Draft environmental impact statement: proposed open pit copper mine and waste containment area, Flambeau Mining Corporation, Ladysmith, Rusk County, Wisconsin. 1976

St. Paul, Minn: Department of the Army, St. Paul District, Corps of Engineers, 1976

EIS-57/1976b

Draft Environmental Impact Statement

Flambeau Mining Corporation

Proposed Copper Mine

Ladysmith Rusk Co., Wisconsin

August 1976

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

PROPOSED OPEN PIT COPPER MINE AND WASTE CONTAINMENT AREA

FLAMBEAU MINING CORPORATION
LADYSMITH, RUSK COUNTY, WISCONSIN

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

August 1976

FOREWORD

This draft statement considers the environmental impacts associated with authorization of Federal permits necessary to develop a waste containment area for waste rock and tailings from an open pit copper mine and concentrating plant, as proposed by Flambeau Mining Corporation at Ladysmith, Rusk County, Wisconsin.

After receipt of the Flambeau Mining Corporation permit application, a public notice was issued which described the proposed activity and requested comments from agencies and the interested public on the pending permits. This public notice offered an opportunity to recommend any appropriate conditions that should be placed upon this permit should it be granted, and the opportunity to request a public hearing.

Upon evaluation of the Flambeau Mining Corporation permit application and available information, the District Engineer determined that the proposed project would significantly affect the quality of the human environment. Therefore, in accordance with the National Environmental Protection Act of 1969 (NEPA), this draft environmental impact statement was prepared by the St. Paul District, Corps of Engineers. It will be circulated to Federal, State, and local agencies and interested groups and individuals, who are invited to review and comment on the document.

After receipt and consideration of comments on the draft statement, the Corps will prepare a final environmental impact statement, which will include a discussion of questions and objections raised by the comments, and final analysis of the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects.

Each of the parties commenting on the draft EIS and receiving the final EIS, or those commenting on the above mentioned public notices, will receive another public notice or clarifying statement regarding final disposition of the Corps permit actions. A Statement of Findings (SOF) providing a concise analysis of social, economic, and environmental considerations leading to final conclusions and recommendations will also be issued. It is presently anticipated that a final decision with respect to these and other matters pertaining to the applicant's permit requests will be made in the spring of calendar year 1977.

This draft EIS was prepared to assure compliance with the requirements of the National Environmental Policy Act of 1969 (NEPA). It was prepared in accordance with the requirements of the Department of the Army, Engineers Regulation 1105-2-507 dated 15 April 1974 and Council for Environmental Quality (CEQ) guidelines dated 1 August 1973.

A State of Wisconsin impact statement prepared by the Wisconsin Department of Natural Resources and an environmental impact report submitted by the applicant were the base documents used as information sources for the preparation of this draft statement.

Coordination with all known interests is a continuing process and attempts to maintain this coordination are being made. (See section 9 of this statement for more detailed information.) Single copies of this statement are available at the Corps of Engineers, St. Paul District Office, 1135 U.S. Post Office and Custom House, St. Paul Minnesota 55101.

SUMMARY

PROPOSED OPEN PIT COPPER MINE
AND
WASTE CONTAINMENT AREA
FLAMBEAU MINING CORPORATION
LADYSMITH, RUSK COUNTY, WISCONSIN

(X) Draft Environmental Statement ( ) Final Environmental Statement

Responsible Office: St. Paul District, Corps of Engineers, 1135 U.S. Post Office and Custom House, St.Paul, Minnesota 55101
Telephone: 612/725-7505

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: Flambeau Mining Corporation, a subsidiary of Kennecott Copper Corporation, proposes to establish a 55-acre open pit copper mine near Ladysmith, Wisconsin. The mine would be in operation for 11 years, after which time Flambeau would reevaluate the copper ore deposit. They would then close down the operation or continue to mine by underground methods for an additional 11 years. Flambeau would construct a concentrator plant adjacent to the mine pit to concentrate the ore for shipment by rail to smelters in the western United States. Flambeau proposes to build a 156-acre waste containment area approximately 2 miles south of the mine pit to contain waste rock stripped from the mine pit and tailings from the concentrator plant. Waste material would be transported to the containment area via truck and pipeline. The proposed project lifetime is 11 years with potential extension for an additional 11 years.

3. a. Environmental Impacts: Implementation of the proposed project would allow Kennecott, through its subsidiary Flambeau, to produce 11,000 tons of copper annually for up to 22 years. The annual production would be a .65 percent increase in annual domestic copper production based on 1973 figures. The primary benefits associated with the project would be economic in nature, through employment and tax revenues. The project would create a maximum of 220 jobs during the construction phase and 78 jobs during operation. The estimated annual payroll is $1,020,000 with a total capital investment ranging from $15 to $18 million. During operation, annual income, real estate, and production taxes paid by Flambeau and their employees would range from $16 to $22 million.

b. Adverse Environmental Effects: Depletion of the known copper mineral resources in the area. Loss of 79 acres of decidous-coniferous forest and 20 acres of shrub swamp and sedge meadow wetland along with their associated wildlife. Loss of about 200 acres of producing

agricultural lands. Possible contamination of groundwater and heavy metal contamination of wetlands vegetation by leachate from the waste containment area. Minor deterioration of air quality and a minor increase in noise levels. Alteration of landscape and aesthetic degradation from creation of open pit, haul road, and waste containment area. Periodic traffic delays because of blasting in the pit. Local housing shortages with the influx of workers. Some unemployment created at the closing of the mine in 11 or 22 years.

4. Alternatives:

a. No action
b. Alternative Waste Containment Sites
c. Alternative Waste Containment Configuration
d. Alternative Waste Containment Design
e. Defer Development of the Deposit
f. Alternative Mining Methods
g. Alternative Haul Road Routes
h. Alternative Plant Sites
i. Alternative Rail Spurs
j. Alternative to Concentrating and Smelting
k. Alternative Industrial Water Supply
l. Alternative Sewage Disposal and Potable Water
m. Alternatives for Reclamation of the Mine Pit

5. Comments Requested: See page 101 for a list of those furnished a copy of this draft statement.

6. a. Draft Statement to CEQ _____.

b. Final Statement to CEQ _____.

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
OPEN PIT COPPER MINE AND TAILINGS DISPOSAL AREA
FLAMBEAU MINING COMPANY
LADYSMITH, RUSK COUNTY, WISCONSIN

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INTRODUCTION

The purpose of this statement is to assess the environmental impacts associated with the proposed construction and operation of an open pit copper mine and associated tailings disposal facilities near Ladysmith, Rusk County, Wisconsin. This document uses information from the environmental statement prepared by the Wisconsin Department of Natural Resources (DNR) as well as from an environmental impact report, Preliminary Environmental Impact Report for mining the Flambeau Copper Deposit, Rusk County, Wisconsin, 1974, prepared for Flambeau Mining Corporation by Bear Creek Mining Company.

1.000 PROJECT DESCRIPTION

BACKGROUND

1.001 In the middle 1960's, Kennecott Copper Corporation (Kennecott) through its exploration subsidiary, Bear Creek Mining Company discovered a minable copper deposit southwest of Ladysmith in Rusk County, Wisconsin. Flambeau Mining Corporation (Flambeau), a wholly-owned subsidiary of Kennecott, was formed and assigned the responsibility for the mining phase of the project.

1.002 Flambeau Mining Corporation applied to the Wisconsin Department of Natural Resources (DNR) for the permits which are necessary to develop the mining operation. In compliance with the Wisconsin Environmental Policy Act of 1971, the DNR began preparation of a State environmental impact statement (EIS).

1.003 On 25 July 1975 the Corps of Engineers (Corps) published regulations implementing their jurisdiction resulting from Section 404 of the Federal Water Pollution Control Act, as amended, 1972 (Public Law 92-500). One of the primary points of this expanded jurisdiction was that it encompassed wetland areas contiguous and adjacent to streams with a rate of flow in excess of 5 cubic feet per second and lakes over 5 acres in size. Also a part of these regulations was a phasing procedure. This was designed to ease the administrative burden of handling the substantial number of permit applications that were expected to result from the expansion of jurisdiction.

1.004 The proposed waste containment site includes approximately 20 acres of wetlands. The DNR advised Flambeau to contact the St. Paul District, Corps of Engineers, to determine if the wetlands involved were affected by the 25 July 1975 regulations.

1.005 On 30 October 1975 Flambeau contacted the Corps to determine if Department of the Army (DOA) permits were required to fill in the wetlands involved. The Corps determined that the wetlands would come under Corps jurisdiction as of 1 July 1977 under the phasing program set up under the 25 July 1975 regulations. However, the 25 July 1975 regulations also give the District Engineer the discretionary power to assume jurisdiction over wetlands ahead of a particular phasing date if he feels it is in the best overall public interest to do so.

1.006 The District Engineer informed Flambeau on 18 December 1975, that the wetlands involved constituted a valuable resource and that he was exercising Corps jurisdiction over the wetlands ahead of the 1 July 1977 phasing date. Therefore, Flambeau would be required to have a permit from the St. Paul District, Corps, to fill in the wetlands involved.

1.007 Flambeau made application (Number 76-53) on 13 February 1976 to the Corps for a Section 404 permit to fill in approximately 20 acres of wetlands as part of a copper tailings disposal site.

1.008 Since the environmental review indicated that the proposed project would have significant impact on the quality of the human environment, it was determined that an EIS was necessary in accordance with the National Environmental Policy Act of 1969 (Public Law 91-190) and DOA Engineering Regulation 1105-2-507.

1.009 Flambeau will need 12 permits from the Wisconsin DNR to construct and operate their proposed mining facility. Flambeau has recently applied for some of these permits.

PROPOSED ACTION

1.010 Flambeau Mining Company proposes to mine a finite copper sulfite deposit near Ladysmith, Wisconsin (exhibit 1). The ore would be mined by the open pit method and concentrated in a concentrating plant constructed near the pit. Waste mine rock and concentrator tailings would be disposed of in a diked disposal basin about 1.5 miles south of the open pit (exhibit 2).

1.011 The mine would operate for 11 years, producing approximately 1,000 tons per day (tpd) of ore that would be concentrated to produce 160 tpd of shippable concentrate. The concentrate would be rail hauled to Kennecott smelters in western United States. The existing deposit is not large enough to justify the building of a smelter at the mine.

1.012 At the end of the 11-year period, Flambeau would reassess the deposit and the economic feasibility of continuing the operation via underground mining. Flambeau estimates that if they did go to underground mining, the operation would be extended an additional 11 years.

Construction Phase

1.013 The first step in the construction period would be the establishment of an access road from State Highway 27 to the plant site. This would be a standard 22-foot graded roadway with 3 feet of shoulder on each side, and would be tree lined. Other major work performed during the construction period would include:

1. The removal of overburden and waste rock (called "prestripping") to expose 3 to 4 months' ore supply;

2. The use of the overburden and waste rock for the construction of the haul road and the first lift of the waste containment area dikes; and

3. The construction of the concentrator, ancillary facilities and explosive magazines.

1.014 The construction period is expected to last 1 1/2 years after the beginning of the mine prestripping. During the construction period, an average of 121 persons would be employed, peaking at 220 in the fourteenth month of construction (exhibit 4). Local subcontractors and local labor would be used as much as possible. It is anticipated that the skills not available locally would be obtainable from the region's larger cities such as Eau Claire or Minneapolis. This type of work force is normally housed in trailers near the site but probably not on corporation land.

1.015 In sequence, the construction in the mine area would be:

1. Felling and grubbing trees and shrubs over the pit area. Some of the timber would be chipped for use as mulch over bare soil on the outside of the waste containment dikes, road banks, etc., to assist in promoting revegetation. The balance would either be sold, or otherwide disposed of in accordance with State regulations.

2. Establish security measures to control access to the pit area, to prevent unauthorized entry and to serve as a safety measure.

3. Removal and temporary stockpiling of the topsoil and silty glacial subsoils obtained from within the pit area. When the

haul road is completed, this material would be transferred to another stockpile area located within the SW 1/4 of Section 16 (exhibit 3).

4. Construction and approval of the explosives magazines.

5. The removal of overburden and waste rock either by drilling and blasting followed by loading into 50-ton off-highway haulage trucks, or by ripping with a crawler dozer and scraping. Either method could be used depending on the nature of the material. Excavation would commence in the northeast portion of the area to be prestripped so that silt-laden waters would flow into the excavation and not into the Flambeau River.

   Continuous on-site testing of the materials excavated would be carried out by the mine geologist who would direct the material either to the haul road or to various stockpiles, and after completion of the haul road, to the waste containment area.

6. A drainage ditch would be constructed in the top of the clay-saprolite layer at the 1,085 elevation level within the pit to collect groundwater inflow and surface water runoff. The ditch would be graded at -2 percent toward sumps at the southwest end of the pit. One pump capable of pumping the average sump inflow to the gravel pit and for sundry usage would be installed with a similar capacity pump as standby. During storm conditions, excess water beyond the installed pumping capacity would flow into the pit bottom and would be pumped from the pit bottom sump to the waste containment area. Before sufficient dike has been constructed in the waste containment area, such excess water would be disposed of in the gravel pit.

7. Spillways would be provided as required to divert surface water runoff to the 1,085 level drainage berms.

8. A visitor's observation post would be constructed as soon as practicable.

1.015 The work in the mine area consists mainly of removing sufficient overburden and waste rock to expose 75,000 to 100,000 tons of ore i.e., sufficient for 3 to 4 months' milling. The overburden materials would be used for the construction of the plant site, roadways haul road, and waste containment area dikes. Exhibit 5 shows the waste material production schedule on an annual basis and also the disposition of waste materials during the preproduction, production, and post-production periods. The estimates of material quantities available are based on the soil samples and geologic data obtained from soil test work.

1.016 The steeply-dipping Precambrian rocks which contain the ore body are overlain by 30 to 60 feet of flat-lying sandstone and glacial deposits. Ancient weathering of the upper portion of the Precambrian bedrock has converted it to clay-rich saprolite. This material has a very low permeability and would be used to construct an impervious core in the waste containment area dikes. Overlying the saprolite is a poorly-cemented Cambrian sandstone, varying in thickness from 0 to 30 feet. If it is found that the sandstone can be adequately compacted, it would be placed in the downstream section of the waste containment dike or in fill sections of the roadway. Otherwise, it would be disposed of inside the waste containment area. Overlying the Precambrian bedrock and Cambrian sandstone are unconsolidated granular glacial deposits of variable composition ranging in thickness from 15 to 60 feet. The coarser glacial materials would be used as a subbase for the haul roads and traffic areas in the plant site and for dike construction. Some of the finer glacial materials would be used as fill for the subbase of the haul road. The rest would be stockpiled, covered with vegetation, and used as a soil cover for the final rehabilitation of the waste containment area. Top soils would be stockpiled separately and covered with vegetation until used in stabilization and final rehabilitation.

1.017 Diamond drill hole data indicate that the blast holes below the overburden would be dry. Accordingly, it is anticipated that for most of the blasting a mixture of ammonium nitrate prills and fuel oil (AN-FO) would be used as the blasting agent. Although ammonium nitrate is not considered an explosive until it is mixed with fuel oil (this mixing takes place at the blast hole site immediately prior to loading the hole), it is proposed to store it in the magazine area. A 30-ton capacity storage bin - roughly one month's supply - would be provided.

1.018 Two other magazines would be constructed. One would be designed to store a total of 5 tons of explosives, including primacord, some dynamite for secondary blasting and some mixed AN-FO in plastic bags for use in the occasional wet hole. The other magazine would be similar and used for the storage of boosters and caps. The American Table of Distances for storage of explosives requires that barricaded magazines storing 5 tons of explosives must be a distance of 865 feet from inhabited buildings, 345 feet from passenger railways and 260 feet from public highways. In addition, the separation of magazines must be 78 feet. The magazines would be 875 feet from the nearest inhabited building along the west edge of State Highway 27, 1,020 feet from State Highway 27, still further from the railway, and 100 feet apart.

1.019 The magazines would be surrounded by a wall of earth of sufficient thickness and height to meet applicable safety standards. This earth would be obtained from the till of the open pit. As required by law, the mounds of earth would be kept clear of vegetation. Erosion prevention measures such as the use of crushed rock or asphalt covering would be taken to prevent siltation.

1.020 The plant would be located on the southerly side of the pit on a hill surrounded by the 1,150-foot contour (exhibit 2). The site is roughly 65 feet above the river. Within the plant site area would be the concentrator, including crushing, grinding and flotation sections, the warehouse, offices, workshop and changehouse, and other minor buildings. Based on the soil conditions found in the preliminary borings made near the plant site area, the proposed plant could be supported on a normal footing or mat-type foundation with soil bearing pressure in the range of 4,000 to 7,000 pounds per square foot. Additional borings and detailed soil investigations would be necessary once the concentrator and other buildings have been designed.

1.021 The concentrator buildings, shops, warehouse and offices would be painted to blend with the surroundings, and the plant site landscaped and planted with trees.

1.022 The company's design criteria for the concentrator include:

1. An adequate dust collection system for the dry crusher circuit so that the dust created at the crushers and transfer points is removed and not allowed to pollute the atmosphere in or outside of the building.

2. Provision for the installation of a heating system for use in the winter plus adequate insulation. The products of combustion from this heating would be vented to the atmosphere.

3. Sprays for dust suppression at the concentrate stockpile.

1.023 The proposed waste containment area would cover 156 acres in Section 21 (T34N., R6W.) (exhibit 6) and is designed to store 2,617,000 tons of tailings from an open pit operation, 2,886,000 tons of tailings plus 740,000 tons of washing plant silt from a possible subsequent underground operation, and 4,009,000 cubic yards of surplus waste material from the open pit. Assuming all of the pyrite is used in the dikes, and that none is refined, the average dimensions of the dike walls would be 57 feet high, 80 feet wide at the top, and 363 feet wide at the base.

1.024 The company's design criteria established for the waste containment area were:

1. To provide dikes and a reservoir that would be as impermeable as possible so that seepage losses during the life of the operation and thereafter would be minimal.

2. To provide stable dikes with an adequate factor of safety.

3. To locate the waste containment area in an area where its presence would not be obvious. To further remove it from the public eye, a screen of trees and shrubs is proposed around the perimeter.

4. To terrace the outer walls of the dikes so that they can be planted with trees and other native flora as the dike increases in height during the life of the operation.

5. To site it in an area which was not a unique ecological habitat, since destruction of existing ecological relationships within the confines of a waste containment area is complete.

1.025 The requirement of stable and relatively impermeable dikes dictated the use of solid dikes with a clay core, and ruled out the traditional method of building dikes from the coarse fraction of tailings. The dike material and the clay for the core can be obtained from the open pit operation. Exhibit shows a section of the designed waste containment area dike and the estimated permeability of the soil materials used in its construction. The core is a highly impervious saprolite obtained from the open pit.

1.026 A computer study of the stability of the dike section using the designed 1:1 upstream slope and a 3.4:1 downstream slope indicated the following factors of safety (exhibit 8).

2.39 along the assumed failure surface AB

3.46 along the assumed failure surface CD

3.63 along the assumed failure surface EF

Since a factor of 1.5 is normally considered safe, the proposed dike's stability is adequate, especially when considered in conjunction with the high strength of the foundation soils at depth. Since the dike would be built in stages with high soil compaction, there would be consolidation of the soils which would also contribute to dike stability.

1.027 In sequence, the construction in the waste containment area would be:

1. The foundation preparation for the dike section would consist of stripping off all topsoil in excess of 6 inches and all peat in the low areas under the dike. The foundation soils for the dike are sandy or clayey silts.

   In an area along the central part of the north dike permeable sands were found underneath the impervious silts. To reduce leakage through the foundation of the wall in this area, a cutoff trench would be excavated 13 to 15 feet deep and roughly ten feet wide. A similar cutoff trench would be excavated to a depth of six to nine feet along the lower reaches of the west dike. The material excavated from these trenches would be placed within the waste containment area. The trenches would be backfilled with saprolite, compacted to at least 95 percent of the maximum dry density as determined by the Standard Proctor Test.

2. The larger trees and bushes would be cut from the designated waste area and the timber stockpiled to be cut into chips for use as a mulch. No grubbing of tree stumps or vegetation would be done so as to preserve the natural density and continuity of the upper layers of silts and clays.

3. The existing drainage ditch, which runs east-west through the center of the waste containment area, would be cleaned of stones, trees and debris, and filled with compacted saprolite. A replacement drainage ditch would be established around the south side of the dike.

4. There would be sufficient material from the prestripping of the open pit to construct all of the first lift of the waste containment dike to an elevation of 1,142.5 feet. Construction of the dike structure would begin in the lowest elevation of the waste containment area at its southwest corner. The haul trucks would place borrow material from the mine stripping operation. Typically, two parallel lifts would be formed along the dike location with a central trench left temporarily open. When the parallel lifts became high enough, the open trench would be filled with compacted saprolite to form the dike's clay core. This fill and compact construction sequence would be repeated until the full initial dike was completed.

   Over the life of the mine operation, the dike walls will have to be raised four 4 times in order to provide containment volume at a level elevation. Because of the area's sloping topography, the initial lifts of the dike would not close, but be of a "C" shape in the lower area of the facility.

   The core of the dike would be saprolite 40 feet wide. The inside wall would be sand or mine rock 90 to 100 feet wide at the base. The outside wall would be 240 feet wide at the base and would be made of sand or mine rock covered with glacial till material capable of supporting vegetation.

   Except for the outside facings of gravel and soil, all materials in the dike would be mechanically compacted with appropriate equipment in roughly 12-inch lifts. Compaction of the saprolite core would be carried to at least 95 percent of the maximum dry density of the material.

5. The decant system for the waste containment area would be located in the southwest quadrant. The decant system would consist of a floating pump barge, completely enclosed and insulated with cold weather electric heating provisions. Access to the pump barge would be by a 15-foot wide dike which would be raised as the tailings surface raises. The waste water reclaim line would be an 8-inch diameter pipe located on the surface of the access road and connected to the pump barge with an 8-inch diameter flexible rubber tube. Power lines for pump and utilities operation would also be located on the surface of the access road. An air compressor/bubbler system would be

employed around the pump barge to prevent freeze-up during cold weather operation.

6. To keep the tailings wet so that dust formation would be minimized and to provide additional protection for the dikes, a ring feed would be installed on top of the first lift of the dike. A pipe carrying the tailings would be sited on top of the dikes around the waste containment area. The pulp would be delivered to the waste containment area. Thus, there would be little water against the dikes and a large pool of water in the center of the waste containment area. In addition to preventing dust formation, this technique allows time for the settling of the metal hydroxides and degradation of the reagents used in the concentrator. During freezing weather, the pulp would have to be delivered to the waste containment area through a single pipe because a ring feed system would freeze.

7. Eight monitor wells to detect seepage have been installed and an additional nine monitor well-test holes would be drilled to further define groundwater characteristics. In addition, eleven more monitor wells located within the dike and along the outer toe of the slope and seven surface water sampling sites are planned. These wells will all provide a warning of any deterioration of groundwater quality (exhibit 9).

