigation efforts to be implemented.

TERRESTRIAL ECOLOGY

A variety of techniques could be used to determine the effect of the project on terrestrial ecosystems. The simplest technique is probably periodic aerial photography to identify and document changes in vegetation and land forms. Other, more quantitative techniques could also be used for a more detailed analysis of changes in species composition, density and abundance.

AIR QUALITY

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 do to the low emission levels.

MITIGATION ALTERNATIVES

Impacts to Wetland No. 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 No. 1 does not reappear, this alternative would not be a viable permanent mitigation measure.

Other wetlands which could be affected by the groundwater drawdown (Nos. 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 reducing the 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. 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

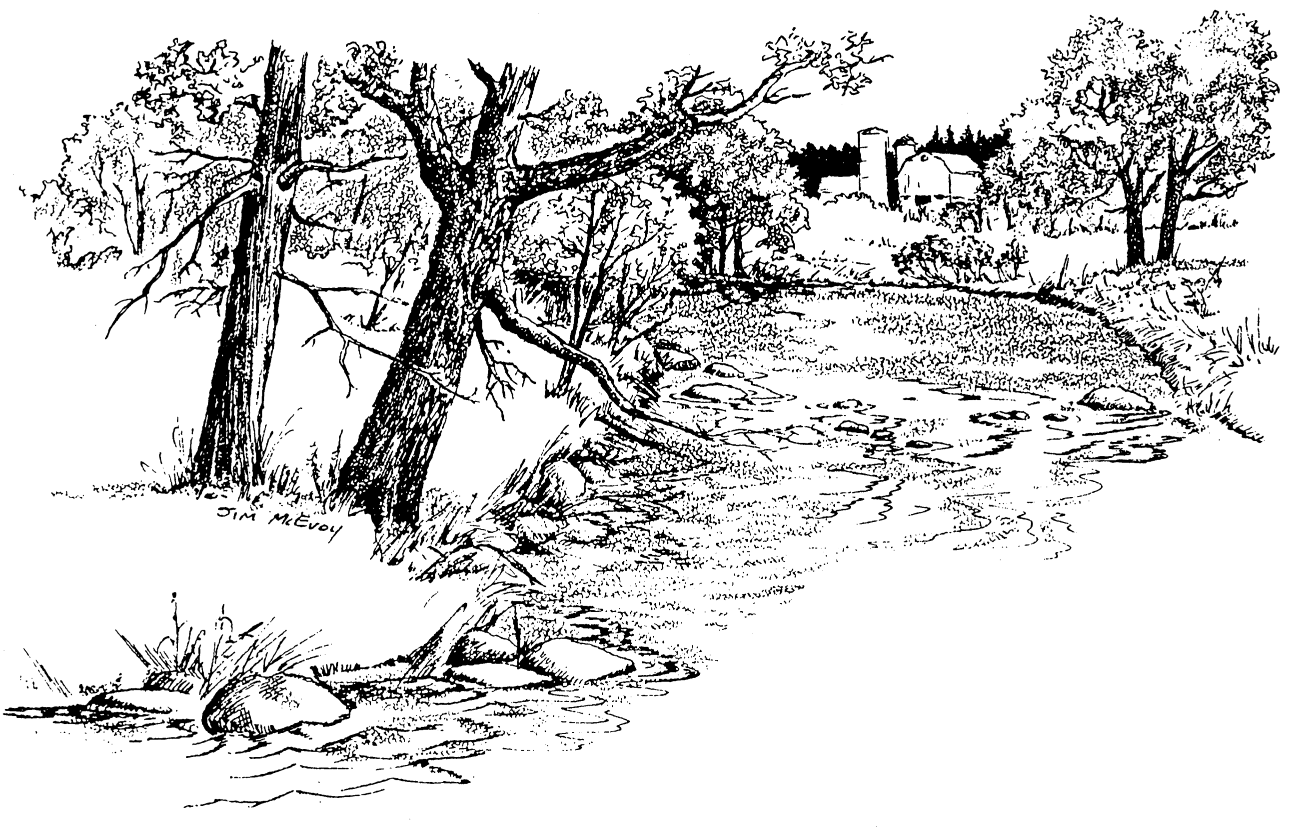
One alternative for reclaiming the mine site would be to not backfill the pit, allowing the pit to fill with water to form a lake. The creation of a small lake could increase the aesthetic value of the project site and add to the land value. This alternative was considered in detail in the 1970s. Landscaping 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.