1.028 The haul road design criteria were that the road was to be an all-season road for 90-ton gross load trucks with minimum maintenance throughout the year and with no paved surface. The location of the haul road is shown in exhibit 2. The haul road would be constructed over subgrade soils that are susceptible to severe frost action, i.e., silty fine sands, silts and clayey silts with a groundwater table in some areas at 3 to 5-foot depth. Because of these conditions cuts would be minimized with most of the roadway being built on fill. The final design of the haul road is based on limiting frost penetration into the subgrade. This requires a total subbase thickness of 54 inches of nonfrost-susceptible sands. To obtain the specifications required for the different layers of subbase material from prestripping material, it may be necessary to use a temporary washing and screening plant.

1.029 The prestripping material would be required in a certain sequence for road building, i.e., silty fine sand for subgrade and fill for the haul road, followed by clean sand for the lower subbase, and then gravelly sand for the middle subbase. This would necessitate a certain amount of stockpiling within the pit limits to provide a buffer between the mining of the material and its usage on the road. The silty fine sand found near the surface within the open pit would be used as fill. Over the subgrade there would be a lower subbase consisting of 24 inches of selected clean coarse sand, i.e., containing less than 12 percent passing a No. 200 sieve. The next subbase would be 18 inches of gravelly sand. The surface 12 inches of crushed gravel would be purchased. Treatment of the road surface, probably water sprayed from a truck, would minimize dust formation.

1.030 Compaction of all subbase and base coarse materials would be at lease 98 percent of the maximum dry density. In areas where fill sections are greater than 54 inches, the fill would be compacted to at least 95 percent of the maximum dry density.

1.031 Safety considerations dictate a 55-foot road width for all-weather, two-way traffic in connection with off-highway haul trucks having a gross load of 90 tons. An additional five feet in width is required for a ditch to contain tailings in the event of a pipe break. The tailings pipeline and reclaim water pipeline would be in the ditch. The road would be crowned to promote adequate surface runoff. With the shoulders, the total width required at the sub-grade would be 73 feet, 6 inches.

1.032 A culvert would be required to enable crossing over an intermittent stream between the process plant and Meadowbrook Creek. This would be a 48-inch corrugated steel pipe or a concrete culvert. During construction the stream would be diverted through a gravel-lined channel. Chapter NR 116, Wisconsin Administrative Code, limits the height of backwater caused by this culvert to 0.5 feet during the 100 year flood. A larger box culvert would be required for the crossing of Meadowbrook Creek, and this would be constructed of reinforced concrete. Instead of constructing a bypass around the culvert site and placing the culvert in the natural channel, the culvert would be constructed to the south side of the natural stream without disturbing it and then the stream would be diverted into the culvert upon completion of construction.

1.033 This scheme avoids disrupting the natural stream bed during culvert construction and incorporates the emergency tailings catchment basin dike construction with the stream diversion dike construction causing less soil disruption and less sediment flow.

1.034 Upon completion of the culvert, the stream channel would be straightened and realigned to flow through the culvert. This realignment would increase the average slope of that portion of the channel by 0.3 percent. This increase would increase the existing stream flow velocity of 4 1/2 feet-per-second to 5 1/4 feet-per-second. Due to the cobble-boulder nature of the stream bed no significant scouring is anticipated because of this velocity increase.

1.035 The design of the reinforced soil bridge crossing County Highway P is subject to approval by the Rusk County Highway Department. The intent is to elevate the waste haul road over County Highway P at their intersection 500 feet west of State Highway 27 as shown in exhibit 10. This arrangement does not alter County Highway P and provides a safer haul road in that the bridge support structure is much less subjected to destructive collision by 50-ton haulage trucks. It also provides a better haul road gradient over the life of the operation.

1.036 As soon as portions of the haul road were completed, the banks would be covered with a layer of till mulched with wood chips or straw, fertilized and planted with native vegetation. Dust formation due to loading and hauling would be suppressed by the use of water sprayed from a water truck. The tailings pipeline would be located in a specially shaped ditch on the east side of and paralleling the mine waste haul road. The pipeline would rest on the compacted subbase material of the haul road edge. Provision would be made at the intermittent stream and at Meadowbrook Creek for catchment basins to temporarily store tailings in the event of a tailings pipeline break. The basins are designed to hold 2 million gallons or the equivalent of 56 hours of tailings flow. Tailings held in these basins would be pumped back into the pipeline upon resumption of operations. Possible pipeline materials include 8 inch, 100 psi (pounds per square inch) rating, Driscopipe 7600 Industrial Polyethylene pipe.

1.037 A railroad spur (exhibit 46), approximately 6,100 feet long, would be constructed from the Soo mainline west into the plant area. The spur would cross a gravel township road and State Highway 27 at right angles. Appropriate highway safety indicators would be erected at each crossing in accordance with the rules of the Wisconsin Division of Highways and the Wisconsin Public Service Commission.

1.038 Route selection was made for the shortest distance between the main line and the plant with minimal cut and fill. Where cut and fill were necessary, the banks would be mulched and reseeded with native vegetation. Culverts would be installed to reduce blockage of drainageways and to eliminate ponding on the uphill side of the spur line.

1.039 An onsite sewage treatment plant would be constructed to handle approximately 3,000 gallons per day of human sewage. At the end of each work shift for a period of about 15 minutes, it is estimated that about 100 gallons per minute (gpm) of waste water would be generated. Sufficient surge tank storage capacity would be provided ahead of the sewage treatment plant to allow for the design treatment rate of 3,000 gallons per day. The treatment system would be of the "extended aeration/aerobic digestion" type. The sewage treatment effluent would be pumped to the waste containment area through the tailings line. Design of the sewage treatment facility would be in accordance with local and state codes. After the system was installed the site would be revegetated.

1.040 The present design plan includes three bulk storage tanks for petroleum products. Storage facilities for No. 2 oil for heating and diesel equipment use would be API steel storage tanks for 55,000 and 70,000 gallon capacity. These tanks would be located above ground in the concentrator area where they may be serviced by rail or truck tankers. A 12,000 gallon capacity underground nonmetallic tank would be provided for gasoline storage.

1.041 All tanks would be designed and installed according to standard industrial and insurance carrier codes for bulk storage of petroleum products, including EPA regulations of December 11,1973 as amended relating to protection of navigable waterways. The surface tanks would be appropriately bermed with all process equipment - pumps, valves, meters, etc., located inside the berms.

1.042 Electric power takeoff would be from the existing Lake Superior District Power Company 33 KV line which follows the railway line. A 100-foot right-of-way, 50 feet each side of the line, would be required. Lobbing of tree branches may be required, as well as removal of some trees.

1.043 A system of collection ditches and sumps would be constructed within the open pit area to collect groundwater inflow and precipitation into the pit.

1.044 To predict groundwater flow conditions after pit excavation, the company used a finite element computer flow model. Groundwater flow into the pit as calculated from the model would be 1,620 gpm. Allowance was made in this calculation for inflow resulting from reversal of the existing hydraulic gradient on the northwest, or present down-gradient, side of the pit. The bedrock ridge described in an earlier section of this report would prevent the intrusion of river waters through the groundwater system into the pit from the southwest end of the pit. From permeabilities measured in the test wells, it is estimated that the glacial outwash materials present in the northwest sector of the pit perimeter would transmit an average of 50 gallons per square foot per day (0.0347 gpm). Thus, the highest amount of groundwater flow and intrusion of river water through the glacial outwash materials in the 1,000-foot segment of pit wall subject to such intrusion is estimated to be 347 gpm.

1.045 Although the hydrological studies suggest that the glacial materials surrounding the mine pit could yield up to 1,620 gpm, based on their permeabilities and the existing groundwater conditions, the long-term yield of such a volume of groundwater is considered unlikely for several reasons. First, experience with other mine pits has shown a rapid initial inflow into a pit during excavation followed by great reduction in flows of up to 80 to 90 percent of the initial flow. Secondly, in this case, 82 percent of the water-bearing upper pit perimeter wall would consist of till within which aquifer continuity is very poor.

1.046 Finally, if the till and outwash in the cone of depression were to be dewatered, incident precipitation and regional groundwater flow recharge would have to come through adjacent soils, most of which have low to very low transmissivities. Thus, the effects of evapo - transpiration plus the above factors indicate a very slow infiltration through the soils into the mine pit. The company's long-term estimate of groundwater flow into the pit after flows have stabilized is 320 gpm, which is 20 percent of the calculated theoretical figure. However, this estimate cannot be proven quantitatively with the existing data.

1.047 During pit construction, silt-rich waters from the pit would be collected by this system and pumped to settling ponds in the abandoned gravel pit nearby and allowed to seep into the groundwater. This water would be of nearly the same quality as the groundwater since it would be derived from groundwater seeping into the pit.

1.048 After completion of construction, approximately 223 gpm would be diverted from this system via pipe to the waste containment area for industrial make-up waters. It is anticipated that all of the industrial water requirements could be obtained from groundwater inflow into the pit plus precipitation into the pit and waste containment area. Should it be found that an outside source of water is required, a supply would be obtained from high capacity wells constructed northwest of the gravel pit.

1.049 During the startup and shutdown phases of the operation, it would be necessary to use water from the Flambeau River to supplement existing flows. A detailed water budget for the operation is given in exhibit 11

1.050 A domestic low capacity well would be constructed on the project site for potable water consumption in the changehouse, offices, laboratory, etc. Construction of a water storage tank near the process plant would ensure sufficient pressure and capacity. The potable water supply required is estimated to be 2 gpm.

Operations Phase

1.051 The envisioned open pit mining method is conventional for an operation of this size. Technical details, i.e., bench height, berm width, hole size, spacing, and explosive charges, could change in practice as additional information on the nature of the rock is developed. An overall slope angle of 35 degrees would be maintained unless rock mechanic studies indicate a change. Bench height would be 35 feet. To break the required tonnage of ore and waste on a five-day mining, seven-day milling work basis, forty 6-3/4-inch blast holes per week would be required. These would be drilled by a mobile rotary blast hole drill. The cuttings from the hole being drilled would be flushed out by compressed air.

1.052 Ammonium nitrate for blasting would be loaded into a bulk transport truck of 1 1/2-ton capacity provided with a unit for adding and mixing the required amount of fuel oil immediately prior to pumping the mixture into the hole. In the event of a wet hole, a plastic bag liner would be used to contain the ammonium nitrate fuel oil explosive or else a moistureproof explosive would be used. Each hole would be loaded with roughly 300 pounds of explosives which would fill one-half of the hole. The rest of the hole would be filled with fine rock arising from the drilling operation. Millisecond delays would be used so that the holes are exploded in sequence. The primary reason for their use is to obtain the desired breaking effect of the rock. This practice has the side benefits of minimizing the noise impact, ground vibration, and air blast. The amount of explosive used is estimated as six tons per five-day week. In summer months, blasting would normally take place once per week. In the winter under freezing conditions, more frequent small blasts would be used to avoid freezing of broken open pit material.

1.053 Because of the proximity of the open pit to State Highway 27 and the possible danger from an occasional flying rock, it would be necessary to stop traffic for a period of roughly five minutes during the blast. Permission for this action must be obtained from the Wisconsin Department of Transportation. Based on experience at other open pit operations, the noise level from such a blast is predicted to be below the legal limits at the nearest inhabited building which would be the crusher building of the concentrator 1,000 feet from the center of the open pit and 520 feet from the pit limits. Based on the considerable amount of test work reported by the Bureau of Mines and explosives manufacturers, the ground vibration level at the crusher building from the detonation of a 300-pound charge per hole is estimated to be 1.7 in./sec., which is less than the safe vibration level of two inches per second. On the same basis, the air blast at the crusher building is estimated to be less than the safe level of one pound per square inch. Blasting would produce fugitive dust and noxious fumes, including nitrous oxides. The fumes are normally rapidly dissipated in the atmosphere. There is no known practical method for capturing the fumes.

1.054 The waste rock would be loaded into 50-ton haulage trucks for transport to the waste containment area where it would be used for building dikes. The ore would also be loaded into 50-ton haulage trucks for delivery to the primary jaw crusher. During dry periods, the haulage roads would be sprinkled by a water truck to suppress dust.

1.055 The noise produced by a moving 50-ton truck is estimated as between 86 and 88 dBA. The Caterpillar Tractor Company has established the noise levels of its type 773 50-ton off-highway truck equipped with Caterpillar's 600 hp engine as follows:

Stationary test	Distance (in front of truck)	50 feet
	Noise level	87.5 dBA
Moving test	In second range, direct drive at 1,900 rpm	Left side 86.5 dBA

There are no legal limits for off-highway truck noise, but this is lower than the EPA standards for highway motor carriers over five tons.

1.056 The feasibility of extending the life of the mine by converting to an underground operation at the end of the open pit life would be reevaluated after several years of open pit operation. Should steeper than planned pit slopes be feasible, the economical depth of the open pit would be greater, thus reducing the amount of ore remaining for underground mining. In this event, the proposed vertical shafts could be uneconomical compared with providing access to the remaining ore from the open pit bottom. Should the bottom of the open pit be 285 feet below the surface as presently anticipated, access to the underground ore body would be by means of a two-compartment, production shaft sunk to a depth of 830 feet in the footwall of the ore body. This

shaft would ultimately be equipped with a combined man-cage and haulage skip in one compartment, and a ladderway, utilities, and a counterweight in the other. Shaft stations would be cut at about 200-foot intervals below the pit bottom, and cross cuts would be developed from these to the ore. A main station with pumping and ore-handling facilities would be constructed on the 400-foot msl level which would serve as the main haulage level for the mine. Stoping (creating of step-like levels in an open pit mine) would commence at the 400-foot msl level.

1.057 To bring the underground mine to the production stage, the following items would also be required:

1. Excavation of a vertical ventilation shaft, about 50 square feet in cross section, that would intersect the ventilation raises; and the installation of a 50,000 cubic foot per minute fan.

2. Construction of ventilation and service raises in ore between levels at the extremities of the ore body. These would serve as upcast airways and would be equipped with pipes to handle the fill to be emplaced in the worked out stopes.

3. Construction of an ore pass and parallel service raise in the ore between the levels at the end of the production shaft cross cuts.

4. Installation of slusher trenches on the 400-foot level and loading pockets with spillage-handling arrangements below that level.

5. The erection of a gravel-washing plant to produce backfill.

1.058 Because of the absolute need for minimizing surface subsidence and the incompetence of the hanging wall, cut-and-fill would be used as the stoping method exhibit 12. The ore body is continuous on strike and has a comparatively short strike length of + 1,200 feet on either side of the shaft system. Accordingly, it would be possible to consider the whole ore body below the pit as one stope.

1.059 The coarse fraction from the tailings contains up to 50 percent pyrite and would be unsuitable for fill due to fire hazards. Therefore, gravel for the fill would come from a new 30-acre pit south of the former Rush County gravel pit located near the mine. This material would be crushed or screened to 1/2-inch and mixed with cement to provide a 1 to 30 cement to gravel ratio. The discard from the screening plant, amounting to 740,000 tons, would be pumped to the waste containment area. As mining progresses, the cement-rich fill would be pumped from the surface into the mined-out stopes at 70 percent solids to prevent excessive subsidence of the surrounding ground. Water drainage from the fill would be pumped to the surface and into the tailings pipeline. Surface diamond drill holes have indicated that the underground mine would have comparatively minor water problems. Water from the fill operation would amount to roughly 30 gpm. Provisions would be made for a 200 gpm continuous pumping system and a 100 gpm standby system.

1.060 The underground work schedule would be three shifts per day, 5 days per week, with a mine production rate of 1,400 tons per day The total number of employees on the property during this phase would be expected to be 143. The underground mining operation would prolong the overall life of the venture by about 11 years.

1.061 The main process at the plant site is concentrating. The flow of material in the concentrator is shown in exhibit 13. In the case of the open pit operation, ore would be delivered to the concentrator by 50-ton rear-dump trucks during the day shift 5 days per week. In the case of underground mining, ore would be brought by truck from the headframe ore pocket to the concentrator.

1.062 A stockpile would be established adjacent to the concentrator so that the crusher could be fed by a front-end loader over the weekend when the mine would not be operating. The ore would be dumped into a 100-ton live capacity pocket from which it would be drawn by an apron feeder and delivered to a jaw crusher.

1.063 The jaw crusher product would drop onto an elevating belt conveyor system and eventually discharge onto a -3/4 inch vibrating screen located on top of an 800-ton fine ore storage bin. Screen oversize would be recirculated through a vibratory cone crusher which discharges onto the same elevating conveyor system as the jaw crusher. Screen undersize would normally drop into the 800-ton fine ore storage bin located inside the concentrator building to minimize cold weather operational problems. At times, it may be desirable to use selected crushed material for purposes other than concentrate production (ballast for railroad spur, flux material such as metachent for use in the smelting process). At these times, the normal grinding and concentrator circuits would be bypassed and a shuttle conveyor would be used to receive the crushed product and convey it directly to railroad cars for shipping.

1.064 However, in the normal case fine ore would be drawn from the bin by a variable-speed slot belt feeder and would be fed to an 8-foot diameter by twelve-foot long rod mill for grinding. The process of crushing through to feeding the fine ore to the rod mill is dry and, consequently, dust-forming. Dust would be removed by means of hoods under suction (exhibit 14). Two separate dust handling systems are anticipated. One would operate on the crushing system through to the fine ore bin and would function only when the crusher system is in operation. The other system would operate on the feed from the fine ore bin to the rod mill for three shifts per day, seven days per week. An alternate for the second system would utilize a chemically activated dust suppressant spray system and avoid the problems of dust collection and handling and their attendant high costs.

1.065 Based on a yearly average production rate, 492 gpm of industrial water would be added to the fine ore feed to the rod mill. Roughly 419 gpm, or 85 percent of this amount, would be recycled water. The coarsely-ground ore slurry from the rod mill would be discharged to a sump from which it would be pumped to a bank of cyclone classifiers. The finely-ground slurry fraction from the classifier overflow would

go to the flotation circut. The coarsely-ground slurry fraction from the classifier underflow would be fed to a ball mill for further grinding. The ball mill discharge would be recirculated to the sump serving the cyclones. To the rod mill and the ball mill feed, a total of 5,000 pounds per day of slaked lime would be added to give an alkaline (pH 11) pulp in the flotation circuit.

1.066 The ore slurry at 25 percent solids would be delivered to a bank of mechanical rougher flotation cells. At this point, approximately 150 pounds per day of promotor (typically Aerofloat 238) and 120 pounds per day of a frother (typically 25 percent cresylic acid, 75 percent methyl amyl alcohol) would be added. By aeration and the addition of these chemical reagents, the copper sulfide mineral grains are physically separated from the ore pulp in a froth. The copper sulfide-rich froth, called rougher concentrate, would be continually removed from the top of the flotation cells. The impoverished pulp from the rougher cells constitutes the plant tailings and would be pumped to the waste containment area. The rougher concentrate would be cleaned in a bank of cleaner cells and recleaner cells to produce the final mill concentrate and a cleaner tailings which would be returned to the head of the rougher flotation cells for recycling.

1.067 The final concentrate would be pumped to a thickener and then to two vacuum filters located in the concentrator building for further dewatering. Filter cake would then drop onto a reversing conveyor from which it would proceed either of two ways: it would proceed by conveyor directly to rail shipment or stockpiling with a moisture content of approxiately 13 percent, or it would proceed by conveyor through a concentrate dryer and then to rail shipment or stockpiling with a moisture content of approximately 7 percent. Concentrate stockpiling will be within a covered type enclosure to prevent dusting problems.

1.068 The noise level from the concentrator and, in particular, close to the crushing section (which normally operates on day shift only, five days per week) is estimated to be below legal limits (90 dBA). This is based on noise levels at other Kennecott operations. For example, the noise level 3 feet away from the open door of the Bonneville, Utah, concentrator, which can crush and grind 35,000 tpd of run-of-mine ore from the Bingham Pit, is 74.0 dBA and 85.0 dBC with the crusher section running, compared with 62.5 dBA and 72.0 dBC with the crusher idle. (The dBA scale most resembles the response of the human ear; the dBC records impact peaks with no levelling effect.)

1.069 The dikes of the waste containment area would continue to be built up in 12 1/2-foot lifts with a vertical 40-foot wide saprolite (clay) core in the center. Each layer would be mechanically compacted to 95 percent of the maximum dry density. Each lift would be stepped back on the outside wall, a horizontal distance of 30 feet from the edge of the lift below. As portions of each lift are completed, they would be covered on the berm and slope with a six-inch layer of the silty sand from the till, mixed with suitable mulch and fertilizer, and planted. Indigenous trees would be established in soil-filled holes on the berms.

1.070 The tailings slurry would contain the following concentrations of typical reagents used in the concentrator:

Reagent	Parts Per Million (ppm)
Promoter - Aerofloat 238	0.45
Frother - Cresylic acid	14.00
Frother - methyl amyl alcohol	16.00

The toxicity of the promoter and the methyl amyl alcohol frother in the strengths above is minor. Concentrations of 100 to 200 ppm over periods of 3 to 5 days would be required to kill fish such as trout and salmon. Furthermore, the promoter biodegrades and the concentration is reduced to 0.1 ppm after 15 days. The methyl amyl alcohol frother biodegrades to a concentration of 0.5 ppm in 16 days. The cresylic acid frother in the above concentration is toxic to fish life. Cresylic acid, however, in the presence of organisms found in tailings solutions, completely breaks down into harmless constituents in less than 8 days. The high alkalinity of the solution inhibits the oxidation of pyrite during mine operation. Computer studies based on the measured permeabilities of the soils in the floor of the waste containment area and the constituents of the dikes show that it would take much more time for any leakage to traverse from the inside to the outside of the waste containment area than is required for reagent degradation. The quantity of leakage from the waste containment area is estimated at less than 25 gpm. Sampling and analysis of the groundwater would be carried out on a continuous basis until seepage chemistry and treatment measures can be established in practice.

1.071 The 50-ton trucks would be carrying waste to the waste containment area normally on day shift, but there may be occasions when a second and even a third shift may have to be used. Water trucks would be used to prevent dust formation in dry weather and also to water the vegetation on the slopes of fill areas until it is well established.

1.072 The tailings from the concentrator consist of rock and minerals ground so that approximately 94 percent passes a 200 mesh sieve. The tailings slurry, which is 25 percent solids, is piped into the waste containment facility via an 8-inch pipeline paralleling the haul road on the east of up-slope side. One of the design criteria is adequate provision for containing spillage in the event of a pipe break. In the event of a loss of head due to a pipe break, the pumps would automatically trip out, but pulp already in the pipeline would flow by gravity into the ditch. It would flow to catchment basins for emergency tailings storage.

1.073 The tailings would eventually comprise a semi-consolidated mass of high density, near 120 lbs. per square foot, after mining ceases. During mining activity, the mass would be saturated to prevent dust generation and oxidation. Near shoreline characteristics, where the coarser grain tailings would settle due to peripheral discharge, may become firm enough to support a man and some light equipment. However, further out in the area, an unconsolidated zone of slimes and water would exist which would be nonsupportive except for the floating reclaim water raft.

1.074 Concentrate loading of railcars would take place outside the concentrator building by means of a conveyor belt tripper on the conveyor line to the stockpile enclosure. A retractable loading and filling spout would be utilized to minimize dusting problems from this type of loading system. Sufficient railtrack would be provided beyond the load point to allow for the anticipated railcar storage. Alternatively, concentrate would be loaded into railcars from the stockpile enclosure with a front-end loader.

1.075 At the present stage of project planning, the smelting facility for processing Flambeau concentrates has not been determined. Kennecott presently operates four copper smelters in the western states. The Flambeau concentrates would conceivably be sent to one of these company operations or to one of several custom smelters in the U.S. or foreign countries. The company has no plans to build a smelter in the State of Wisconsin. The size of the Flambeau deposit is not large enough to justify economically the construction of a smelter.

1.076 The principal energy used in the project would be electricity. It is estimated that during the productive life of the open pit mine-mill operation, the weekly power usage would be 219,240 kilowatt-hours, and that the maximum 15-minute demand would be 2,600 kilovolt-amperes. The load factor and power factor are estimated to be 0.75 and 0.87 respectively. An additional 367,553 kilowatt-hours per month would be required for an underground operation, and the estimated 15-minute demand would be increased by 1,800 kilovolt-amperes. Diesel fuel use is estimated at 15,625 gallons per month and gasoline use is projected to average 590 gallons per month.

1.077 The various buildings would require heating in the winter and, although the engineering for the concentrator and other ancillary facilities has not yet been completed, a preliminary estimate of the heat requirement is:

	Floor Area Square Feet	BTU's Per Hour
Truck shop	2,700	540,000
Warehouse	1,350	135,000
Offices	1,350	135,000
Concentrator	5,500	550,000
TOTAL	10,900	1,360,000

The building heating systems would be capable of firing either No. 2 fuel oil or alternately coal in anticipation of future fuel shortages of either oil or coal. Centrally-located steam boilers would produce buildings. No. 2 fuel oil is a standard, domestic heating oil with a typical 0.3 percent sulfur content. This oil has a heat content of 140,000 BTU's per gallon, of which 80 percent can be converted to useful steam heat. During the winter months, it is estimated that an average of 175 to 290 gallons per day would be required. Bituminous coal has a heat content of from 12,500 to 13,000 BTU per pound, of which 80 percent can be converted to useful steam heat. It is estimated that an average of 1.6 tons per day would be required during winter months. Use of Illinois coal with a 1.7 percent sulfur content would produce 54.4 pounds of sulphur dioxide per day.

1.078 It is estimated that 223 gpm of water would be required for industrial purposes, 73 gpm as new makeup water for the concentrator and 150 gpm for workshops, road sprinkling and other sundry uses. It is anticipated that most or all of this water could be obtained from water inflow into the pit water collection ditches and sumps, plus precipitation into the pit and waste containment area. Additional outside water supply, if needed, would be obtained from high capacity wells constructed in the west half of Government Lot 8, Section 4, T34N, R6W.

Rehabilitation Phase

1.079 The rehabilitation of the mine area would be a continuous process commencing with exploration and continuing for some years after the mine has closed down. During the life of the operation, a total of $2,136,000 has been estimated for environmental control and site rehabilitation. These funds amount to 9.3 percent of the estimated $23 million operating costs (11 year) or 14.2 percent of the initial $15 million initial capital investment. No specific breakdown of the estimated environmental and site rehabilitation costs has been made since 1) compliance requirements are not totally known and 2) inflation could make dollar estimates based on 1974 values deceptive.

1.080 Eight separate tree screens were planned for the 842 acres immediately adjacent to the mine pit, haul road, concentrator and magazine buildings, soil stockpiles and the waste containment area. Indigenous trees, selected and planted according to advice from local DNR foresters, have been planted in four of the areas: west of State Highway 27 and east of the haul road, for one-fourth mile of State Highway 27 and east of the process plant and mine area (Section 9); west of State Highway 27 and east of the haul road, for one-fourth mile south of Meadowbrook Creek (Section 16); west of the process plant site beside the Flambeau River (Section 9); and north of the proposed pit between the mining operation and Ladysmith. Data on soils, water supply (existing and expected), land use history and the projected uses of the land at the close of mining were all considered in the development of these screens so that the probability of success could be maximized. The screen plan developed around the

mine pit has been produced using tree species that can survive the expected lowering of the water table around the pit, plus certain species known to be capable of tolerating modest root-wetting which probably would occur if the pit is rehabilitated as a lake. Local plant materials have been used, and many tree screens already planted include trees moved from the area of the mine pit. The site would also be used to test experimental plant materials in conjunction with the Soil Conservation Service.

1.081 Revegetation of roadsides and the dikes of the waste containment area is a priority item during the construction phase because allowing these to be unprotected would result in serious erosion and siltation problems for Flambeau. Revegation schemes were developed for the fifteen-degree sloped lip of the mine pit, the settlement basin in the old gravel pit, the haul road, and the dikes of the waste containment area. Soils used as dressing materials would be tested and treated with conditioners as needed to ensure a well-developed seed bed. The ecological tolerances and uses of available plant materials have been considered in the context of expected conditions. For example, emerald crown vetch is a tenacious and excellent revegetator of slopes up to 40 degrees and will persist even on north-facing slopes in northern Wisconsin. However, crown vetch is less used by wildlife than birds-foot trefoil, but the trefoil will not persist on north-facing or shaded slopes. Accordingly, plans are to use the trefoil in sunny locations, and the crown vetch under more stressful conditions. Waterloving grasses (reed canary or garrison creeping foxtail) would be used in ditches, on the inside of settling basins, and on the inside of the waste containment area. Sodding could be employed wherever special problems are anticipated such as the haul road crossing of Meadowbrook Creek. These plans are aimed first to prevent erosion problems that would cost a great deal to correct, and secondly to provide an improved wildlife habitat and aesthetic value to these areas.

1.082 The principal metal mining activity would physically disturb a core area of 312 acres. All mining related activities would be confined within a total area of 842 acres. The remaining 1,908 acres are expected to be used as visual screens and a buffer zone around the mine-dominated core. The major portion of this land is in agricultural production, mostly as pasture, with lesser acreages in other uses. It is planned to continue most of these land uses and to apply the best available techniques for improving the economic yield from these lands. Some acreage would be converted to new uses. Lands leased to tenant farmers or selectively cut would be monitored by the company. Intensive yield forestry would be practiced on part of this acreage according to recommendations by the Department of Natural Resources.

1.083 The buildings that have been installed during the mining operation would be removed and reused elsewhere or otherwise disposed of. The exposed surface soil would be recovered and any foundation excavations filled in with fresh soil from the soils stockpile area and these sites replanted either to grasses or trees.

1.084 The surface of the haul road, the magazine road and the parking areas not to be included in the final lake rehabilitation plans would be ripped and plowed or disced to prepare an adequate seed bed. The road would be allowed to revert naturally or may be planted as required to more quickly reacquire a natural character.

1.085 The disposal or rehabilitation of the railroad spur and power lines would be studied and appropriate courses of action taken at mine closing as recommended by the appropriate authorities in the light of the expected land uses for these properties. Generally, if not required for any other purpose, Flambeau would plan to dismantle and remove these facilities.

1.086 The estimated 135 million gallons of water remaining in the waste containment area would be discharged to the pit or the Flambeau River (see Alternatives Section). The surface of the waste containment area would be covered with at least 12 to 18 inches of low-permeable silty soils after the dewatering is complete. The area would be planted to local vegetation. The shape of the replanted waste containment area would be that of a large (about 130 acres) very shallow bowl sloping at one-half percent or less toward the center. To drain this basin, a channel would be cut from the center to the southeast. This channel would cut through the dike at an elevation and width capable of passing waters of the 100-year flood. The channel would be concrete lined with a concrete spillway through the dike and down the southwest wall. This permanent drain system should reduce movement of water through the tailings after the mine is shut down.

1.087 The open pit would be filled with water to an approximate elevation of 1,092 feet above sea level to form an ellipsoidal-shaped lake of approximately 50 acres having a maximum depth of approximately 250 feet. In anticipation of a record storm, a sluiceway would be constructed to meet the 100-year flood condition. This sluiceway could either be built on top of the 5-foot levee between the pit lake and river, or the levee could be removed and the sluiceway constructed upon the restored land surface.

1.088 It is the intent of Flambeau to create a lake having acceptable water quality. Since the final alternative for filling the lake has not been selected, feasible alternatives are presented in the Alternatives Section of this document.

2.000 ENVIRONMENTAL SETTING

PHYSICAL ENVIRONMENT

Climate

2.001 The proposed project site is located in a humid continental (cool summer phase) climatic belt which stretches from New England, through the Great Lakes States, into south central Canada. The winters are long, snowy, and cold while the summers are relatively short with a few short periods that are hot and humid.

2.002 Weather observation data are available for Weyerhauser which is located 18 miles west of Ladysmith. Limited data are also available for Ladysmith from 1965 to 1971 (Ladysmith Ranger Station).

2.003 The long-term monthly mean temperature at Weyerhauser varies from a low of 12.4 degrees Fahrenheit in January to a summer high of 68.7 degrees Fahrenheit in July. The lowest temperature recorded at Ladysmith in recent years was -33 degrees and the maximum was +94 degrees. The minimum-maximum range recorded at Weyerhauser is -41 degrees to +109 degrees.

2.004 Precipitation at Weyerhauser averages 30.10 inches per year. Data taken at Ladysmith for 1965-1971 indicate an average annual precipitation of 35.73 inches. A comparison of these figures reveals a recent succession of years with above average precipitation. Long-term average monthly precipitation is lowest in January and February and highest in June, July and August. The greatest total precipitation for one day was 4.06 inches for a day in August 1941.

2.005 Wind data are not available for Weyerhauser. Data interpolation from Minneapolis and Wausau should approximate the long-term wind patterns. The prevailing winds are westerly from late fall through early spring and from south and westerly directions the remainder of the year. April and May are the windiest months, and July and August are the least windy. Wind direction and velocity at Ladysmith have been measured from April 1 to October 1 during recent years. The highest monthly average wind velocity is 11 mph during May and the lowest average wind velocity is 7.9 mph during August.

Ambient Air Quality

2.006 Rusk County is located in the Northwest Wisconsin-Duluth, Minnesota Interstate Air Quality Control Region. There has been no long-term air quality monitoring in Rusk County.

2.007 Air quality in Ladysmith can be assumed to be similar to or better than that of Eau Claire (pop. 44,619) for which air quality data exists. A summary of air quality data and the National Ambient Air

Quality Standards is presented in exhibit 15. From these data it appears that ambient air quality near the mine site would comply with current standards.

2.008 The only major air pollution source in Ladysmith had been Peavey Paper Mills, Inc., which emitted 762 tons of particulate and 585 tons of sulfur oxide in 1974. Particulate emissions for 1975 and subsequent years will be substantially reduced due to the recent installation of air pollution control equipment.

Ambient Noise Levels

2.009 Flambeau conducted a survey of background noise levels at 27 sites on or near the mine site. The results are presented in exhibit 16. The average noise levels were elevated when the Ladysmith Sand and Gravel processing plant was in operation. There were no sustained noise levels during the surveys that exceeded the Occupational Safety and Health Administration standard of 90 dBA for an 8-hour period.

Geology and Topography

2.010 The Canadian Shield is an extensive region of Precambrian-age rock that forms the bedrock for a land area of about 1,800,000 square miles. Most of this area lies in Canada, but about 93,000 square miles lie in the northern parts of Minnesota, Wisconsin and Michigan. Major rock types of the Shield consist of gneisses, mixed-volcanic suites and the so-called greenstone belts, and sediments including banded iron formations. Surrounding, intruding and replacing these rock types are intrusive igneous rocks of varying compositions. All of these rocks have been subjected to structural deformation (folding or faulting) during Precambrian time. However, they have been little disturbed since Cambrian time, and the Shield now forms one of the most geologically stable areas on the earth's crust. Present-day seismic activity in the region and in Rusk County is extremely low.

2.011 It is within the greenstone volcanic belts that a considerable portion of the massive sulfide deposits are found. Greenstone belts consisting of volcanic and volcani-sedimentary rocks are found in northern Wisconsin and are generally covered by a thin mantle of Pleistocene glacial material or, further to the south, by ever-increasing amounts of younger Paleozoic sediments.

2.012 One of many such covered greenstone belts lies south of Ladysmith in Rusk County. It is within this steeply-dipping northeast-trending complex suite of volcanic rocks that the Flambeau deposit was identified in 1968. The volcanics are terminated west of the project site by a granite intrusion which is believed to be the southern extension of a large granite body underlying Ladysmith. There is no indication that sulfide mineralization extends beneath Ladysmith.

2.013 The Flambeau deposit is completely covered by Pleistocene glacial material. The glacial material varies in thickness from 10 feet over the mineralization between the river and pit to 30 feet at the east end of the proposed pit. Rapid thickening of the glacial material to the northwest suggests the presence of an ancestral Flambeau valley now filled with at least ninety feet of gravel-rich outwash. These outwash deposits are currently being mined for gravel and are locally an important source of well water. East of the outwash is a south-southwest-trending transition zone. This zone, of variable width, composition and permeability, is a transition between the outwash material and the more silt-rich till deposits to the east. Glacial till, characterized by high silt content, variable composition and generally low permeabilities, overlies the southwest, south and east half of the ore body. Interbedded with and overlying the till is a silty sand probably derived from windblown material.

2.014 Overlying the Precambrian bedrock at the mine site but beneath the glacial material is a thin outlier of flat-lying Cambrian sandstone. The sandstone, a clean, well-sorted friable rock, lies directly over the copper mineralization. Absent over the western one-third of the ore body, it reaches a maximum thickness of thirty feet over the northeast end of the orebody and thins to zero feet approximately 500 feet on either side of the ore body. It continues northeastward for an unknown distance.

2.015 In late Precambrian time, intensive weathering and disintegration of the steeply-tilted volcanic rocks formed a clay-rich layer, termed saprolite, at the Precambrian bedrock surface in the ore body area. The saprolite layer is thickest adjacent to the ore body and beneath the Cambrian sandstone, and thins rapidly away from the mineralization under the glacial cover. Saprolite is particularly well developed in those rocks rich in plagioclase feldspar such as the actinolite schist. The presence of this saprolite layer limits groundwaters from reaching the Precambrian bedrock surface.

2.016 The Precambrian bedrock consists of a complex interfingering suite of volcanic and volcaniclastic rocks now metamorphosed and altered to schists and phyllites. These rocks were probably volcanic flows, ash beds, pumice deposits and volcanic-derived sediments of Middle Precambrian age. Within this complex volcanic pile is a distinctive rock type, a quartz-sericite schist, termed the ore horizon, since it contains the copper ore body. The ore horizon pinches and swells along strike for 15,000 feet and varies in width from 25 to 200 feet. Only the one ore horizon containing the single known ore body has been found exhibit 17 . This ore body extends under the Flambeau River.

2.017 The ore horizon, because it contains more quartz than the adjoining rocks, has resisted erosion to form a gentle broad northeast-trending ridge in the Precambrian bedrock surface. This bedrock ridge is of significance to the development and operation of the open pit mine, for it acts as a natural impermeable barrier between the river and the pit located some 300 feet to the east. The buried ridge rises beneath the east bank of the river to reach a subsurface elevation of 1,095 feet under the west pit perimeter. This elevation is approximately 10 feet higher than the average river level.

2.018 The Flambeau ore body lies conformably within a quartz-sericite schist and is intimately associated with lenses of metachert. The ore body strikes north 45 degrees east and dips approximately 70 degrees to the northwest. Diamond drilling has outlined a tabular-shaped sulfide deposit 2,400 feet long, averaging 50 feet in width, and extending to 800 feet beneath the surface. Deeper drilling has not intersected economical mineralization. Massive sulfide mineralization, greater than 50 percent sulfide, grades at depth into semimassive sulfides which vary from 20 to 50 percent sulfide. An envelope of disseminated sulfides, predominantly pyrite with minor amounts of chalcopyrite, encloses the ore body and is found along strike within the ore horizon. The width of this pyrite halo averages 110 feet to the north of the ore body but only 55 feet to the south. Contacts between the massive-semimassive ore body and the enclosing rock vary from knife-edge sharp to gradational over 15 to 20 feet. Therefore any improvements in mining technology or higher copper prices would not have an appreciable effect in increasing ore reserves.

2.019 Pyrite is the predominant sulfide mineral. The chief copper mineral is chalcopyrite which is found scattered throughout the pyrite. In the upper or north wall of the ore body the sulfides are crudely banded; however, the character of the mineralogy changes across the ore body as well as with depth. Sphalerite, a zinc sulfide, increases noticeably toward the lower contact of the ore body, imparting a well-banded appearance to the ore body when mixed with pyrite and chalcopyrite. At depth, pyrite decreases, sphalerite is reduced to minor amounts, and the chalcopyrite grains coalesce to form irregular masses. The uppermost 50 to 150 feet of the ore body were enriched in copper during the ancient weathering interval which produced the clay saprolite. Chalcocite is the predominant copper mineral in the upper portion of the enriched zone, whereas bornite predominates in the lower half. The disseminated pyrite halo has been enriched on either side of the massive sulfide vein. Zinc minerals are virtually absent in the enriched zone.

2.020 Copper with trace amounts of gold and silver would be produced from the Flambeau ore body. Although small amounts of zinc are found in the lower wall and in satellite lenses beneath the vein, the company reports insufficient tonnage to warrant recovery under present economic conditions. The company has tested the ore for asbestos. They report that "no cummingtonite (asbestos) or other problem fibrous silicate minerals" are present in the Flambeau ore. Their absence is important from a public health standpoint since asbestos fibers are suspected to cause lung cancer when inhaled in small quantities over an extended period of time.

2.021 Excluding the valley of the Flambeau River, the majority of the landforms within the project area were formed during the last glacial period, about 12,000 to 16,000 years ago. This period was the Woodfordian substage of the Wisconsin stage of the Pleistocene epoch. Glacial deposits average 30 to 50 feet thick and in some localities exceed 100 feet.

2.022 Although sizable flatland tracts do exist, most of the area varies from undulating to slightly hilly. With few exceptions, the flat areas occupy the floors of depressions and are poorly drained. Elevations range from a low of approximately 1,090 feet, where the Flambeau River exits the site, to a high of approximately 1,170 feet east of the deposit. Steep slopes and greatest relief are generally restricted to the outside banks of the meandering Flambeau River. These river bluffs typically range between 30 and 50 feet, but rarely exceed 60 feet in relief. No rare or particularly unusual landforms have been identified within the area controlled by Flambeau. The banks of the Flambeau River have some scenic value.

2.023 The outwash deposits of the Flambeau Valley are located inside (enclosed by) the large meanders of the Flambeau River. Normally, outwash plains are quite flat, but because the Flambeau outwash was deposited on irregularly-shaped stagnant ice, basins or pits were created by subsequent melting of the ice. It is difficult, based on topography, to distinguish valley outwash from adjoining areas of hummocky stagnation moraine or from the ground moraine to the east in Section 9. Further complicating the differentiation between the permeable outwash and the less permeable ground moraine in the mine site is the presence of a thick aeolian blanket of sand which overlies and obscures the contact. This sand blanket, up to 10 feet thick, is derived from sand blown from outwash to the west.

2.024 The most significant characteristic of the Flambeau River Valley in the project area is its distinctive meandering form. Meandering streams usually have floodplains, however the distinctly meandered segment of the Flambeau River between the Dairyland and Thornapple Dams possesses virtually no floodplain. The valley is typically asymmetrical in cross-profile with steep, high relief, undercut slopes on the outside of the meander curves and gentle, low relief, slipoff slopes on the inside. The meanders of the Flambeau River are disproportionately large for its present discharge. In fact, the radius of curvature of these meanders is greater than that of the meanders on the Chippewa River near its mouth. They appear to have formed late in the glacial period after outwash deposition had ceased, and after the glacier had receded from the immediate area, but while the Flambeau was still receiving large quantities of glacial meltwater. If this is correct then the course, depth, and form of the Flambeau River valley have changed very little in all of postglacial time - about 10,000 years.

Soils

2.025 Soils in the project area are predominantly silt loams derived from thin local loess overlying acidic sand and gravel outwash and stony sandy loam reddish brown glacial till. These soils are productive of small grain and hay crops commonly planted on dairy farms of the area.

2.026 Natural drainage ranges from good over outwash where the water table is below 4 feet, to poor where the water table rises seasonally above the soil surface on both till and outwash plains. Some soils derived from outwash have a sandy loam surface texture, rather than silt loam. Also present are bodies of wet alluvial soils, mucks and peats.

2.027 The Soil Conservation Service has mapped soils to a depth of 5 feet over the northern end of the project site exhibit 18. The Onamia (#38) soil is a well drained loamy soil over sand and gravel outwash. The Brill series (#48) is a moderately well-drained silty soil underlain by sand and gravel at 20 to 40 inches. At the southwestern end of the proposed pit are Chetek (#33) series soils. These are loamy soils on a small set of stream terraces. The major soil series over the northeast end of the proposed pit is Poskin (#324). This soil type is a somewhat poorly drained silt over acidic sand and gravel. The water table is 1 to 3 feet below the surface.

2.028 The company has tested the geologic soils in the proposed plant area to a greater depth to determine their suitability for construction. The soils consist of an upper layer of silty sand to 8 or more inches below the surface. This deposit is underlain by cleaner gravelly fine to coarse-grained sands. Clay deposits were found beneath the sands approximately 20 to 35 feet below the surface. The clays are quite firm, with low water contents and unconfined strengths in excess of 4.5 TSF (tons per square foot). Below the clay is a dense silty and clayey sand or silty sand with varying amounts of gravel to either the sandstone or bedrock.

2.029 Soils along the proposed haul road route are primarily the Freer (#156) and Alban (#330) series. Although no particular problems would be expected with the Alban series, the Freer soils are poorly drained with a water table at less than 3 feet. This soil is highly susceptible to frost action.

2.030 Soils in the area of the waste containment site in Sections 20 and 21 consist of two associations: Almena-Auburndale and Peat. Almena-Auburndale association occupies a broad nearly level to gently undulating glacial till plain. The Almena soils are somewhat poorly-drained silt loam found on low broad interstream ridges. Auburndale soils are poorly drained and found at the foot slopes of the Almena. The silt loans have a well developed but thin silt-rich cap. Because of the above average silt content and the topographical position of the Auburndale soil in broad depressional areas, perched water tables or surface water areas are commonly found. The company has conducted extensive soil testing in the proposed waste containment area. The borings generally revealed at least 42 to 48 inches of tight silts or clayey silts (Auburndale). Two interior borings had 20 and 24 inches respectively.