A specific land use could be proposed as part of the reclamation plan. A designated land use, such as forestry, recreation, or wildlife, would enable the post-mining land management to be oriented toward supporting a beneficial land use. The reclamation plantings could be redesigned with a specific land use objective. For example, the entire mine site could be planted to trees to support a forestry use. Specific wildlife habitats could be created. Regardless of the intended land use, the plant species list proposed for reclamation could be changed to eliminate non-native species (other than for temporary erosion control) and to use additional species indigenous to the area.

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.

Reclamation wastes such as demolition debris could be disposed of in a separate on-site facility. In particular, wastes currently proposed to be disposed of in the overburden above the bedrock could instead be placed in a one-time disposal site. This alternative may promote a more rapid stabilization of the land surface over the pit. 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 rail, access, 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 will 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.



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.

The DNR's most 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.

LIST OF CONTRIBUTORS

Department of Natural Resources Employee	Job Title or Area of Expertise	Bureau or Location
George Albright	Section Chief	Environmental Analysis
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William Clark	Environmental Impact Coordinator	Spooner
Roger Gerhardt	Hydrogeologist	Water Supply
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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
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David Olig	Environmental Specialist	Wastewater Management
Frank Pratt	Fish Manager	Hayward
Robert Ramharter	Flambeau Mining Co. Project Coordinator	Environmental Analysis
Robert Read	Ecologist	Environmental Analysis
Gordon Reinke	Unit Leader	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 DEIS 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

Council on Environmental Quality
Bureau of Mines

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 DEIS 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 DEIS 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.
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.
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 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 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.
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.
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 are 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.
Precambrian	The oldest, major era in the geologic time scale, equivalent to about 90% of geologic time. Rocks in this era were formed between the earth's formation and 450,000,000 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 readily decomposes when exposed to air and water releasing metals and 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.
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 and field studies. Additional analysis was provided to the Department by staff members from the Department of Transportation and Departments of Revenue in Wisconsin.

1. Mining permit application for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 19, 1989.

2. Environmental Impact Report for the Kennecott-Flambeau Project, Volumes 1-6. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 1989.

3. Groundwater withdrawal permit application for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 1989.

4. Prediction of groundwater quality downgradient of the reclaimed pit for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. July 1989.

5. 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 for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. July 1989.

6. Application for water regulatory permits and approvals for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 1989.

7. Preliminary Engineering Report for wastewater treatment facilities for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. March 1989.

8. WPDES permit application for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. April 1989.

9. Air pollution control permit application for the Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. March 1989.

10. Wetland inventory and assessment Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. March 1989.

11. Scope of Study Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. October 1987.

12. Notification of Intent to Collect Data Kennecott-Flambeau Project. Prepared for Kennecott Minerals Co. by Foth and Van Dyke and Associates, Inc. July 1987.

13. Groundwater model for the Kennecott-Flambeau Project Ladysmith, Wisconsin. Prepared by Thomas A. Prickett and Associates Inc. and Engineering Technology and Associates Inc. July 1989.

14. Environmental Impact Statement for the Flambeau Mining Corporation proposed copper mine, Rusk County Wisconsin. Wisconsin Department of Natural Resources. February 1976.

APPENDIX A

Summary of Surface Water Quality
Sampling Results (10-87 to 9-88)

	Average	Range mg/l
Aluminum	0.062	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.v.)(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 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	126.00	60.00	5.00	8
# of Detects	0	0	0	0
% of Detects	0.0%	0.0%	0.0%	0.0%

APPENDIX B (Continued)

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%

APPENDIX B (Continued)

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

APPENDIX B (Continued)

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%