Hydrology

Flambeau River

2.031 The proposed project site includes an unimpeded 4.2-mile segment of the Flambeau River (see exhibit 19). The river drains a total area of approximately 1,993 square miles, 1,838 of which are in Rusk County. The Flambeau has a low gradient of about 3 feet per mile. There are nine dams and impoundments on the river, four of which are in Rusk County. The nearest dams are the Thornapple Dam (13 foot head) located about 9 river miles southwest of the project site and the Peavey Paper Mill Dam (17 foot head) located approximately 3.8 miles above the site. The other dams on the Flambeau in Rusk County are the Dairyland REA

(REA-Rural Electrification Administration) Cooperative Dam (68 foot head) and the Big Falls Dam (50 foot head) both of which are located upstream from the project site.

2.402 Through the project site, the Flambeau River is a broad, meandering, entrenched stream with very little floodplain. The average width of the river is 350 feet and the average gradient is approximately 2 feet per mile. The course of the river at the project site has apparently changed very little in postglacial time. The disproportionately large meanders were probably formed while the Flambeau River was receiving large quantities of glacial meltwater.

2.032 River flow data are kept at a U.S. Geological Survey gaging station located 2.5 miles downstream from the Thornapple Dam. Average (mean) discharge at the station is 1,776 cubic feet per second (cfs). Normal or median discharge is 1,500 cfs. The recorded maximum discharge was 17,400 cfs on May 1, 1954, and the recorded minimum was 100 cfs in August of 1957. The discharge rate which is equalled or exceeded 95 percent of the time has been established as 734 cfs at Ladysmith. River flows in the Ladysmith area are influenced by rainfall, snowmelt and runoff, and the operation of several power plants, especially the Dairyland Dam.

2.033 Observations by the DNR since 1969 indicate an average water level of the Flambeau River west of the ore deposit of 1,085 feet above mean sea level, (msl), and a normal high water mark of 1,086 msl. Prior to 1969, the average water level at this site was 1,094 msl, but removal of the Port Arthur Dam, six miles below the mine site, has lowered the average level by 9 feet. Flood elevation and flows for a 100-year recurrence flood have been estimated from data provided by the Big Falls gage station. A 22,500 cfs 100-year flow has been predicted which would crest at an elevation of 1,098 msl, or 13 feet above the average water level. These flood elevation calculations were based on a velocity of 4.5 feet per second using the Conger method.

Tributary Streams

2.034 There are seven small streams which drain into the Flambeau River from the project site (see exhibit 20). Stream D (Meadowbrook Creek) and Stream G have continuous flows. Streams E, F and G have been channelized over parts of their lengths and generally exhibit sluggish flows. Maximum discharge rates of these streams in 1973 were measured or estimated by company personnel.

Stream	Maximum Discharge - 1973 cfs
A	1.0
B	1.4
C	6.2
D (Meadowbrook Creek)	No measurement
E	3.1
F	1.1
G	3.1

Discharge rates for streams A, B, C, F, and G were measured using the V-notch weir technique. The discharge of Stream E was estimated from data on stream G. The Meadowbrook Creek discharge rate was not measured in 1973; however, the 100-year occurrence flood discharge was estimated to be 1,800 cfs using the Conger technique.

2.035 There are two small man-made ponds located in the NE¼SE¼ of Section 9. Other small wetland areas and ponds of less than one acre are present in depressional areas throughout the project site.

2.036 Much of the eastern portion of Section 20 and the western part of Section 21 consists of wetlands. These wetlands extend into the west half of Section 20 beyond the project area and occupy a total area of approximately 470 acres. This area is drained by Stream G which flows some 2.6 miles to its mouth at the Flambeau River in the SE¼, Section 24, T34N., R.7W. Water usually stands over this area to a depth of 1 foot or more. The area is underlain by a few inches to several feet of peat.

Surface Water Quality

2.037 The Flambeau River is required to meet the water quality standards for recreation, and fish and aquatic life of Chapter NR 102 of the Wisconsin Administrative Code. The applicable standards are given in exhibit 21. There are seven major discharge points in the Flambeau River basin, all of which are above the mine site. Exhibit 22 summarizes these major effluent sources.

2.038 The effluent sources which most directly affect the surface water quality at the mine site are the City of Ladysmith sewerage treatment plant and the Peavey Paper Mill discharge.

2.039 The DNR did water quality sampling of the Flambeau River near the project site in 1969. Flambeau Mining Company has conducted more detailed water quality analysis along the Flambeau River since April 1970 and continues to the present. The data obtained from these surveys is on file with the St. Paul District, Corps of Engineers and may be obtained upon request. The survey results show that, generally, State water quality standards are satisfied. However, there are significant concentrations of iron, manganese, nitrate, and phosphates.

2.040 The following parameters are considered to be indicative of Flambeau River quality within the project area:

Hardness - The water is considered to be soft, or moderately soft. Total hardness ($CaCO_3$) averages less than 50 mg/1, (milligrams per liter) total alkalinity (bicarbonates) less than 40 mg/1 and the pH is within a neutral range and meets state standards.

Dissolved Oxygen - The dissolved oxygen (DO) content varied mainly with seasonal changes of temperature and remained above the 5mg/1 minimum standard with the exception of the Ladysmith sewage effluent.

Solids - More than half of the total solids (total residue) in the river were volatile or probably organic in nature. Increases in total, suspended and volatile solids immediately downstream from the Ladysmith sewage outfall as well as increases in soluble phosphorus, chlorides, BOD, and fecal coliform counts document that organic effluents are being introduced from the sewage treatment plant.

Phosphorus - Soluble phosphorus may be a limiting factor for plant growth during certain periods of the year. The required range of available phosphorus for growth of most algal species is 0.01 to 0.05 mg/l. Soluble phosphorus concentrations in the Flambeau average 0.04 mg/l with a minimum concentration of 0.006 mg/l.

Available Nitrogen - Although the technique used for nitrate analysis is regarded as inaccurate, the estimated nitrate concentrations appear quite normal for stream waters of this type. However, the ammonia values are excessively high. In oxygenated systems, ammonia is converted to nitrates or nitrites and a concentration of more than 0.1 mg/l is indicative of organic pollution. In the Flambeau system, the excessive ammonia levels present may reflect the decay of organic matter in the oxygen-poor waters of wetlands tributary to the river. Deposits of peat and other materials are abundant in backwater areas of the Flambeau and the man-induced water level changes in this stretch of the river cause large fluctuations which periodically flush water out of these areas of anaerobic decomposition and ammonia production. Total available nitrogen is not a limiting factor for plant growth in the river.

Heavy Metals - Reported levels of heavy metals varied considerably in the company testing.

Arsenic - Concentrations of arsenic greater than 0.05 mg/l constitute a hazard in the marine environment. Levels less than 0.01 mg/l present minimal risk of deleterious effects (EPA, 1972). The concentrations reported in the water quality study were quite consistent and appear to be normal for this environment. Arsenic does not appear to be detrimental in its present concentrations.

Iron and Manganese - Average levels of these metals were not found to be unusual for this drainage basin, but the excessive variation between samples is noteworthy. Concentrations in excess of 0.3 mg/l constitute a hazard to marine life and are aesthetically displeasing to humans due to the effects on the taste of the water if it is consumed. At times iron concentrations exceed recommended standards. Levels below 0.05 mg/l present minimal risk of deleterious effects to marine life (EPA, 1972).

Zinc and Copper - Values of up to 4.8 parts per million (ppm) zinc and 0.40 ppm copper were reported. Such concentrations could have retarded diatoms and other algal species growth. At an average hardness concentration of the Flambeau and 22 degrees Centigrade, 4.29 mg/l of zinc would reduce the growth of a diatom population by 50 percent; however, at 30 degrees Centigrade, only 1.32 mg/l produces the same effect. Therefore, the zinc concentrations of 4.8 and

3.9 mg/l reported from Stations 1 and 4, respectively, during July 1970, probably had an adverse effect. Lower values of 1.2 and 2.4 mg/l zinc were recorded during June 1970. Copper in excess of 0.15 mg/l produces a noticeable effect on Scenedesmus (algal species). Copper sulfate concentrations as low as 0.05 mg/l have been found to be harmful to certain algal species. Toxic effects may have been present during April and May 1970 when concentrations exceeded the indicated harmful values.

Fecal Coliforms - Coliform counts vary considerably in both surveys. Downstream of the Ladysmith sewerage outfall, fecal coliform counts alone regularly exceed the 200/100 ml total coliform standard established for recreational use. This could constitute a public health hazard for swimming. (Wisconsin Administrative Code, NR 102).

2.041 The water quality of Stream G (see exhibit 20) is much lower than that of the Flambeau River itself. Dissolved oxygen concentrations met State standards only twice during the survey. Total solids averaged 260 mg/l higher than at the highest station on the Flambeau. Suspended solids average 91 mg/l higher, total iron averaged 2.74 mg/l higher, soluble phosphates averaged 0.26 mg/l higher, total volatile solids averaged 72 mg/l higher, chlorides averaged 1.8 mg/l higher, color averaged 80 standard units (s.u.) higher, hexane extraction averaged slightly higher, nitrates averaged higher by 0.26 mg/l, and odor averaged slightly higher than the Flambeau River. This tributary is a very small stream flowing through a swampy area. At times during the warmest months, the company reported difficulty in taking samples because of the extremely low stream flow. The decaying vegetation in the area no doubt contributed much to these results.

2.042 The excessive variation of several water quality parameters plus human-caused water level changes in the Flambeau result in a mixed water quality. Poorest water quality exists immediately downstream from Ladysmith, as a result of the combined effluents from the municipal sewage treatment plant, the paper mill, and the water level fluctuations. Fecal coliform counts and dissolved oxygen were the only parameters that might frequently fail to meet State water quality standards. Copper and zinc concentrations may be harmful to plant and invertebrate populations during certain times of the year. Iron concentrations may also be harmful to aquatic life.

2.043 Lowered water levels, due to the removal of the Port Arthur Dam, coupled with spring runoff and man-caused surges resulting from power generation above the mine site, combine to physically disrupt the river ecosystem. Periodic flushing of stagnant waters from shoreline areas could be one cause of the high levels of ammonia and heavy metals that appear in the river waters both above and below the project site. However, although specific river flow rates were not taken during sampling of the Flambeau River, there is no correlation between high iron concentrations and high river flows, the season of the year, or sampling point locations on the river. Heavy metals associated with scattered areas of mineralization in the greenstone belts that are contacted by groundwaters could also be drawn into the river when the water levels are lowered. It is quite clear that the ecological condition of the river at present is unstable.

Groundwater

Mine Area

2.044 Within the project site, free groundwater is contained, with minor exceptions, in the unconsolidated glacial materials, the Cambrian sandstone which lies above the Precambrian bedrock, in the area of the ore body, and to a slight extent within the fractured Precambrian bedrock itself. The highly impermeable clay saprolite developed during ancient weathering of the Precambrian rocks serves as a barrier to downward movement of groundwater. As a result of this controlling factor, the slope of the present water table roughly parallels the nearly-horizontal ancient bedrock surface. The thickness of the zone of saturation above this surface ranges from 18 to 80 feet. Perched water tables, or zones of differential permeability, of limited areal extent occur in isolated areas above shallow layers of impermeable glacial material. Seasonal fluctuations in the depth to the main water table are on the order of 4 to 5 feet.

2.045 Movement of groundwater in the saturated zone above bedrock takes place through horizontally discontinuous but vertically interconnected aquifers.

2.046 Two basic types of glacial materials are present. The areas inside the large meanders of the Flambeau River are occupied by glacial outwash deposits consisting of moderately well-sorted sands and gravels. Elsewhere, the project site is largely underlain by glacial till consisting of an unsorted mixture of material. Aquifers are more abundant, extensive and better interconnected in the outwash deposits than in the till. Confined aquifers, perched groundwater tables, or zones of differential permeability, are more abundant in the areas underlain by till than in the outwash area.

2.047 To determine groundwater conditions in the proposed mine area, the company drilled 20 wells during June 1970 at the locations shown in exhibit 23. Low-capacity and short-duration pumping tests were conducted in eight of these. A total of sixteen tests from wells drilled in July 1973 were also conducted at selected locations around the planned pit perimeter. Additional information was obtained from nearby domestic wells, from the mineral exploration core holes, from soil test borings and from three shallow pits excavated to bedrock along the proposed southwest perimeter of the mine.

2.048 The average depth and configuration of the water table in the proposed mine and is shown in exhibit 23. The water table, which reflects the hydraulic gradients, slopes approximately 1.5 percent to the northwest across the ore body, steepens to 6 percent in the north-northeast-trending transition zone between glacial till and glacial outwash deposits, then flattens to 2 percent in the outwash material inside a large meander of the Flambeau River northwest of the ore body. The water table roughly parallels the slope of the Precambrian bedrock

surface which appears to slope 2 percent to the northwest into the ancestral Flambeau Valley, except along the southwest end of the proposed pit where the water table slopes to the southwest to the Flambeau River.

2.049 Fluctuations of the water table, measured in wells 6 and 12 in the area underlain by till and wells 8 and 15 in outwash, indicate that water table levels are controlled by precipitation and runoff rather than by river levels.

2.050 The transition zone between glacial till and glacial outwash, as determined by drill hole data, soil test borings, and geomorphological studies, is from 250 to 400 feet wide and follows the line defined by test wells 20, 12 and 40, as shown in exhibit 24. Hydrogeologic cross-sections related to exhibit 24 are presented in exhibit 25. Exhibit 26 summarizes the field test data and aquifer characteristics for wells 8, 9, 29, 34, 39, 42, and 43, and for the 16 field permeameter tests in the vicinity of the ore body. (The apparent low soil permeability at ST 9-18 may be explained by a small sample quantity obtained for this test. The low permeability at ST 9-22 may be due to silt and clay seams which were found in the sandstone.) The wells were located between the proposed pit and the Flambeau River in the outwash zone to test the area of greatest permeability, where aquifer yields were expected to be greatest. The highest permeability values were found in wells 8, 29, and 43. Well 43, located in outwash materials 300 feet from the river and 800 feet from the proposed pit, had the highest values. Drawdown tests performed on wells 29 and 34 (each surrounded by four monitor wells) supplied data that indicated very low values and yields for the outwash deposits. These data suggest that interaction of the Flambeau River with groundwater in the mine area is slight.

2.051 Bear Creek Mining Company, Kennecott's exploratory subsidiary, has sampled groundwater quality at the proposed mine area and at the proposed waste containment area. The results of their survey at the mine site are presented in exhibit 27. In all wells iron and manganese levels exceeded the respective recommended standards of 0.3 mg/l and 0.05 mg/l established by the U.S. Public Health Service and by chapter NR 111, Wisconsin Administrative Code as the maximum acceptable levels for potable water supplies (for aesthetic reasons). Copper, zinc and lead were also present in excess of normal background levels. Test wells 40 and 41 were found to average more than 1.0 part per million of copper, which exceeds State and Federal drinking water standards. The same wells also had high lead levels which exceeded the drinking water standard based on health considerations of 0.05 mg/l. Fecal coliform were found in all wells, but the test results are considered invalid because of the well construction and sampling methods.

2.052 The presence of high levels of zinc, copper and lead in several wells indicates interaction with the ore body, as does the pattern of pH recorded for the test wells. Wells 6, 40, 41, 29 and 17, sited at points across the strike of the ore body and progressively down the hydraulic gradient, had average pH's of 7.1, 6.2, 6.2, 6.4 and 6.7, respectively. The trend established by these data indicates interaction of groundwater with the ore body as the waters move down slope

across the body and then recovery by dilution to near neutrality in the sands and gravels to the northwest. Since there is also some groundwater movement to the southwest along the strike of the ore body, it is likely that this groundwater containing high concentrations of heavy metals is not diluted prior to entering the Flambeau River.

Waste Disposal Area

2.053 Groundwater conditions in the waste containment area were determined from data developed in 8 monitor wells and 60 soil test holes as shown on Exhibit 28. Hydrogeologic cross-sections of the area are presented in Exhibit 29.

2.054 The Precambrian bedrock surface slopes toward the northwest into the ancestral Flambeau valley in this area as it does in the area of the ore body. A layer of clay saprolite of variable thickness is also present at the bedrock surface. A thin remnant of Cambrian sandstone overlies bedrock west of the area. Glacial deposits overlying bedrock range in thickness from 55 to at least 124 feet and, except northwest of the area, consist of till overlain by a continuous mantle of silty materials ranging from 3.5 to 11.5 feet in thickness. Northwest of the area, topsoils are underlain by coarser-grained sandy materials which were deposited along the edges of a large stagnant ice mass which formerly occupied the present wetland area to the west. The wetlands occupy the site of a basin in the original ground moraine surface, which after the stagnant-ice mass melted, filled with lacustrine silts and a thick accumulation of peat.

2.055 Because of the presence of extensive layers of relatively-permeable silty materials at shallow depths over most of the area, perched water tables or areas of differential permeability are common. The depth of the soil to the normal groundwater table varies from about 15 feet at the highest point along highway P to less than one foot in the lowland area just west of the proposed waste containment area. The existing groundwater flow pattern is to the north-northwest. Most of the flow is toward the Flambeau River and emerges as seeps and springs along the river bank. Some groundwater does flow into the wetlands west of the proposed waste containment area.

2.056 In general, soil permeabilities are low to very low and uniform under the waste containment area. Presently, most incident precipitation runs off this area into the adjacent wetlands because of the low capacity of the soils to transmit water. Exhibit 30 lists the average permeabilities of the soils which underlie the area. Most of the soils tested had permeabilities near 1 foot per year (1×10^{-6} cm/sec) (centimeters per second), although some permeabilities were as low as 0.03 ft/year (2.8×10^{-8} cm/sec). The thicknesses of these relatively impermeable strata range from the surface down to 3.5 feet to more than 11 feet deep. Northwest of the proposed waste containment area the 3.5 feet of impermeable soil (Soil 4, 1 foot/year) is underlain with a layer of more permeable sand (Soil 5, 1,000 feet/year). All of the testing consistently showed that the permeability of the near-surface soils was quite low, and in fact, the underlying soils also had quite low permeabilities. This is due to the high percentage of silt and the generally dense nature of the underlying till.

2.057 The major exception is a layer of the cleaner sands found outside the northwest corner of the proposed dike in borings ST 21-9, ST 21-64, ST 21-37, ST 21-36 and ST 21-35. Similar sands were also encountered between borings ST 21-28 and ST 21-29 near the northwest corner of the proposed dike and between borings ST 21-14 and ST 21-15 on the northern edge of the dike. Permeabilities in these areas are approximately 100 ft/year. These cleaner, more permeable sandy subsoils are underlain by dense, less permeable silty sands which are located at a depth of 13 to 15 feet below the surface.

2.058 Groundwater quality in the waste containment area is somewhat different than at the mine area. In all wells sampled, iron and manganese levels exceeded the USPHS (U. S. Public Health Service) and DNR aesthetic standards for potable water. Color and odor also exceeded the USPHS and DNR aesthetic standards for drinking water in the very limited testing for these parameters. Total hardness is a potentially objectionable quality in all of the wells. Individual samples from wells 21 and 27 showed dissolved solids concentrations above the USPHS recommended upper limit of 500 mg/l. The base metal content of all wells sampled was relatively low and is believed to approximate local background levels. The best water quality of the area was observed in well 26, located in an area underlain by permeable sand-sized materials. All wells sampled in the waste containment area possessed coliform bacteria at some test period. Although the levels were lower than those of the mine area, the test results are thought to be unreliable because of well construction and sampling methods.

Terrestrial Habitat and Biota

Flora

2.059 The basic plant communities of the Flambeau project site are shown in exhibit 31. The mixed deciduous-coniferous lowland forest occupies the most acreage of any plant community in the study area. (exhibit 32). Of the 1,000 acres in the study area, the mixed deciduous -coniferous lowland forest comprises approximately 280 acres, or 28 percent. The forest is classified as lowland because of the relative closeness of the groundwater table to the surface of the forest floor. This forest community borders the marshes and swamps.

2.060 The predominant species are the trembling aspen (Populus tremuloides), red maple (Acer rubrum), the elms (Ulmus sp.), black ash (Fraxinus nigra) and white birch (Betula papyrifera). The forest is being disturbed at the present time. Some of the more mature trembling aspen south of the waste containment area were cut for pulp in 1972 by former owners. There is evidence from the old stumps in the forest that this area had suffered a fire many years ago. Local residents claim that the present pulp cutting is the third crop from this land. Burned sites are the most favorable to the trembling aspen which makes up 47 percent of the trees in this lowland forest.

2.061 If this forest is allowed to remain undisturbed, natural vegetational succession will continue toward tolerant trees. The aspen and red maple will provide a very good canopy for the growth of shade tolerant species such as sugar maple (Acer saccharum), iron wood (Ostrya virginiana), and basswood (Tilia americana). With the arrival of these species and their eventual dominance, this forest will succeed toward the mesic classification. During the period of time of the company study (spring of 1973), the predominant ground-layer species that were examined were those species that were in flower. A floristic summary reveals that most of the species were found to be in the Crowfoot buttercup (Ranunculus rhomboideus), lily (Liliaceae), violet (Violaceae) and dogwood (Cornaceae) families. Some of the species that indicate the high degree of soil moisture were: jack-in-the-pulpit (Arisaema triphyllum), trillium (Trillium sp.), and swamp buttercup (Ranunculus septentrionalis).

2.062 The shrub swamp occupies approximately 240 acres or 24 percent of the study area. This community has two locations; one is a border to a sedge marsh while the other is a major stand. The dominant vegetative species in the shrub swamp is the tag alder (Alnus rugosa), which is so dominant that only an occasional willow (Salix sp.) can be seen reaching to a competitive height. Near the outer boundaries of this community, tamarack, aspen, red maple, and black ash are frequently observed. Within the ground-layer the families with a high degree of representation are: Balsam touch-me-not (Impatiens capensis), Crowfoot Buttercup, Rose (Rosaceae), fern (Polypodiaceae), dogwood, violet, arum (Araceae), sedge (Carex sp.), mint (labiatae), and madder (Rubiaceae). Small openings where no tag alder grow are present in this alder swamp community. These "gap-phase" examples of microsuccession are dominated by cattail (Typha latifolia) and narrow leaved cattail (T. augustifolia). However, because there are also many small tag alder present near the borders of these spaces, it seems likely that in time the cattail will be replaced by tag alder. The shrub swamp soil is waterlogged black and mucky. Often it is covered by a foot or more of water, and if kept in this condition the alder swamp has a high degree of stability. One factor that has helped to maintain the stability of a major part of this swamp is a beaver dam located about one-half mile west of the west dike of the proposed waste containment area. This damming may have preserved the tag alder as the climax vegetation.

2.063 The importance of this community is its value to wildlife. Due to the presence of the beaver pond, there is a potential brood area for ducks. Adjacent to the beaver pond, the shrub swamp community provides a feeding area for woodcock (Philohela minor), and a nesting and feeding area for ruffed grouse (Bonasa umbellus). During the winter months the alder swamp is populated by snowshoe hare. (Lepus americanus).

2.064 The mixed deciduous-coniferous upland forest is the third largest plant community consisting of approximately 176 acres or 17.6 percent of the area that was studied. Transects through this forest habitat showed that it is more complex than the lowland deciduous-coniferous forest. In fact, it contains more species of trees than any other woody plant community and is the most advanced plant community on the basis of natural succession. The most numerous trees (in descending order) are: white birch, red maple, aspen, sugar maple, black ash, basswood, elm (Ulmus sp.), hemlock (Tsuga canadensis), bur oak (Quercus macrocarpa), butternut (Juglans cinera), and balsam fir (Abies balsamea). This community is not very homogeneous. There are almost pure stands of various species of trees isolated within the general community. The few hemlock found in this community are isolated and quite large. Basswood exhibits the same phenomenon, only to a lesser degree.

2.065 This forest is classified as wet mesic. Left undisturbed, this forest will succeed to the mesic classification. The red maple, white birch and black ash will slowly be replaced by more shade-tolerant species such as sugar maple, hemlock and basswood. In this geographical area, these three species are the climax vegetation.

2.066 A complete list of the woody species in the upland mixed deciduous-coniferous forest is provided in exhibit 33. The most prevalant springtime herbaceous groundlayer families include the lily, Crowfoot buttercup, fern and violet. A detailed list of ferns and fern allies is found in exhibit 34.

2.067 Of special interest is the number of dead trees in the mixed decidous-coniferous upland forest in the area designated for the open pit mine. After analyzing a one-acre quadrant, it was discovered that 23 percent of the trees were dead. Of the 362 trees with a minimum two-inch d.b.h. (diameter at breast height) counted, 277 were alive and 85 were dead. Several of the elms and ashes had dead branches but were counted as being alive since there was some green foliage. Of the 85 dead trees, 75 of them were bitternut hickory (Carya cordiformis). The exact cause of death of these trees has only been hypothesized. One probable cause is the 8 to 12-foot lower groundwater table as a result of the removal of the Port Arthur Dam in 1969. Since the bitternut hickory is normally found on wet bottomlands, an 8 to twelve-foot drop in the water table may have caused severe "die-back" in the trees. The Ladysmith DNR forester has indicated this could be a cause, but also that these trees are on the edge of their range and often do not live to maturity. Bitternut hickory are often affected by a disease that forms numerous galls on their twigs. Since there are known diseases of bitternut hickory, and since this is the northernmost part of its range (where it probably is less hardy), the water table drawdown and "die-back" combination seems the most probable explanation.

2.068 The sedge meadow comprises about 111 acres or 11.1 percent of the study area. It is an open community where the soils are wet but without standing water during the growing season. During the spring runoff and after a heavy summer rain the soil may become covered with a few inches of water. The soil is a combination peat and muck. Sedges are the dominant vegetation although cattails appear toward wetter conditions. The outer boundaries of the sedge meadow are fringed with tag alder and willows. Just inside these shrubs red-osier dogwood and Spirea alba are located, whereas most of the sedge meadow vegetation is composed of sedges of the genus Carex, grasses, mints (Scutellaria galericulata), the swamp milkweed (Asclepias incarnata), the cattails, and Iris versicolor.

2.069 The old field community comprises approximately 103 acres or 10.3 percent of the study area. Parcels are classified as old field because they have not been disturbed (plowed) 2 to 3 years and were allowed to revert to forest. If this process is allowed to continue, the old field will eventually succeed to a shrubland and then to a climax forest in several hundred years. The old field community within the study area already exhibits a range of succession from small trees to shrubs to grassland. The invading trees are trembling aspen, large-toothed aspen (Populus grandidentata), red pine, white birch, red oak (Quercus rubra), and bur oak. Some of the prevalent shrubs include staghorn sumac (Rhus typhina), pin cherry (Prunus pennsylvanica), and chokecherry (P. virginiana). The predominant families with representatives in the groundlayer vegetation are grass, composite, sedge, pink rose (Rosa sp.), pea (Fabaceae). In one section of the old field community, near the eastern boundary of the pit site, a perched water table enables the soil to remain quite moist. The predominant shrubs here under these conditions are willows, whereas much of the groundlayer species is in reed canary grass (Phalaris arundinacea) and goldenrod (Solidago sp.).

2.070 The bog in this study area comprises 28 acres or 2.8 percent of the total area that has been studied. The term bog refers to a soil-vegetation complex in which a rather specialized group of herbs and low shrubs grow on a wet, acid soil composed of peat. This particular bog is quite old, has filled in any open water spaces and is being invaded by wet-lowland and wet-mesic species of trees. Tamarack, white birch, trembling aspen, and white pine (Pinus strobus), can be seen growing on the sphagnum mat. The pattern of natural succession would be for the bog to become a wooded (tamarack) swamp, then a lowland wet mesic forest, and finally a mesic forest exhibiting climax vegetation. If left undisturbed, this is the pattern that would undoubtedly be followed here; tamarack is already the most prevalent tree. The two most important families of plants growing on the mat are heath and the sedges.

2.071 The river basin community comprises approximately 23 acres or 2.3 percent of the total study area and was formed as a result of the removal of the Port Arthur Dam. The removal of the dam caused the level of the Flambeau River to drop 8 to 12 feet along the project site. The drop in water level exposed a considerable amount of land that is now being invaded by terrestrial vegetation. The environmental conditions along the river basin range from semi-aquatic to xeric (dry soils). The semi-aquatic areas are where cool springs run down the bank to the river. There is very dense vegetation along these miniature streambanks. The xeric conditions exist in open areas where the river had deposited large amounts of sand and gravel.

2.072 Because of the wide range of conditions, there is also a wide variance in the invading plants. The most prevalent woody species is the willow. However, there has been considerable invasion by the silver maple (Acer saccherinum), box elder (A. negundo) and tag alder. Other woody species that are invading but are not numerous are red maple, cottonwood (Populus deltoides), balsam fir, and elm. The silver maple invasion is interesting because there are no known natural stands of it in the immediate area. Of the herbaceous plants the most predominant families are grass, sedge, composite, Crowfoot buttercup, and the rush.

2.073 The wooded swamp comprises approximately 15 acres or 1.5 percent of the total study area. The characteristic vegetation of the wooded swamp is the tamarack. Coupled with a sphagnum mat and a high number of ericads (heather) in the understory, the tamarack swamp is very closely related to the bog. Associating with the tamaracks are tag alder, white birch, and an occasional white pine. The prevalent families of the groundlayer species are heath, dogwood, sedge, lily, orchid, (Orchidaceae), primrose (Primulaceae). and Crowfoot buttercup. This wooded swamp, if left undisturbed, would undoubtedly succeed to a lowland mixed coniferous-deciduous forest as has been described earlier. Black ash, red maple, and aspen would slowly invade the fringes of the wooded swamp until they had completely crowded out the tamarack.

2.074 Flambeau has undertaken the monitoring of vegetation down gradient from the proposed waste containment area to determine the background levels of heavy metal concentrations. Copper, lead and zinc have been monitored to date. Plants that have deep root systems and those that require a rather moist environment were sampled. Average metal concentrations along each of the five transects studied are reported in exhibit 35.

Fauna

2.075 Flambeau carried out a 3-phase quantitative-qualitative vertebrate study which entailed: (1) a qualitative vertebrate survey in the fall of 1972; (2) a qualitative large mammal survey in the fall of 1972 through the spring of 1973; and (3) a quantitative small mammal survey conducted from April 14 through June 18, 1973. The quantitative survey was carried out to determine species populations and densities. Because of the low capture success, the results of that survey are not presented. However, the results of the qualitative survey indicate the species which are known to inhabit the project site.

2.076 A composite list of all mammal species identified on the project site is presented in exhibit 36. The bobcat (Lynx rufus) is listed as having changing status in Wisconsin. Deer were found over most of the project site. Deer browsing in the Meadowbrook Creek area during winter came from east of Highway 27. Otter (Lutra canadensis), in addition to moving in the bog area, plied the river edge itself but did not venture up Meadowbrook Creek. Although fox were numerous in the early winter of 1972, reduced numbers were observed later probably due to trapping. Beaver (Castor canadensis), may have also been lost through trapping. Mammals seen on the west bank of the Flambeau include white-tailed deer (Odocoileus), otter, red fox (Vulpes fulva), raccoon (Procyon letor), striped skunk (Mephitis mephitis), muskrat (Ondatra zibethica), gray squirrel (Scuirus carolinensis), red squirrel (Tamiscuirus hudsonicus) and chipmunk (Tamias striatus).

2.078 Many of the larger mammals, such as the otter, bobcat, fox, muskrat, mink (Mustela vison), weasel (Mustela sp.), raccoon, skunk and beaver, are considered furbearers and are either hunted or trapped. There are specific hunting and trapping seasons on most of these species, and all species have been taken on the project site.

2.079 Among the small mammals, deer mice (Peromysus sp.), were the predominant species captured. Chipmunks and grey squirrels were also captured in large numbers.

2.080 Avian populations were studied quantitatively and qualitatively from March 3, 1973 to July 12, 1973, as a part of the company's impact study. The different species of birds present in this area were also noted as part of a vertebrate population study conducted in the months of October and November 1972. More data were accumulated from December 1972 through early March 1973. The areas under study are quite typical of north central Wisconsin. In the study areas are found a small pond, marshlands, creeks, old fields, meadows, plowed ground, wooded swamp, upland hardwoods, lowland hardwoods, brushy areas or thickets and roadsides.

2.081 A composite species list, including winter observation, is given in exhibit 37.

2.082 The bird populations in the various habitats were normal as compared to records of previous years compiled by the Wisconsin Society for Ornithology. One exception was the numbers of purple martins (Progne subis) seen. For reasons unknown, the martin population of the Mississippi River Valley was only 15 percent of normal during the 1972 season. Since martins often return to the same nesting area where they are hatched, it was expected that the martin numbers would again be low in 1973. This proved to be true. Not all of the species that migrate through this area were seen, nor were all species seen identified. No owls were seen during the spring and summer period, although one species was seen during the fall and winter surveys. An immature bald eagle (Halioeetus leucocephalus) was sited in the vicinity of the proposed waste containment area by DNR personnel during November 1974. Bald eagles are on the Wisconsin List of Endangered Species. The upland plover (Bartramia longicanda) is listed as having changing status in Wisconsin.

2.083 Cursory spring 1973 qualitative survey of amphibians and reptiles on the mine site was conducted by the company. Three transects were made in the area of the proposed pit, and the proposed waste containment area. No record was made of where each species was seen. Although no populations estimates were made, the following species were found in 100 hours of field work by the company's consultants.

REPTILE AND AMPHIBIAN SURVEY

Reptilia

Common snapping turtle (Chelydra serpentian)	Uncommon
Painted turtle (Chrysemys picta)	Very common
Eastern garter snake (Thamnophis sirtalis)	Common

Amphibia

Tiger salamander (Ambystoma tigrinium)	Common
Blue-spotted salamander (Ambystoma laterale)	Probably common
Red-backed salamander (Plethedon cinereus)	Fairly common
American toad (Bufo americanus)	Very common
Spring peeper (Hyla crucifex)	Very common
Grey tree frog (Hyla versicolor)	Common
Pickeral frog (Rana palustris)	Uncommon
Mink frog (Rana septentrionalis)	Common

2.084 The number of insect species is greater than any other group of animals. Because insects occupy every level of ecosystems, they are important components of the fauna, serving to link many other species to the plant communities. Insects were collected and observed in representative habitats because most insects are bound to a particular habitat by food preferences or other requirements. Collections were made near or in small pond, marsh, grassland, pasture, old field, upland hardwood, small creek, wet banks, brush and roadside habitats. Collecting was done by sweep net, hand collecting, and sightings. No

effort was made to take large numbers of insects. A few specimens were keyed to species, e.g., giant water bug (Belastoma sp.) dobson's fly (Coradalus cornutus) and an unusual Lygaeid. Collecting was done once a week from late March until July. A total of twenty hours of collecting was done. No unusual insect families were collected, and insects seen were typical for the Ladysmith area. This observation is based on a number of past years spent in the field collecting, and comparisons with lists in publications.

Aquatic Biota

Plankton

2.085 Phytoplankton and zooplankton were sampled from midway in the water column on 2 May 1973 by Dames and Moore Consulting firm, from six stations ranging from 1.6 miles upstream of the proposed open pit site to 3.9 miles downstream of the pit site.

2.086 Sixty-six species of phytoplankton were identified. Fifty species were diatoms. The diatoms not only dominated the species list, but also comprised over 50 percent of the cells in most of the samples. Species of the diatom genera Fragilaria, Melosira, Navicula and Nitzschia were common in all samples. None of the species commonly occurring in the samples is considered to be a pollution tolerant or pollution-indicative organism.

2.087 Thirteen zooplankton taxa were identified, including two copepods, two protozoans and seven rotifers. The rotifers were the dominant organisms in the samples taken.

2.088 Plankton quantities were relatively low at all locations. Plankton abundance and distribution were probably influenced by the weather conditions at the time of sampling. These included abnormally high water levels, low water temperature and low solar illumination.

Benthos

2.089 Benthic organisms were collected at the six locations mentioned above between April 26 and May 4, of 1973. Approximately 80 different species were identified. The chironomids, trichopterans and ephemeropterans were represented by 27, 11 and 10 different species, respectively. The chironomids dominated all the quantitative samples, comprising from 41.3 percent to 50.2 percent of the total benthos. Total density of organisms ranged from a low of 248 organisms/m^2 to 800 organisms/m^2.

Fish

2.090 Fish were sampled at ten locations in the Flambeau River using fyke nets and in Meadowbrook Creek with a 110-volt AC shocker. Fifteen species were collected. Seven species were taken in the Fyke nets and ten species by electrofishing. Minnows dominated the catch from

Meadowbrook Creek. Northern pike (Esox lucius), which were not collected in the Dames and Moore survey, have been taken from Meadowbrook Creek during past DNR surveys. No one species was predominant in the collections from the Flambeau River. The total number of fish collected in the Flambeau River was very low. This was probably due to a low survey gear efficiency. However, it appears that the fish populations in the river near the proposed mine site are somewhat limited by a lack of instream cover, and fluctuating water levels during spawning seasons.

2.091 An electrofishing survey of the Thornapple Flowage (impoundment on the Flambeau River below the mine site) was conducted by the Department in May of 1972. Eleven species were collected. Black bullheads (Ictaluras melas) were the most abundant species followed by walleyes (Stizostedion vitreum).

2.092 A list of the fish species collected from the Flambeau River is given in exhibit 38.

Historical and Archaeological Resources

2.093 The Wisconsin State Historical Society has not recorded any archaeological activity sites in the entire town of Grant. There are no historic sites in Rusk County listed in the National Register of Historic Places as of 20 July 1976. The State Historic Preservation officer has indicated that no sites of historical significance would be affected by the project (Exhibit 49).

2.094 FMC employed a qualified archeologist, Dr. William McHugh, then of the Department of Anthropology, University of Wisconsin, Milwaukee, to conduct a search for evidence of prehistoric sites on the project area. A study of aerial photographs, interviews with local residents and collectors, foot traverses, in selected areas soil phosphate testing, searches for disturbed plant habitat indicators, and test pits were used in a search for activity sites. Special attention was given to likely locales such as the bluffs along the Flambeau River and the areas along Meadowbrook Creek. One flake of chert, a flintlike rock, was found along the eroded north shoreline of the Flambeau in Section 17, but it did not show any evidence of either manufacture or utilization.

2.095 Interviews with residents revealed two small, local collections reported to have come from lands within the project site, and one small collection from just west of the project site. These collections indicate some prehistoric aboriginal activity in the area. Mrs. John Cadotte owns two specimens obtained from the north end of the proposed project site. Both are made of Hixton Silicified Sandstone which originates at an aboriginal quarry site near Hixton, Wisconsin,

some 100 miles to the south. A side-notched projectile point indicates a Late Archaic time period (2,000 BC - 1,000 BC). A bifacially-worked knife suggests the presence of an activity area in this locale, but sod covering the field precluded a surface survey.

2.096 Most of the artifacts from the Drum collection were reported by Mr. A. Drum to have come from the areas he farmed around a now-filled ancient lake east of Highway 27. This area is now grown up in sod and did not permit a close examination of the surface. The overwhelming majority of artifacts in this collection are projectile points which indirectly indicate that a substantial amount of prehistoric hunting activity occurred around the shores of this small lake. Projectile point typology indicates the presence of Late Archaic (2,000 BC - 1,000 BC), Early Woodland (1,000 BC - 500 BC), Middle Woodland (500 BC - AD 500), and Late Woodland (AD 500 - AD 1,400) activity around this small lake. Several of the small points in the collection are made of locally available quartzite but others are made of chert foreign to the project site area.

2.097 The Raasch collection was recovered from the Flambeau shoreline one-half mile west of the project site. It includes a large scraping plane, a lamellar flake and a stemmed point which are made of Hixton Silicified Sandstone. A Middle Woodland time period (500 BC - AD 500) is suggested by these artifacts.

2.098 The archaeological survey of the Flambeau project area determined that prehistoric cultural activities had indeed left traces in the form of artifacts from the project area. Physical survey of selected parts of the area failed to locate any of the specific locales of prehistoric human activity.

2.099 As a result of the findings of the Mc Hugh survey, Flambeau commissioned Joseph Tiffany, a professional archaeologist, to resurvey the project site. Mr. Tiffany found no artifacts. However, he recommended that if the alternative "c" railroad right-of-way were selected (see para 6.027), it should be moved further south to avoid the area where Mr. Drum found his artifacts. The SHPO concurs with this recommendation.

Recreational Resources

2.100 There are increasing pressures on recreational resources in all of Wisconsin. Rusk County does not possess a well developed recreational base and much of the tourist trade bypasses the county for the lake areas to the northwest.

2.101 The nearest Federal recreation land is that block of the Chequamegon National Forest in Taylor County. Brunet Island State Park in Chippewa County is the closest State park. The Flambeau River which flows through the project site is designated as part of the Chippewa River Water Trail. The southern end of the Flambeau River State Forest is located in the northeast corner of Rusk County less than 20 road miles from Ladysmith. There are five state wildlife areas in Rusk County with a total of 2,297 acres. The 1,044-acre Silvernail Wildlife Area is located north of Ladysmith. The DNR maintains a public access site at the former Port Arthur Dam.

2.102 The county and some local municipalities provide lands for outdoor recreation. About 85,000 acres of the locally administered land is county forest land. Land entered under the Forest Crop Law is also open to public hunting and fishing. This amounts to over 20,000 acres.

2.103 Approximately 8 river miles north of the proposed mine site is the Dairyland Reservoir, formed by a hydroelectric dam built in 1951 which encompasses 2,000 acres. Approximately 17 road miles south of the site is a large hydroelectric dam built in 1948 which has created the Holcombe Flowage with 112 miles of shoreline extending up the Jump and Chippewa Rivers. These areas are developing with many year-round "summer" homes and some resort facilities. The Thornapple Flowage just south of the project site is not heavily used for recreation.

2.104 The number of lodging rooms available in Rusk County in 1973 for tourists was 250 with a Statewide total of 75,750. The largest of these facilities are classified as small motels with less than 30 rooms. The number of available rooms was 0.33 percent of the total in the State, which is essentially equal to the population percentage, indicating that the economy of the area is not greatly influenced by tourism.

2.105 There is little recreational use associated specifically with the area of the project site, except that which occurs on the river course through the property, i.e., canoeing and fishing. In the uplands there is some hunting, trapping and berry picking.

Socio-Economics

Population

2.106 The human population of the proposed project area can be considered at four levels: (1) the residents of the project site; (2) the residents of Grant Township, which wholly encloses the proposed operations; (3) the population of Rusk County; and (4) the population of Ladysmith, county seat of Rusk County, immediately adjacent to the site. Ladysmith is the only community in Rusk County classified as a city. All other communities are classified as towns and villages and have populations of less than 1,000.

2.107 During late 1972, the residents of the project site were identified and heads of households were surveyed for basic demographic and income data. A total of 86 persons in 34 households were located. When compared to the populations of Rusk County and Wisconsin, the residents of the project site were on the average significantly older. More than half the residents are age 46 or older. The median age for the state during the 1970 census was 27.2 years, while for Rusk County it is 30.4, and for the project site it is 46 to 50.

2.108 The population of the State, Rusk County, Ladysmith, Grant Township and the project site can be summarized as follows:

	1970 Population	Percent Change Since 1960	Percent 65 Yrs. and Over
State of Wis.	4,417,713	+11.8	10.7
Rusk County	14,238	- 3.8	14.2
Ladysmith	3,674	+ 2.5	19.7
Grant Township	931	-11.3	15
Mining project site	86	N.A.	16

2.109 Rusk County had its largest population in 1940, and the population of the county has declined at a relatively steady rate since that time. Out-migration during the decade of the 1950's was 4,190; during the 1960's 1,561 persons moved elsewhere. The number of farms declined from 2,608 in 1935 to 980 in 1969. Total farm acreage also decreased during this same period from 261,528 acres to 212,623 acres and, as might be expected, the farm size significantly increased from 100 acres to 217 acres.

2.110 DNR projections estimate a decline in the Rusk County population of 1.78 percent by 1980 and nearly no change from 1980 to 1990 (DNR, 1972).

2.111 The University of Wisconsin Department of Rural Sociology predicts a population decline of 5.1 percent from 1970 to 1980 and a further 3.8 percent decline by 1990. However, the Department of Administration reports an estimated 3.3 percent increase in the population of Rush County from 1970 to 1974 (Department of Administration, 1974). It appears that the future trend in population is uncertain, but will probably be in the range of 13,000 to 14,500.

Land Use

2.112 The project site includes single family residential, commercial, industrial, institutional, agricultural, forestry, and open space uses. Structures on company land included 6 dairy farms, 5 general farms, 31 single family residences, a commercial building, a town hall, and assorted accessory structures. Some of the residences and accessory buildings are being removed or destroyed since they occupy lands needed for other uses associated with mining or have become economically or aesthetically burdensome. Many residences on the margins of the site continue to be occupied on a rental basis. A former dairy products hauling company building may serve as a temporary field office during the construction phase of the project. The Grant Town Hall continues to be used for some town government functions. A former Rusk County gravel pit is located in Section 9, but has been idle since the company purchased it. Some of the agricultural land has been pastured or cultivated recently while other fields, forest, and wetlands have lain essentially idle in recent years.

2.113 In the absence of a county land use plan, current zoning district classifications indicate the county's intent for future land use. Proposed land use on the FMC holdings of 2,750 acres as determined by zoning is as follows:

Zoning District	Acreage	Percent of Total
Agricultural	2,077	75.5
Industrial	221	8.0
Residential	171	6.2
Resource Conservation	160	5.8
Forestry	116	4.2
Commercial	5	0.2
	2,750	99.9

2.114 Current zoning is appropriate for some of the mining operation. The company intends to petition for changes in zoning district classifications on lands between Highway 27 and the Flambeau River (excluding the 300 foot Shoreline Protection Zone along the Flambeau River and Meadowbrook Creek). Approximately 1,100 acres of land zoned for agricultural, residential, forestry and possibly resource conservation would be changed to an industrial zoning classification.

2.115 Of the 23,013 acres in Grant Township, 14,072 acres are zoned as agricultural, representing 61 percent of the total area. Approximately 10 percent is zoned as resource conservation, 8 percent for forestry, 5 percent for residences, 0.9 percent for industry and 0.8 percent for commercial ventures. This township has experienced intensive, yet marginal, agricultural land use. Following the pattern of the whole county, much land is in the process of reverting to forest. A relatively new impact on the township is the extension of commercialism along State Highway 27 south of Ladysmith.

2.116 Grant Township agriculture consists primarily of dairy grazing, i.e., two cuttings of hay and some oats and corn. Tame hay and some clovers are used for pasture grazing. The following information from the office of the Rusk County Extension Agent gives a profile of Grant Township agriculture for 1972:

1. Number of farms	103
2. Farm population	382
3. Cropland (acres)	4,782
a. Clover-timothy-hay (acres)	3,348
b. Oats for grain (acres)	866
c. All field corn (acres)	347
d. Alfalfa hay (acres)	12
e. Barley for grain (acres)	7
f. All other lands (acres)	202
4. Livestock	
a. Milk cows	945
b. Beef cattle	633
c. Grain-fed cattle marketed	97
d. Stock sheep	28
e. Brood sows	7

2.117 Buildings, homesteads and farmsteads in Grant Township in 1967-1968 were inventoried as follows:

116 Occupied year-round residential structures
10 Seasonally-occupied structures
121 Farmsteads
26 Mobile homes
7 Vacant farmsteads
24 Vacant nonfarm residences

2.118 Rusk County includes an area of 590,275 acres of which 98.7 percent is unincorporated. Woodlands constitute the largest land use in Rusk County (54 percent), with cropland (15 percent) next, followed by "other cleared or open land" (14 percent), then wooded wetlands (10 percent). The woodlands were largely stripped of white pine, hemlock and hardwoods prior to 1900. Forest management, since the mid-1930's, has enabled Rusk County to have 54 percent of its county in forest land now. At the present time, aspen is the major tree of all types present, amounting to nearly one-third of the total volume of the available forest reserve.

2.119 Cropland and pastures are used primarily to support dairying in Rusk County. Dairying was the primary function of 59 percent of the farms during 1967-68. General crop farming was reported to be the primary function of 24 percent of the farms. Beef cattle operations constituted 5 percent of the total. At the present time, there are about half the number of farms present in Rusk County that there were during the peak years of the forties, but the remaining farms are larger in acreage than their predecessors. Out of the 174,000 acres of cleared land in either crop production or simply cleared and open but uncultivated, 84,000 or almost half is not being cultivated at the present time.

Public Facilities and Community Services

2.120 Health services are represented by a new 52-bed hospital located on the north bank of the Flambeau River adjacent to Highway 27. Institutional care for the elderly is found in three facilities: the Glen Flora Nursing Home, the Ladysmith Nursing Home, and the Rusk County Nursing Home associated with the hospital facilities. Total bed capacity of these facilities is 170, and they have been approximately 93 percent occupied.

2.121 The Ladysmith public water supply is from four wells and is untreated except for disinfection. Wells 2,3, and 4 are located in Section 2, T34N, R6W on the inside of a meander of the Flambeau River near the Peavey Paper Mill. Well number 5 is located just north of the track at the County Fairgrounds in Section 34, T35N, R6W. The public well closest to the project site is over two miles northeast of the proposed mine. The supply capacity exceeds demand, but storage facilities are limited. Potable water in Grant Township is from private wells.

2.122 Law enforcement services are of average capacity for a community of this size. The presence of the county sheriff in Ladysmith provides some extra service in the environs.

2.123 The sewage system of Ladysmith includes both primary and secondary treatment. It has a capacity of 645,000 gallons per day. Corrective measures have been ordered by the DNR, including the installation of effluent disinfection facilities. Outside of Ladysmith, private on-site sewage disposal systems are used.

Education

2.124 The Ladysmith School District encompasses an area of 207 square miles and includes the project site. Enrollment in 1974-75 was 1,507 students with a professional staff of 90. The total equalized assessed valuation for the district was $41,689,300 in 1974 or about $28,000 per pupil. Estimated school costs for 1974-75 were $2,262,768 or about $1,500 per pupil. The State estimated aid payments were $1,261,624 or about $850 per pupil. It can be seen that over half the costs of school services are paid by State aid. The local full-value school tax rate in 1974 was estimated to be about $24 per thousand valuation. The 1973-74 potential borrowing power was $4,310,370, of which $2,075,000 (51.9 percent) was committed as long-term indebtedness.

2.125 The school facilities are generally new. The estimated capacity is 2,000 students. The recent rapid fall in the Rusk County birth rate (from about 375 live births per year in 1950 to 1965 to 244 live births per year since 1965) suggests that the school-aged population will begin to decline.

Transportation

2.126 The transportation network through the project site consists basically of State Highway 27, County Highway P, and township roads. State Highway 27 running north-south intersects the proposed mining property for 1¼ miles and is tangent to it for an additional 1½ miles; County Highway P runs east-west intersecting the property for 1½ miles. There is approximately ¼ mile of city street tangent to the property on the north and township roads are tangent for approximately 1¼ miles. The principal motor vehicle traffic is along State Highway 27 which is an all-weather two-lane highway in good condition.

2.127 The Wisconsin Department of Transportation studied traffic flows in the area during 1973. The average daily traffic count on Highway 27 between Ladysmith and County Highway P was 2,090. The traffic count on Highway P was 150. The mining company conducted traffic counts in April and June 1973. The densities are normal for these types of highways and, except for late afternoon, no significant overloading was recorded.

2.128 Tracks of the Soo Line Railroad run through the northeast corner of the project site. This is the principal rail connection between Chicago-Milwaukee and Superior-Duluth.

2.129 A 34-inch crude-oil pipeline, owned by Lakehead Pipe Line Company, Inc., crosses the project site diagonally in a northwesterly direction, buried approximately three feet below the surface. The 80-foot wide pipeline right-of-way crosses the Flambeau River approximately 1,340 feet southwest of the mouth of Meadowbrook Creek, continues across the project site, and crosses under State Highway 27 north of its intersection with County Highway P.

Economy

2.130 The basic economy of the State of Wisconsin is furnished by its manufacturing and agricultural activities, and the percentage of income from manufacturing in the state is well above the national average. The percentage of state income provided by farming is also significantly higher than that for the nation. The percentage of income from service activities and government is somewhat lower than the national average, while other activities, including construction, transportation, utilities, wholesale and retail trade are comparable with the nation. Mining contributes approximately 0.2 percent of the total income to the state.

2.131 The overall economic growth of the state since 1960 has been somewhat less than the economic growth of the nation. During the past decade, farming income in Wisconsin has increased at a rate greater than the national average, but manufacturing, which is the more important industry in Wisconsin, increased at a rate slower than the national average. The relative increase in terms of constant dollars is actually declining. Agricultural employment is predicted to continue to decline as it has during the past decade. This does not necessarily mean that agricultural income will decline or even cease to grow since the size of individual farms and the use of mechanized farming methods have been increasing.

2.132 Average family income in the state was reported in 1969 to be $10,068, while the Rusk County family income was reported to be $6,724. A more recent survey conducted by BCMC in the project area during early 1973 showed family income in the impacted area to be somewhat higher than the Rusk County average, but still well below the state average. In the project area the average family income was reported to be $7,678, but ten families reported pensions as their sole income.

2.133 Personal income earned by the residents of Rusk County arose primarily from four sources - manufacturing, farming, wholesale and retail trades and government. Manufacturing in Rusk County, although important to its economy, has not grown substantially. There was a decline in the value of manufactured goods from 1963 to 1967. In 1967 there were some 32 manufacturing establishments ranging in size from 1 to 200 employees. In 1972 there were 30 manufacturing establishments, one of which had 250 employees. In general, manufacturing is concentrated in Ladysmith where 14 of the 30 manufacturers are located, including five of the seven largest employers.

2.134 Although the State of Wisconsin during this period emjoyed high employment, and a high median income with relatively little poverty, Rusk County did not share in this general prosperity.

2.135 Over 40 percent of the Rusk County work force was engaged in either agricultural or manufacturing occupations while the remainder was dispersed in other activities. Unemployment was 6.4 percent of the total work force.

2.136 More recent data coming from the first eight months of 1972 shows a total work force in the county of 5,104 but with unemployment increasing to 9 percent. Increased employment since 1970 has been predominantly in agriculture which averaged 1,159 the first eight months of 1972, as contrasted to 857 for the year of 1970. Unemployment is very seasonal and is influenced by the fluctuating demand for agricultural workers. This can be seen in the following data for the first eight months of 1972.

	Rusk County Agricultural Employment	Percent Unemployed of Total Work Force
January	1,000	10.7
February	1,040	10.3
March	1,090	10.6
April	1,160	10.1
May	1,260	8.0
June	1,220	8.6
July	1,240	7.9
August	1,260	5.5

2.137 The manufacturing sector, according to census reports, had an employment of 830 in Rusk County in 1970 while the State of Wisconsin survey of 1972 indicated a total manufacturing employment of only 690 in Rusk County. The eight largest manufacturers are shown below:

City	Manufacturer's Name	Product	No. Employed
Ladysmith	Conwed Corp.	Finished cabinets	35
Ladysmith	Great Lakes Millwork Corp.	Millwork, doors, etc.	91
Ladysmith	Peavey Paper Mills	Paper products	100
Ladysmith	Fiberstrong, Inc.	Molded fiberglass	55
Ladysmith	Balko, Inc.	Boat trailers	24
Ladysmith	Kenneth Mills	Handcraft kits	161
Hawkins	Northern Sash & Door Co.	Millwork, windows	250
Glen Flora	R & W Novelty	Novelty items	20

2.138 All other manufacturers had less than 20 employees. As can be seen, the employment by manufacturers is concentrated in Ladysmith and Hawkins. Employment in neither the county nor Ladysmith is dependent upon the fortunes of any single manufacturer. It is apparently somewhat dependent upon the demand for forest products.

2.139 The assessed property values in the Town of Grant have risen dramatically in recent years. This may be the result of inflated prices paid by the mining company and may also reflect prices paid by real estate speculators acquiring recreational land.

2.140 The State makes various types of aid payments to local units of government. State payments to the Town of Grant were $304,325, or 103.90 percent of the amount collected in 1973. The City of Ladysmith and Rusk County also received more State aid than State revenue which was collected. Considerating the state as a whole, 62.47 percent of state revenues collected were returned as State aids. The Rusk County communities benefit disproportionately from State aid payments.

Aesthetic Quality

2.141 The Flambeau River remains an important aesthetic resource in spite of the recent lowering of its level by the removal of the Port Arthur Dam. The "new" land exposed has some charm even in its earliest stages of tree succession. West of State Highway 27, Meadowbrook Creek flows through a stand of mature conifers which possesses exceptional beauty. There are no areas possessing unique open space qualities present on the Flambeau holdings or the nearby lands.

3.000 RELATIONSHIP OF THE PROPOSED PROJECT TO LAND USE PLANS

3.001 At present, the Flambeau holdings are zoned as follows:

	Acreage	Percent of Total
Agricultural	1,930	74.1
Industrial	221	8.5
Residential	171	6.6
Resource Conservation	160	6.2
Forestry	116	4.5
Commercial	5	0.2
	2,603	100.1

3.002 The Agricultural use is mostly dairy pasture grazing on tame hay with some corn and oats being raised occasionally. The area zoned Agricultural includes forest and brushland and abandoned fields.

3.003 The lands zoned Industrial are those on which gravel mining formerly took place as well as the earliest purchases by Flambeau for which zoning requests have already been granted.

3.004 Structures on the Residential acreage are used as follows:

6 dairy farms
5 general farms
31 year-around household units
1 Township hall

3.005 The Resource Conservation zoned land is lowland forest and wetlands. The area zoned Forestry is presently woodlands allowed to progress without managed cutting. The single Commercial area ia a trailer sales outlet.

3.006 Flambeau would need to have approximately 1,100 acres of their holdings rezoned to Industrial by Rush County and the Town of Grant. The land use categories requiring rezoning are:

Agricultural	915 acres
Residential	135 acres
Forestry	45 acres
Commercial	5 acres
	1100 acres

3.007 At the present time, it does not appear that it would be necessary to rezone any land currently zoned Resource Conservation.

3.008 During operations, the remaining acreage would be managed as shown in exhibit 39.

3.009 The land use plan upon the cessation of mining has not been fully developed. The open pit would become a lake and the waste containment area would be revegetated. The ultimate use and ownership plans for the property are not known at this time. In a letter to the DNR dated November 14,1975, Flambeau made the following statement:

> "Flambeau Mining Corporation believes that it would be inappropriate to prematurely commit future corporate management to ultimate land use and site ownership. We have already implemented a multiple land use plan for the 2,750-acre site and have increased the tillable acreage since out purchase. This multiple land use plan would continue in effect for the 2,400 acres not disturbed by the mining operation. It is our goal to husband the land in such a way that future management will have several options available to them for consideration of final land use and ownership.
>
> Therefore we feel that ultimate land use and lake access can only be evaluated nearer the end of the life of the mine in the economic, zoning and land use climate of that time."

The question of ultimate use and ownership is somewhat unique for Kennecott management in that they have never abandoned a mine site in the past.

3.010 Of the 1,100 acres that would be rezoned, about 326 acres would be directly altered by the project as shown below.

	Acres
Mining	
Open pit	55
Gravel (Rusk County pit)	10
Gravel (new pit, contingent)	28
Plant	3
Haulage facilities	
Haul road and pipeline	16
Rail siding	12
Waste containment area	156
Soil stockpile	36
TOTAL	326

3.011 Following the mining operation, approximately 78 acres could be restored to existing land usage while the remaining 248 acres would be permanently altered. Most of this land would be occupied by the open pit lake (55 acres) and the waste containment area (156 acres).

3.012 It does not now appear that rezoning the necessary project lands to industrial would seriously conflict with local land use plans. Without the proposed project, the lands involved would probably remain in present usage for some time.

3.013 The area of the proposed mine pit is well situated for industrial, commercial, or residential development. Without the proposed project, another type of development proposal at some time in the future would probably be able to have the lands rezoned as needed with little difficulty.

3.014 Establishment of a mine pit at the proposed site would negate its use for the next 15-25 years by any other type development. Following that time, the area would probably be well suited for industrial usage.

3.015 Without the proposed project, the area proposed for waste containment would probably stay in its present land usage indefinitely. With the proposed project, its use would be limited to Resource Conservation or possibly Recreational following close-down and revegetation.

4.000 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

SOCIAL EFFECTS

Noise Levels

4.001 The noise impact of the Flambeau operation on the hospital-nursing home and college complexes has been estimated by utilizing data from Kennecott's crushing operation at Bonneville, Utah, which has a production rate of 35,000 tons of concentrate per day. The calculations of noise levels were based on a flat terrain void of vegetation or buildings. The noise levels which would be expected at the hospital-nursing home and college complexes, assuming the only source of noise to be the Flambeau crushing operation, would be 22.0 dBA. If the heavy equipment in the open pit was the sole noise contributor, the levels at these sensitive areas would be about 37.5 dBA. These levels are well below the present normal background noise levels of 54 dBA near the hospital. The Flambeau operation should make no significant contribution to community noise levels. The adjacent sand and gravel operation is the primary source of noise at the present time and would continue to be the major contributor when the mine was in operation.

4.002 Blasting in the pit would elevate noise levels somewhat. Air blast or overpressure from Flambeau blasting activity was estimated to be less than one pound per square inch at the nearest inhabited building (concentrator). 1.0 psi is approximately 167 dB units of sound pressure level. In open air where blasting sound can spread out spherically in all directions, sound pressure decreases as distance from the source increases. Sound pressure in this condition of spherical divergence conforms to the inverse square law.

4.003 Open pit blasting noise has not been a problem at any of the company's operating mines. Most probably this condition results from the nature of copper mineralized material. Unlike the flinty and extremely hard homogeneous taconite that requires heavy blasting to achieve fragmentation, copper ores are relatively soft and generally intensively fractured in place. Standard practice in the nonferrous industry involves light blasting that only shakes the material by lifting it a few feet and setting it down in place. Very little throw or displacement is ever encountered.

4.004 Proper design of blasting techniques is a principal method of economic and environmental control. The variable parameters include hole size, depth and spacing, explosive weight, location and delay detonation. All of these are varied and adjusted in practice to achieve the required fragmentation in each area of the mine that is consistent with desired economic and environmental criteria. Impact noise occurrences would be of short duration but could be unsettling to nearby residents.

Aesthetic Values

4.005 During the initial development of the open pit, construction of the haul road and buildings, there would be a negative visual impact. At present, the areas to be disturbed have no especially unique scenic qualities. The massive visual impact of construction would be controlled and ameliorated as far as possible through the vegetation management plan which aims to provide tree screening and the re-vegetating of roadsides, pit edge and other areas as rapidly as possible. Once construction is complete, the open pit mine would be developed, the reaction to which would depend on the aesthetic values of each visitor. At project close, the open pit is expected to be rehabilitated as a deep water lake which may possess positive aesthetic attributes when developed according to the vegetation and shoreline management plans.

4.006 The development of the waste containment area would also intrude on the existing landscape. Initially during construction, there would be negative aesthetic impacts, and also later as the dikes are extended upwards in 12 1/2 foot lifts. At project close, the waste containment area would have developed into a symmetrical flat-topped hill with stepped sides covered with grasses and shrubs.

4.007 The scenic value of the Flambeau River should not be compromised by this project. Plans to leave and augment existing tree corridors along the shoreland should actually enhance the scenic value of this segment of the river. Tree plantings within the shoreland protection zone of the Flambeau east bank have already been undertaken by the BCMC staff.

4.008 Two archaeological surveys of the proposed project site have found no archaeological sites.

Historical and Archaeological Values

4.009 The proposed project should have no impact upon historical or archaeological resources (exhibit 49).

Recreation

4.010 The increased population stimulated by employment opportunities at the mine would create a slight additional demand for recreational facilities. It is not anticipated that this demand would exceed the existing supply of facilities.

4.011 The proposed mining venture would have minimal impact on recreation in the fringe areas of the project site. There is a minor amount of fishing and some trapping in the tag alder marsh and throughout the project site. There is some upland game bird and large game hunting. Although hunting and trapping would be discontinued, fishing would continue to be an allowed form of recreation along the Flambeau River within project lands.

Transportation

4.012 The proposed 5,450-foot railroad spur with its 100-foot right-of-way would require alteration of about 12 acres. No unique habitat areas or topographic features would be affected. A township road and State Highway 27 would be crossed.

4.013 County Highway P would not be significantly altered by the haul road crossing located approximately 500 feet west of the intersection of County Highway P and State Highway 27. To ensure safety and free movement, the Flambeau haulage truck traffic on the haul road between the mine and waste containment area would be segregated from public traffic on Highway P by means of a "reinforced soil" haul road overpass over Highway P constructed at Flambeau expense and according to specifications approved by the county. During its construction, traffic on County Highway P would be slightly inconvenienced for a period of 2 months. An alternate route from State Highway 27 to the continuation of Highway P west from the southwest corner of Section 20 exists via a gravel township road.

4.014 Other than construction of the rail crossing, no alteration of State Highway 27 is envisioned. Traffic on the highway would be inconvenienced for a period of approximately two weeks during the construction of the crossing. The crossing would be made at a right angle to the centerline of the highway and would be constructed at Flambeau expense according to specifications approved by the Wisconsin Department of Transportation and the Public Service Commission. Rail traffic on the spur line to the concentrator would interrupt traffic on the highway during two intervals of approximately two minutes' duration each on every other day throughout the life of the mining operation. As far as practicable, rail traffic on the spur would be scheduled for hours of low highway traffic density.

4.015 Because of the proximity of the open pit to State Highway 27 and the danger from an occasional flying rock during blasting, it may be necessary to stop traffic for a period of roughly 5 minutes during some blasts, depending upon the location of the blast. Blasting would take place once per week in the summer and six times per week in the winter as presently planned.

4.016 The peak time for traffic density increases and potential safety hazards would be during the construction phase of the project. There would be 225 persons reporting to work daily during the 14 months as well as deliveries of construction material and equipment. During mine operation, an estimated 30 trips for all company vehicles per day would be made on State Highway 27 and ten or fewer on County Highway P for mine company business. Employee trips would be considerably reduced as the arrivals and departures of the 78 employees would be spread over three shifts daily.

4.017 There is no way to estimate traffic density changes due to visitors to the mine. The parking lot to be provided at the observation point on the northeast edge of the pit should reduce potential traffic hazards caused by persons stopping along Highway 27 to view the operation.

4.018 The existing 34-inch Lakehead Pipeline Company oil line would be crossed by the Flambeau haul road about one-fourth mile north of County P. A liaison relationship between the two companies has been established to insure that adequate protection of the pipeline would be assured. Details of the crossing of the line are not available, but it is anticipated that construction of, and operation on, the haul road could be carried out with no impact on the pipeline.

Public Health

4.019 The workers in the mine and the concentrating plant would be subject to accident risks inherent to the nature of the operation. Flambeau would employ the most up-to-date safety techniques to minimize this risk.

4.020 The public health in general should not be affected by the proposed project.

Community Cohesion and Growth

4.021 The proposed project is located in a rural area and would have no impact upon the community cohesion of Ladysmith.

4.022 The proposed project may stimulate some community growth with the influx of personnel to work at the mine. However, this should not be substantial enough to cause a significant change in the growth of Ladysmith (i.e. addition of new schools, cultural facilities, recreational facilities, etc).

Population Displacement

4.023 The proposed project should not cause any involuntary population displacement. Some people would move to Ladysmith from other areas in the county and the State to take advantage of new jobs created by the mine (see Employment, 4.041-4.046).

Controversy

4.024 The proposed project is very controversial at the local level. The controversy at the local level has primarily centered around the following pro's and con's of the proposed project:

Pro:

(1) The project would bring a new source of employment and revenue to the Ladysmith area.

Con:

(1) The project is of a finite life and when the mining operation is finished in 11 or 22 years, it may cause an economic depression in the area.

(2) Under the State of Wisconsin mineral tax law, the direct benefits to Grant Township and Rusk County would be small (see paragraph 4.036).

(3) While seepage from the waste containment area would be kept to a minimum by design techniques, there is no way of achieving zero seepage. Thus the potential for groundwater contamination would exist for a long time.

(4) Because Flambeau Mining Corporation would be leaving the area after 11 or 22 years and probably dissolved as a corporate entity, there is a question as to who is responsible for environmental problems such as seepage that may occur after mining ceases.

4.025 As of 15 July 1976 the Corps has received 15 letters in opposition to the project, 1 letter in support of the project, and 2 letters requesting a public hearing be held. A number of the people writing letters of opposition also requested a public hearing.

4.026 The Corps will hold a public hearing on the proposal in Ladysmith, Wisconsin. At the present time no date or meeting place has yet been established.

ECONOMIC EFFECTS

Property Values and Tax Revenues

4.027 The estimated average yearly taxable income for the Flambeau project is $3,600,000. Based on the Wisconsin corporation income tax rate of 7.9 percent, the income to the state from this source would be $284,400 per annum.

4.028 The estimated average yearly salary of direct employees on the project during the construction period with the estimated average yearly salary of service jobs created by the project together with the estimated yearly State personal income tax for each of these categories is shown in exhibit 40.

4.029 In 1972, the sales and use tax in the State was approximately 63 percent of the personal income tax collected, and the alcohol and tobacco tax about 18 percent of personal income tax. In Rusk County these percentages were 99 percent and 36 percent respectively. Based on the statewide averages, which are more conservative than those for Rusk County, and based on the anticipated income, sales and use taxes during the construction period would amount to approximately $146,700. During the operating period, the anticipated sales and use taxes would total $35,700 annually. Annual excise taxes could total approximately $10,200 during this period.

4.030 The method of taxation of both real and personal taxes in Wisconsin has undergone many changes in the recent past. Although these changes are capable of general definition within the framework of this document, revenues that might be expected to be generated at various levels of state and local government are subject to many variables including changes in the law itself, local revenue needs, and final formation of disbursements from the county and municipality shared tax account. With these constraints in mind, the following estimates are made:

Real Estate and Improvements: A copper mining operation is considered for purposes of real estate taxation in Wisconsin to be manufacturing under Wisconsin Statutes, Section 70.995 (1).

The method by which real property used in manufacturing would be subjected to taxation by the local government has recently been changed. Under Wisconsin Statutes, Section 70.995, the Department of Revenue is now responsible for determining the fair market value of the land and improvements used in manufacturing. After this determination has been made, the Department would determine the local assessment rate and certify the manufacturing property to the local assessor at the local rate. Thereafter the local assessor would enter the manufacturing property on the rolls and the tax would be levied.

This procedure for Flambeau property in Grant Township for 1974 real estate taxes is set forth in exhibit 40.

4.031 Based on the rates in effect in 1974 and the capital expenditures for land and improvements anticipated by Flambeau, exhibit 41 sets forth estimated real estate taxes for the operating phase of the proposed project. It should be noted, however, that this estimate is subject to many variables including fair market valuation, the local assessment rate, the mill rate, revenue needs and other sources of revenue of the county and township. Therefore, real estate taxes may be quite different from those anticipated if copper mining does in fact occur.

4.032 By law, the Department of Revenue's determination of fair market value for the land used in copper mining may not include the value of the mineral content (Wisconsin Statutes, Section 70.995 (5)). This value is taxed as a production tax under Chapter 283 of the Laws of 1973, now Wisconsin Statutes, Section 70.87.

4.033 Production Tax: Chapter 283, Laws of 1973, which became effective June 16,1974, imposed a production tax equal to 1.5 percent of the fair market value of copper-bearing ores and concentrates mined in Wisconsin.

4.034 Distribution of this tax under section 70.90, Wisconsin Statutes, would return 1.25 percent to the county, 2.75 percent to the town, village or city wherein lands from which the minerals being extracted are located, 10 percent to the State general fund and the balance to the municipal and county shared tax account. This tax and distribution formula is under review by the Mineral Taxation Committee of the Wisconsin Legislature and may be revised.

4.035 Based on the Wisconsin Statutes as presently written and the expected production and values, the following might be expected:

PRODUCTION TAX ESTIMATES

Average annual production	
Tons copper	11,286
Ounces gold	13,989
Ounces silver	149,297

Estimated market value of production (1974 dollars)

	High	Low
Copper ($0.85/pound)	$19,186,000	
($0.60/pound)		$13,543,000
Gold[1] ($150.00/ounce)	2,098,000	2,098,000
Silver ($4.50/ounce)	672,000	672,000
TOTAL	$21,956,000	$16,313,000
Production tax - 1.5% of market value	$329,000	$245,000
Rusk County receives 1.25% of tax	4,112	3,062
Grant Township receives 2.75% of tax	9,048	6,738
State general fund receives 10% of tax	32,900	24,500
The balance goes to the municipal and county shared tax account	282,940	210,700

[1] The value of gold has fluctuated over the past year and one-half, thus these figures are subject to frequent variation.

4.036 The direct benefit to Grant Township and Rusk County is relatively small under this method of taxation. The greatest benefit of the tax would be to the State's municipal county shared tax account. Tracing the production tax through this account back to Rusk County and Grant Township is a much involved process, subject to many variables, and therefore is not presented in this report.

4.037 However, it might be well to note that some of the differences between revenues collected by the State in comparison to disbursements made to Rusk County and Grant Township would be reduced by the production tax, as well as the income taxes discussed above and miscellaneous taxes discussed below.

Personal Property Tax

Manufacturing Machinery and Equipment: This category of property is now exempt from property taxation, Section 70.11 (27), Wis. Stat., if used exclusively and directly by a manufacturer in manufacturing tangible personal property. However, if the local unit of government would have received revenues based on property now exempt under Section 70.11 (27) for 1974, the state would make certain payments to the local unit, Section 70.996, Wisconsin Statutes. FMC had no manufacturing property in Grant Township on May 1,1974, and therefore the township would not receive any State aid.

Manufacturer's Materials and Finished Products: By 1978 this class of personal property will be exempt from taxation, Section 70.04 (3), Wisconsin Statutes. However, in 1978 for property entered on the tax rolls as of May 1,1977, the State will pay to the local government unit 100 percent of the tax that would otherwise have been paid and a decreasing amount by 10 percent each year thereafter until 1988 when no further payments will be made. Thus, the amount of revenue that the local unit of government might expect to receive would be dependent upon what value is includable on the May 1, 1977 roll. It will also be dependent upon whether or not unrefined copper ore would be included within this class.

Assuming both these contingencies are met to the local governmental unit's benefit, Grant Township might expect the following revenues:

MANUFACTURER'S MATERIALS AND FINISHED PRODUCTS TAX

Expected annual production of copper	11,300 tons
Average weekly inventory on hand (once weekly shipments)	217 tons

	High	Low
Estimated average inventory value	$422,000	$314,000
Estimated mill rate 1977 (0.036679)		
Tax for 1978 received from state	15,479	11,517
Total payments 1978-1987 from state (5.5 times 1978 payment)	85,135	63,344

Upon closing of the mine, most of these revenues would be lost and Rusk County and the Town of Grant would probably require a disproportionately large share of State aid as they do now.

Public Facilities and Services

4.038 There would not be a significant impact on local municipal facilities. The school system is adequate to handle the anticipated enrollment increase of 45 to 70 pupils. No municipal services such as sewer, water, solid waste disposal or law enforcement would be required from the city of Ladysmith for the mine operation itself. However, the anticipated population increase in Ladysmith would require these services. The mining operation itself could make use of the contract solid waste disposal service provided by the Town of Grant or solid waste could be disposed of under private contract between the company and a hauler. Law enforcement could be provided by the Rusk County Sheriff's Department. The Sheriff's Department is small, but being headquartered in Ladysmith, personnel would be nearby for law enforcement service.

4.039 The telephone system has sufficient capacity to meet the anticipated needs of the mining company.

4.040 The total electrical power draw would be about 1.5 megawatts during regular operation and a maximum startup draw of 2.0 megawatts. The monthly electric power consumption is projected to be 1,064,000 kilowatt hours. Such levels could be provided without stress on the capacities of existing generating and distribution facilities.

Employment and Business Activity

4.041 A relatively small increase in population would be expected to result from employment furnished by the project. The estimated number of employees required for construction and operation is given in exhibit 42.

4.042 A maximum population increase to the county of about 351 is estimated during the peak of the construction period which falls to 127 during the subsequent years of operation. This peak would only prevail for two or three months, and during this period, the population of the county would still be slightly below the 1960 level. During this period, the local jobs available directly on the project would average 120 per month. Service jobs created as a result of this stimulus to the economy are estimated at an average of 34 per month during this construction activity. Following construction and during

the subsequent 11 years of operation, the direct employment at the project is estimated at 78; 22 service jobs are also estimated as a result of the operation of the mine. Most of this increase, including the construction crew, would probably come from the State of Wisconsin, so the effect of the Flambeau project on the population of the state should be negligible. The population increase for several months during the construction period would be as high as 2.5 percent which would still not increase the population of the county for these few months to the 1960 level. During the operating period, the increase in population as a result of the project would be only 0.9 percent, and the population of the county as a result of the project would be well below the 1960 level.

4.043 The county presently has a fair existing employment base in agricultural and manufacturing activities. With the exception of the construction period, the project would not be the largest industrial employer in the county as four other manufacturing employers presently have more people on their payrolls than is intended for the Flambeau project. The overall quantitative effect on the percentage of unemployment would be difficult to determine. Some jobs on the Flambeau project would be filled by those presently employed in marginal jobs, and some of these marginal jobs would probably not be continued when vacated. Some now listed as agricultural labor may become employees of the mining operation and still continue their agricultural endeavors to some extent. The effect on employment in Ladysmith is more difficult to predict. Evidently the employment situation in Ladysmith proper is much better than that for the county at large because of the several large employers in the community. In any case, the addition of a substantial basic industry to a small county having a high unemployment percentage would result in an improvement of the unemployment problem.

4.044 When the mine closes, a substantial number of employees would be adversely affected. Some job skills, such as heavy equipment operation, construction trades, stenography, chemistry, and accounting, may enable the employees to find other employment in the area. The company also has a policy of attempting to place employees in other operating divisions or with other mining companies. A shortage of persons trained in mining skill makes it desirable for the company to retain skilled persons in the mining industry.

4.045 Twenty-eight salaried employees would have been brought into the area at the beginning of mining and most would probably choose to leave the area at shutdown. However, some locally hired hourly wage earners may not be able to obtain jobs locally nor be willing to relocate and may become a burden to local units of government.

4.046 There is no surplus housing in Ladysmith. This situation would result in some workers commuting from outside the county. Others would probably be housed in mobile homes near Ladysmith. This would have a temporary land use impact, as parks would develop to accommodate this demand. Sewer and water service may have to be provided by the City of Ladysmith. Even if 75 percent of all operating employees moved to

Ladysmith, the population would increase only 2.6 percent. No new community would have to be built.

4.047 The local economy of Rusk County would be affected primarily by payroll expenditures. During the construction phase, the annual payroll would average $1,900,000. An additional $200,000 would be spent locally for goods and services during this period. These $2.1 million would continue to circulate in the local economy and produce indirect secondary benefits which cannot be quantified.

4.048 The annual direct local economic impact during the operating period would be $1,220,000 consisting of $1,020,000 in wages and $200,000 in local purchases of goods and services. Similarily, this money would circulate in the local economy and would stimulate secondary economic benefits.

Displacement of Farms

4.049 Flambeau's land purchases included 6 dairy and 5 general farms. The farmers have moved and the cropland is currently being rented to neighboring farmers. The farm buildings on the 11 farmsteads have been or are in the process of being moved or razed.

4.050 The project would utilize 200 acres of cropland. Following the mining operation, about 45 acres could conceivably be returned to crop production. The 155 acres in the waste containment and open pit would be lost to agricultural usage.

Regional and National Growth

4.051 Most economic growth from the project would be local in nature. Seven of the counties surrounding Rusk County that are within commuting distance of Ladysmith are qualified as depressed areas by the Economic Development Administration. Barron, Chippewa, Dunn, Taylor and Washburn Counties, all within commuting distance of the proposed project, are qualified under Section 8 of the Title IV redevelopment areas. Price and Rusk Counties are qualified under Sections 7 and 8 of Title IV and Sawyer County is qualified under Section 1 as an economic development area. The Rusk County employment office has confirmed that there is sufficient unemployed skilled and semi-skilled labor available in the eight-county commuting area to fill all available jobs with Flambeau with a minimum of training.

4.052 Most of the construction contracting firms would probably come from the Duluth-Superior, Eau Claire, and Twin Cities areas.

4.053 These firms usually have a steady work force in the skilled positions such as heavy equipment operators, sheet metal workers, electricians, etc. Thus some of the monies spent for construction would be funneled back to these regional centers of trade.

4.054 Since Wisconsin is a major manufacturing center of mining equipment, some of the $11.2 to $14.2 million dollar expenditure for the plant, machinery, and equipment would probably be made in the State.

4.055 On the national scale, the primary benefit would be derived from the annual production of copper. The 11,000 tons of copper produced per year would be a .65 percent increase over the United States' 1973 domestic production.

NATURAL RESOURCE EFFECTS

Geology

4.056 A direct and irreversible impact of the mining operation would be the depletion of most of the known mineral resources contained within the project area.

4.057 All economically recoverable copper would be extracted from the ore body. Yet-to-be-determined characteristics of the deposit itself, and future technology and economics would determine the ultimate extraction. Because the mineralization bordering the ore body is so low in grade and limited in quantity, the possibility is small that future advances in technology and economics would permit later extraction of this material. Assuming that the underground phase of mining is completed, the known usable copper resources of the project area would be totally exhausted by the mining operation.

4.058 Other commodities of potential worth contained in the ore deposit are gold, silver, zinc and pyrite. At least 60 percent of the gold and silver contained in the ore would be recovered in the processing of the copper concentrates. The feasibility of adding a flotation circuit in the mill to produce zinc-bearing sphalerite concentrate would be evaluated before mining reaches the deep-lying mineralization which contains potentially recoverable amounts of zinc. The pyrite-bearing tailings to be produced as an unavoidable by-product from the milling of the copper ore constitute a potential sulfur and iron resource which would not otherwise be available. Although a market for this material is being sought, none is known at this time.

4.059 Well sorted gravel of sufficient quality to be considered a mineral resource is present only in the glacial outwash deposits located west and north of the ore body. A small amount of this material would be removed in the excavation of the open pit. If underground mining of the lower portion of the ore body is undertaken, approximately 1.2 million cubic yards of gravel would be used as backfill in the stopes. This material would be obtained from the former Rusk County gravel pit located 2,000 feet north of the mine. Although Rusk County contains ample gravel reserves, the extraction of this amount of usable gravel would constitute a reduction of the total gravel resource.

4.060 The presence of an active mining organization in Grant Township would create an intangible and potential impact by fostering mineral exploration and thereby increasing the likelihood that additional mineral resources might be discovered, either on the project site or elsewhere in the region. It has been established by exploration drilling and geophysical surveys that the project site contains no shallow mineralization other than the known ore body that could be mined by open pit methods. The proposed surface facilities would not render any presently-unknown ore bodies unminable.

Topography

4.061 There would be four impacts on the landscape: two excavated pits, a low flattopped hill and a road bed.

4.062 The open pit as proposed would occupy 55 acres and would be approximately 285 feet deep at its deepest point. This major geomorphological impact would exist during the final months of operating the open pit or for eleven more years should it be decided to continue with underground mining beneath the open pit. At the cessation of mining the open pit would be filled with water and the walls above the water level would be contoured to slope approximately fifteen degrees toward the lakeshore. Thus, the final impact on the landscape would be an artificial lake covering approximately 50 acres set within a 10 to 50-foot deep basin.

4.063 The waste containment area would present a flat-topped hill occuping 156 acres. Depending upon contingencies related to the sale of pyrite tailings and the economic advisability of underground mining at the end of the open pit mining, the waste containment hill would average 57 feet high with a top surface of approximately 96 acres.

4.064 The remains of the haul road bed would persist as a low, ridge-like hill in some areas. Cuts, embankments and the right-of-way through wooded areas would be visible. The most significant geomorphological feature on the project site, the steep river banks located on the outside meander banks of the Flambeau, would not be physically disturbed by the mining operations.

4.065 Should it prove economically feasible to extend the mining operation a second eleven years via underground mining, there would be additional excavation within the now-abandoned Rusk County gravel pit and possible expansion of this pit by as much as 30 acres. The rehabilitated gravel pit would form a gently-sloped basin some 20 feet deep.

Soils

4.066 Large quantities of soils would be moved, manipulated, stored and reused during the life of the proposed operation. Erosion would be controlled by fertilizing and vegetating exposed soils and slopes.

4.067 An unavoidable impact of the manipulation of soils would be the upset of flora and fauna residents on the soil surfaces and in the organism-modified humus layers. These organisms and soil profiles would be mostly lost. Company tests have indicated that subsoils (parent materials) can support the growth of seed mixtures if there is use of recommended fertilization and liming. Most of the soils to be moved and reused are acidic in nature. As they would be reused, the pH would be adjusted to 6.5 to 7.0 with lime stabilizing vegetation.

4.068 Much soil would be covered through emplacement of buildings, construction of the haul road and construction of the waste conatainment area. Approximately 176 acres of soils would be permanently covered with these structures; about three acres would be covered under the plant site to be rehabilitated later when buildings are removed and roadways restored. Presently these soils support mostly pasture and old field, and lesser amounts of mixed forests.

4.069 The quantities of soils lost to erosion are difficult to predict. The majority of soils to be manipulated are dense silty sands and clays, and are highly impermeable and water retentive after saturation. Silty sands are subject to rapid erosion.

Air Quality

4.070 The two principal sources of potential fugitive dust would be the crushing and grinding operations of the concentrator and the blasting operation in the pit. The threshold limit values for industrial air quality as established by the Mining Enforcement Safety Administration in 1974 are as follows:

1. Silica dust
   $10/mg/m^3 \div$ the percent of respirable quartz +2
2. Total dust, respirable and nonrespirable
   30 $mg/m^3 \div$ the percent quartz +3

Dust collection equipment for the crushing section of the concentrator must meet these federal safety standards.

4.071 Blasting would take place approximately once a week during the summer and somewhat more frequently during the winter. Fugitive dust generated by blasting would dissipate into the atmosphere. There is no practical method for capturing this dust.

4.072 The other source of potential air quality contamination would be the heating system for the plant and associated buildings. If No. 2 fuel oil is burned, 7.5 to 12.4 pounds of sulfur dioxide (SO_2) would be emitted per day. If coal is used, 54.4 pounds per day SO_2 would be emitted.

4.073 Less significant sources of air pollution would include emissions from hauling trucks and dust generation along the haul road.

4.074 These air contaminants would be dispersed over the surrounding area by the wind. The general prevailing wind directions are from northwest to southwest. Wind data from April through October indicate that south and southwest winds occur 35 percent of the time. Winds from these directions would disperse pollutants toward the Ladysmith area which is less than one mile to the northeast. The closest sensitive receptors are Mt. Senario College, the Rusk County Hospital and Nursing Home, and a low density residential area near Highway 27 just south of the Flambeau River. Winds from directions other than south and southwest would disperse pollutants over agricultural and forested areas primarily. It is believed that the impact of the operation on air quality would not be significant.

Hydrology

4.075 The planned mining operation would cause no detectable changes in the flow and water levels of the Flambeau River. The planned withdrawal of 10 million gallons of river water during a 14-day period at the beginning of operations would take place at a rate of 492 gpm, which is 1.1 cubic feet per second (cfs). This is insignificant when compared with the average river discharge of 1,776 cfs at the U.S.G.S. gauging station below the Thornapple power plant. The probable withdrawal of up to 1.77 billion gallons of Flambeau River water would occur at an estimated rate of 5,950 gpm or 13.3 cfs. This is 0.7 percent of the average river discharge at the Thornapple plant, and 1.8 percent of the 734 cfs calculated as the flow exceeded 95 percent of the time.

4.076 Surface flow through intermittent tributary stream A (exhibit 20) would not be affected by the open pit as it originates in and discharges from a minute watershed to the northwest of the pit. Facilities such as the pipeline to the settlement basins in the gravel pit would not obstruct or contaminate the natural flow. Intermittent tributary stream B would be largely eliminated since its watershed is mostly within the perimeter of the planned open pit.

4.077 No alteration in the flow of tributary stream C would be created except briefly during construction of the haul road as the culvert is installed.

4.078 The flow of tributary stream D would be altered and diverted approximately 90 feet south of the existing natural channel upon completion of construction of the reinforced concrete culvert.

4.079 Tributary Stream E which crosses the proposed waste containment area would be diverted around the southeast section of the dike. Basically, the rerouting would substitute a channelized portion of this stream for a part that was channelized by previous owners. It has been determined by the DNR to be non-navigable. The rerouting of this stream would not influence water levels in the adjacent wetlands as all of the wetland basins in Sections 20 and 21 are interconnected. Flows in stream F would not be influenced by the waste containment facility. After the cessation of mining, the revegetated surface

of the waste containment area would be sloped inward at a grade of 0.5 percent towards the center of the area. Runoff would thus be collected and exited from the area via a concrete-lined open ditch through a shallow concrete-lined notch in the south dike. Diverted waters would join the natural flow through the wetland on the southeast end of the waste containment area.

4.080 Stream G would lose 156 acres from its watershed due to the construction of the waste containment facility. Some surface water flow would be generated by the facility. Computer simulations of seepage loss through and beneath the dike, under a 50-foot fluid mass head and with no allowance made for reductions in permeability due to the accumulation of slimes and chemical precipitates, indicate that 0.57 gallons per day per linear foot of dike would escape to the surface outside the toe of the dike after a period of approximately 9.4 years. Thus, the maximum total above-ground seepage around the full perimeter of the waste containment area is estimated to be 4.6 gpm after the 9.4-flow propagation time.

Groundwater

4.081 Excavation of the proposed open pit would have a pronounced local effect on the groundwater gradient and flowpaths adjacent to the pit. The present flow of groundwaters across the mine area would be intercepted by the pit. Normal recharge of aquifers in the glacial outwash deposits immediately northwest of the pit would be altered, and the glacial tills to the southwest, south and southeast of the pit would be partly dewatered.

4.082 Exhibit 43 indicates the expected maximum and minimum extent of the cone of groundwater depression around the pit. Aquifer recharge outside the cone of depression northwest of the pit is expected to continue at the present rates. The low and very irregular permeability characteristics of the glacial tills and the heterogeneity of the till-outwash contact zone northwest of the pit would result in a decidedly asymmetric cone of depression. The lateral extent of the drawdown cone would be mostly controlled by the permeability characteristics of the glacial deposits and is estimated to vary from a minimum of 50 feet at the southwest end of the pit to a maximum of 500 feet in the heterogeneous soils northwest of the pit.

4.083 Many of the trees within the drawdown cone northwest of the pit are species that prefer moist soils, i.e., black ash and hemlock. Soil moisture levels and tree survival would be monitored during the operation because these trees would be of value to Flambeau in the postmining development of the pit into a recreational lake. Some irrigation of these trees may be needed during the life of the operation.

4.084 Because all property within the cone of groundwater drawdown around the pit would be owned by FMC, no private water wells would be affected (exhibit 42). Excavation of the pit would, however, intercept the water supply to the two seeps located northwest of the pit with the result that flow from these seeps would be drastically reduced or would cease entirely. Preservation of the water-dependent vegetation

at these sites would be maintained through irrigation as required.

4.085 An additional water quality monitoring site would be established due west of the gravel pit to determine if discharge to the gravel pit has an effect on the quality of the Flambeau River. Similarily two domestic wells owned by the company between the gravel pit and the river would be included in the water quality monitoring program.

4.086 The diversion of stream E to the south, around the southeast corner of the waste containment facility would have little effect on groundwater supply outside the facility. The rerouted flow of stream E when added to the area surrounding the southeast corner of the facility would be taken up by the adjacent wetlands into which the stream presently discharges.

4.087 Creation of the waste containment area and the imposition of the resulting fluid mass head on the underlying area would produce an increment of recharge to the groundwaters in the waste containment area. Permeabilities and expected vertical travel times through varying depths of soil (which have been somewhat arbitrarily defined) are shown in exhibit 44. The travel times listed are not absolute statements of travel times for a particle of water to pass beyond the confines of the impoundment dikes. These travel times are indications of a part of the total travel time. Additional time would be experienced when the water either would travel downward farther or as it would travel horizontal as part of the groundwater flow.

4.088 The rate of seepage through the entire dike, around its full perimeter, is estimated to be approximately 6 gpm under a 50-foot fluid mass head. Only 1 gpm of this flow would remain in the groundwater system, however, as approximately 5 gpm of that total flow would escape to the surface outside the toe of the dike. The rate of seepage through the floor of the waste containment area is estimated to be 19 gpm under a fluid mass head of 50 feet-which would not be reached until the final year of underground mining. No allowance was made in the estimate for the sealing effect which could be produced by the accumulation of slimes and precipitates within the tailings. Thus the increment of recharge to the groundwater system resulting from the creation of the waste containment area would be 20 gpm at maximum. Seepage would either continue at a reduced rate or cease entirely after the cessation of the operation since the reclamation plan calls for removal of excess tailings water and covering the waste containment area to prevent recharge from runoff.

Water Quality

4.089 Seepage from the waste containment area would constitute the major potential source of contamination of water. Seepage would be released in three ways: 1) through the dike to the surface at a rate of five gallons per minute (gpm); 2) under the dike to the groundwater at a rate of 1 gpm; and 3) through the bottom of the waste containment area at a rate of 19 gpm. These estimated seepage rates through the

dike would occur after 18.6 years due to the relative impermeability of the compacted dike construction, clay core design and low permeability natural base soils. It is expected that seepage would occur sooner through the bottom of the waste area but would still have to travel beneath the dike, taking 9.4 years. These seepage rates are predicted without considering the effect of slime sealing or loss of permeability due to consolidation of the base soils from the weight of the waste containment area materials. The effect of these two factors could minimize the flow of seepage.

4.090 Initially the tailings would be very alkaline due to the addition of lime in the concentrator circuit. However, this condition would be reversed by oxidation of the pyrite in the top layers of the tailings. The chemistry in the tailings basin would probably be as follows:

1) $2FeS_2 + 7\ O_2 + 2H_2O = 2Fe^{++} + 4SO_4^{=} + 4H^+$

2) $4Fe^{++} + O_2 + 4H^+ = 4Fe^{+++} + 2\ H_2O$

3) $Fe^{+++} + 3H_2O = Fe(OH)_3 + 3H^+$

4) $FeS_2 + 14Fe^{+++} + 8H_2O = 15\ Fe^{++} + 2SO_4^{=} + 16H^+$

The oxidation of the sulfide of the pyrite to sulfate (1) releases dissolved ferrous iron and hydrogen ions (acidity) into the water. Subsequently, the dissolved ferrous iron undergoes oxygenation to ferric iron (2) which then hydrolyzes to form insoluble ferric hydroxide (3), and generates more acidity. Ferric iron can also be reduced by pyrite itself, as in (4), where sulfide is again oxidized and acidity is released along with additional ferrous iron which may re-enter the reaction cycle via equation (2). Therefore, once the process has been started by the oxidation of pyrite, little additional oxygen is required to sustain the acid generating reactions. The dissolution of 1 mole of iron pyrite leads ultimately to the release of 4 equivalents of acidity.

4.091 Some of the acidity could be neutralized by reaction with other minerals in the waste rock such as kaolinite:

$$Al_2\ Si_2\ O_5\ (OH_4) + 6H^+ + 3SO_4^{=} = Al_2\ (SO_4)_3 + 2SiO_2 + 5H_2O$$

kaolinite — amorphous silicia

and residual lime:

$$CaCO_3 + 2H^+ + SO_4^{=} = CaSO_4 + CO_2 + H_2O$$

lime

The resulting solution which would escape from the waste containment facility would be a mixture of ferrous and magnesium sulfates and calcium sulfates, limited by the solubility of gypsum, with some free sulfuric acid and aluminum sulfate.

4.092 The initial rate of acid generation within the waste containment facility would be primarily controlled by the diffusion of oxygen into the tailings. Due to weather fluctuations the oxygen flux would vary widely and would be expected to range from 2.0×10^{-11} to 1.0×10^{-8} g 02 / cm^2/sec. during the spring, summer and fall seasons if the tailings surface were left untreated. This oxygen flux range corresponds to an acid generation rate of from 0.1 to 64 lb of sulfuric acid/acre/day. The most likely average oxygen flux of 1×10^{-10} g/cm^2 sec. corresponds to an acid generation rate of 0.75 lb./acre/day, or a total of approximately 100 lb per day.

4.093 The company proposes designs to prevent acid generation but plans to treat acid seepage, should it occur, through recovery wells and surface treatment, lime injection wells or surface interceptor ditches.

4.094 The rate of acid generation would be reduced by treatment of the upper surface of the tailings upon the cessation of mining. The presence of lime-based chemicals (pH 10-11) directly within the uppermost tailings layer from tailing slurry would passivate the pyrite mineral surfaces and would also neutralize acid formed in the aerobic zone. The installation of a sealant, such as bentonitic clay and 2 to 3 feet of low permeability soil on top of the tailings surface, would reduce the oxygen flux and thereby inhibit initial oxidation of the pyrite. The total effectiveness of such a measure cannot be quantified at this time. Experimental studies of the actual tailings materials in situ would be required to develop the quantitative information needed to establish an effective set of treatment procedures.

4.095 Monitor wells to detect seepage and obtain samples for analysis and study have been installed and additional wells are planned to provide warning of any deterioration of groundwater quality. Specific effluent quality standards have not yet been developed. However, it is likely that pH, metal concentrations and sulfates would be monitored. Corrective action could be required if these parameters violated USPHS drinking water quality standards or varied significantly from ambient levels.

4.096 Surface water would have to be sampled to monitor the quality of water reaching the peat area, stream G, and ultimately the Flambeau River. Surface seepage would flow to the southwest from the waste containment area. Seepage would encounter a large area of peat type soils. The peat is acidic, as indicated by the presence of blueberry plants. Surface water samples in the peat area have had a pH of 5.5 to 6. If the seepage is acidic, neutralization would not take place as it flows through the peat area. However, the peat may tend to absorb some trace metals which would have been freed by the acidic seepage.

4.097 Experimentation showed that peat is capable of adsorbing heavy metal ions and alcohol, cresols, and dithiophosphate. Peat does have a finite adsorbtive capacity which indicates that in time all available adsorptive space would be occupied and a flow through of metal ions would occur. In addition, metal ions are known to compete for available adsorption space. This presents the possibility that ions which were initially held by the peat could be displaced by more competitive ions and would be moved down gradient to the next available space. Ultimately this process would lead to contamination of the entire peat area and flow-through of metal ions would occur and contaminate ground or surface waters. Depending on the concentration of heavy metals in the seepage, plant toxicity may occur. Evidence suggests that woody species are more sensitive to metal toxicity than such plant forms as mosses and lichens (Fraser, D.C., 1961). The time required for absorbtive saturation cannot be estimated from available data.

4.098 After flowing through about 1 1/2 miles of peat, the surface seepage (6 gpm) would become part of the flow of stream G which flows for about 1 mile before entering the Flambeau River.

4.099 In time, stream G could be adversely affected by low pH levels and elevated metal concentrations.

4.100 The 6 gpm (0.13 cfs) of surface seepage would be significantly diluted by the Flambeau River. The dilution factor at low flow (exceeded 95 percent of the time) would be over 55,000 and at mean flow would be over 135,000. These high dilution factors would assure that the Flambeau River would not be adversely affected by surface seepage from the waste containment area.

4.101 The discharge of 135 million gallons of treated waste process water from the waste containment area to the Flambeau River is expected to be able to meet current water quality standards (see Alternatives Section). Although there may be some degradation of water quality for a short time, this impact should not be significant.

4.102 Impacts on water quality in tributary stream A would be limited to a minor amount of siltation for a short time during the construction period while a pipeline crossing is installed. Intermittent tributary stream B would be largely eliminated since its watershed is mostly within the perimeter of the planned open pit. The remaining course of this stream between the pit perimeter and the river would not be disturbed. It would drain no waters from within the pit since these would be directed into the 1,085 level collection system.

4.103 Impacts on water quality in tributary streams C and D would also be limited to minor amounts of siltation during the construction of the waste haul road while culverts are installed. Any unplanned leakage from the tailings or water reclaim pipelines would not enter streams C and D, and catchment basins would be provided on either side of both streams to contain any leaking from the pipelines.

4.104 Minor amounts of siltation would occur during the construction period while stream E is rechanneled around the southeast section of the waste containment area. Temporary settling ponds would be constructed to control this siltation. Some siltation would occur periodically throughout the life of the open pit operation as the waste containment dikes are constructed. This would be controlled by temporary settling basins and by vegetation of the lower, already completed, portions of the dikes. Any siltation escaping would quickly settle out in the sluggish waters of the adjacent wetland.

Vegetation

4.105 An estimation of the acreage of vegetative types which would be altered or lost due to mine construction is given in exhibit 45. The bog, river basin, and wooded swamp communities would be unaffected by construction. Less than 10 percent of the mixed deciduous-coniferous lowland and the shrub swamp would be altered. The meadow and old field would experience an acreage reduction of 10 to 15 percent. If surface seepage from the waste containment area is acidic and contains heavy metal ions, some destruction of the bog, wooded swamp, meadow, and mixed deciduous-coniferous lowland forest communities down gradient of the waste containment area could occur. Major losses of producing agricultural fields and mixed deciduous-coniferous upland forest would result from construction. Reforestation and maintenance of the remaining producing agricultural land would partially mitigate these losses.

4.106 Approximately 20 acres of Type II sedge meadow and Type VI shrub swamp would be destroyed and lost from the nation's wetlands inventory.

Wildlife

4.107 The disruption of over 300 acres would displace and ultimately destroy many mouse-size mammals. This would eliminate the food supply of their predators, and it is reasonable to assume that the presence of such mammals as weasel, mink and fox within the project site would be reduced. Disturbance of areas of climax forest would eliminate much of the on-site habitat for squirrel-like mammals. These animals would be dislocated and ultimately destroyed. Similarly, competition for the reduced range would eliminate some larger mammals. Those animals remaining would be somewhat restricted in their movements by barriers such as the open pit, haul road, and waste containment area. The mine site and waste area would reduce opportunities for east-west movement. The haul road would be partially restrictive since animals would cross it, but there would be some road kill. Local migration routes may tend to be reoriented to a more north-south pattern.

4.108 The destruction or alteration of habitat would result in the loss of some birds. With one exception, neither the habitat types nor species present are unique to this area (see paragraphs 2.523 and 4.111).

4.109 The numbers of reptiles and amphibians would also be reduced due to habitat loss. The major area of concern is the possible leaching of soluble salts from the waste containment area and associated variations of the pH. The permeable-skinned amphibians such as frogs and salamanders would not be able to tolerate these habitat alterations. For example, the aquatic shovel-nosed salamander has been found incapable of surviving in stream waters with a pH in the range of 4.5 to 4.9 (Huckabee et al, 1975). The more mobile impervious skinned reptiles such as turtles and snakes would be dislocated and ultimately destroyed.

4.110 No significant flow alterations are anticipated from the mine operation. A possible source of river contamination would be seepage from the waste containment area. This seepage would flow through 1.6 miles of peat bog before reaching tributary stream G which enters the Flambeau River about 2 miles above the Thornapple Dam. Adverse impacts on fish and aquatic life are not anticipated due to the waste containment area's design, the relatively small amounts of seepage, and the high dilution factors.

Threatened and Endangered Species

4.111 No species of threatened or endangered wildlife on the Federal lists (Department of Interior 1973, 1975)(exhibit 50) are found in the project area. The Artic peregrine falcon (Falco peregrinus tundrius) migrates this area of Wisconsin. The project should have no impact upon the Artic peregrine falcon.

4.112 Bald eagles, which are on the Wisconsin Endangered Species List and proposed for threatened status in Wisconsin by the Department of Interior, have been observed over the project site. Since eagles are primarily fish eaters and observations have been in late fall over land areas, it is assumed that the individuals are migrants. No eagle nesting areas are known to exist near the project site. Therefore, no significant effect on these birds would be anticipated.

4.113 No species of threatened or endangered plants as listed in the 1 July 1975 Federal Register have been found in the project area. No species proposed for threatened or endangered status in the 16 June 1976 Federal Register have been found in the area. Therefore, there should be no impact upon threatened or endangered plants from the proposed project.

5.000 UNAVOIDABLE ADVERSE EFFECTS OF THE PROPOSED ACTION

5.001 There would be some minor deterioration of air quality because of the mine operation. Fugitive dust would be generated by blasting in the open pit and from truck movement on the haul road. Other emissions would be produced by the heating system in the plant.

5.002 A minor increase in noise levels would be expected from normal operation. Blasting would produce short duration noise increases.

5.003 During mine operation, the groundwater gradient would be altered around the open pit. The normal flow pattern would be intercepted and soils around the pit would be dewatered. No producing wells would be affected, but there would be a loss of vegetation due to the lowered water table.

5.004 Stream B, a tributary of the Flambeau River, would be eliminated since its watershed lies within the perimeter of the open pit. Stream E would be rerouted to the south and would alter some flow patterns in the wetlands in the NE ¼ of Section 21. Stream G would lose a portion of its watershed to the waste containment facility. The keyed clay core of portions of the dikes may inhibit groundwater flow to the northwest towards the Flambeau River. This loss of natural flow would accentuate the effects of seepage from the waste containment area since the dilution factor would be reduced.

5.006 The discharge of 135 million gallons of waste process water would slightly degrade the Flambeau River's water quality. However, it is anticipated that this discharge could meet current effluent limitation standards. The impact of this discharge would be relatively short-term since it would be a single discharge over a 180-day period at which time the waste containment area would be dewatered.

5.007 The waste containment area could yield up to 25 gallons per minute of seepage which could be slightly acidic and may contain elevated concentrations of heavy metal tons. Six gallons per minute of this seepage would be at the surface and would enter a peat bog which has some filtering capability. The bog is drained by a tributary of the Flambeau River which enters the river about 4 miles to the west. If excessive concentrations of heavy metal ions flow through the drainage system and into the Flambeau River, they could be detrimental to the vegetation of the intervening wetlands and also to the fish and aquatic life of the Flambeau.

5.008 The 19 gpm which could escape through the bottom of the waste containment vessel into the groundwater system would flow to the northwest. Depending on the chemistry of this seepage, groundwater in the vicinity could be contaminated. Surface waters could also be adversely affected due to groundwater discharges such as the seeps along the banks of the Flambeau River.

5.009 The open pit operation would eliminate the existence of the ore body and would destroy 55 acres of woodlands and field. The waste containment area would be constructed primarily over fields and would eliminate 140 acres of fields and 20 acres of wetlands. The proposed pit lake and the revegetated waste containment area would replace the natural landscape features of the site.

5.010 The open pit operation would disturb some gravel deposits along the northwest corner of the pit. This gravel, along with other soil stripped from over the ore body, would be used to construct facilities such as access roads, the haul road, and the waste containment dikes. During the soil stripping, stockpiling, and later construction uses there would be some erosion which reduces the quantity of the soil resource and the quality of the lands and/or waters in which the soil is deposited. In addition, 176 acres of soil would be permanently covered by mine facilities. Their productivity would be lost forever.

5.011 Significant losses of productive agricultural fields and the mixed deciduous-coniferous upland forest would occur on the project site. Other wetland vegetation types could be significantly affected if tailings seepage becomes acidic and carries high concentrations of heavy metal ions.

5.012 The disruption of a total of 312 acres would alter or eliminate wildlife habitat and ultimately reduce the wildlife populations. This loss cannot be quantified. No rare or endangered species would be affected.

5.013 Employment opportunities would attract some workers from outside of the county. This could create housing shortages, escalate rent prices, and lead to the development of some temporary housing clusters. Upon cessation of mining, some unemployment would result, which may place some burden on local and state governments for human resource assistance.

5.014 There would be a negative visual impact during the construction phase of the project. The presence of a large mill complex, stripped soil areas, and road and dike construction would alter the existing landscape.

5.015 Periodic traffic delays would be caused by blasting operations in the pit and rail shipments of concentrate.

6.000 ALTERNATIVES TO THE PROPOSED ACTION

No Action

6.001 The no action alternative would be for the Corps to deny the permit application by Flambeau to fill in the 20 acres of wetlands. Flambeau officials have indicated to the Corps that if their permit were denied, they would pursue redesigning the waste containment area to avoid the wetlands and thus eliminate the need for a Section 404 permit from the Corps.

6.002 Assuming Flambeau would pursue an alternative to the proposed waste containment site, the impacts associated with the no action alternative would be as discussed earlier in Sections 4.000 and 5.000 for the mining and concentrating part of the proposal. For the waste disposal part of the operation, the impacts would be as discussed later in the Section under the heading "Alternative Configuration" (paragraph 6.008).

Alternative Locations for the Waste Containment Area

6.003 Five sites for the waste containment area were evaluated prior to selection of the proposed site. Initially, a site north of the ore body was considered. The advantages of this site were 1) the small land area requirements, 2) short hauling and pumping distances and 3) advantages in separation of waste rock and movement of ore materials. The site was discounted because of the very permeable soils (gravel pit), a social concern for neighboring property owners (residences, college, hospital and nursing home) and the aesthetic infringement on the city of Ladysmith.

6.004 A second site west of the ore body and west of the Flambeau River was considered. The company has sufficient land and the site would not be visible from densely populated areas. However, the largely outwash type soils were considered too permeable and the necessity to bridge the river, with the attendant economic and environmental problems, ruled out use of this site.

6.005 The area immediately south of the proposed plant site lying north of Meadowbrook Creek was not large enough to accommodate the proposed facility and still retain buffers between it and Meadowbrook Creek, the Flambeau River, and Highway 27.

6.006 The three closest potential sites having been eliminated two other sites were given serious consideration. The proposed site, Site A located in Section 21, is described earlier in this report. It was the last site to be evaluated because of the necessity to increase land acquisition and because of the long hauling and pumping distance. Site B is located in Section 10 directly east of the open pit and east of Highway 27 (see exhibit 46).

6.007 There would be economic and operational advantages to Site B. The distance to haul waste rock and pipe tailings would be considerably reduced. This reduced intervening distance would have reduced the project area and reduced the number of displaced residents. There were major disadvantages associated with Site B, however. An elevated pipeline and haul road crossing of Highway 27 would be required. The waste containment area would be more visible because of its proximity to Ladysmith and the higher base elevation. The complex would be within 1,500 feet of the Flambeau River and elevated 55 feet above it. This steep gradient could present hazards in the case of an accidental dike failure. The soils underlying Site B were found to be more permeable than below the proposed site, increasing the possibility of groundwater contamination.

Alternative Configuration of the Waste Containment Area

6.008 An alternative configuration for the waste containment area would be as shown in exhibit 47. This is generally the type of alternative Flambeau officials have indicated they would pursue if the Corps denied their present permit application.

6.009 The impacts associated with this alternate configuration differ from the proposed waste disposal plan in the following manner.

a) The 20-acre wetland would not be altered and little or no wildlife habitat would be lost as the waste containment area would be placed almost entirely on agricultural land.

b) The area of waste containment would be reduced. Therefore, its height would have to be increased from the proposed 57 feet to approximately 110 feet. This would increase the aesthetic impact of the waste containment primarily because of increased visibility to people travelling Highway 27.

c) The safety factor of the dikes would be reduced because of the increased height. It is not expected that this would be a problem because of the substantial safety factor of the proposed dikes.

d) There would be a potential for increased seepage because part of the waste containment area would be over more permeable soils than with the proposed design.

6.010 The Wisconsin DNR has been contacted to determine the acceptability of such an alternative configuration to them. They have responded (exhibit 48) that on the surface, this configuration appears less desirable than the proposed plan.

Alternative Design of the Waste Containment Area

6.011 An alternative to the basic design of the waste containment facility involves a combination of sealing the basin and collecting the leachate above this impermeable floor. Various synthetic materials could be used to line the basin. There have been large scale industrial applications of synthetic liners which, if properly installed and sealed, would be impervious. Such liners could effectively eliminate the potential seepage and surface and groundwater contamination problems. There are problems of proper installation over such a large irregular area as the proposed site. In addition, there is a danger of rupturing the liner, especially considering that a large amount of waste rock would be dumped into the facility. In winter, there is also the danger of puncture from wind blown ice flows. The company has stated that "the high cost of adequate surface preparation and installation makes this alternative prohibitively expensive. When considering the long-term effectiveness of synthetic lines, it should be noted that the guaranteed life expectancy is 20 years maximum."

6.012 Clay soil materials could also be used as a sealant. With proper spreading, grading, and compaction, a relatively impervious seal could be created which would significantly reduce the flow of leachate through the floor of the waste containment area and facilitate leachate collection. The 101,000 cubic yard clay saprolite surplus could be a source of some of this material. Borrow from other sources would be required. Company studies have shown that the installed clay base soils would not be as uniform nor be of lower permeability than the existing soils at the site. The company has stated that "studies also show this technique to be cost prohibitive to the project."

6.013 To collect the ponded leachate above the impervious floor, a series of tile lines would be laid on top of the liner. Leachate would flow to and through these lines by gravity to a central wet well collection area from which it would be pumped to a treatment facility.

6.014 During mine operation and depending on the water budget, this leachate may be able to be recycled through the mill process water circuit. If this is not possible, the highly alkaline (pH 11) leachate would have to be treated prior to disposal. Treatment would consist primarily of neutralization of a pH of 6 to 9 by the addition of acid and removal of suspended solids. The effluent would probably be discharged to the Flambeau River.

6.015 After mine closure, the addition of alkaline process waters would cease. In time, oxidation of the pyrite tailings would produce an acidic condition in the waste containment basin. Metals would be returned to solution under acidic conditions. To remove the metals, the pH would have to be raised to the 8-9 range in the treatment facility. The metals would be precipitated as insoluble metal hydroxides suspended in solution. This partially treated effluent would then pass through a clarifying system, either a mechanical clarifier or clarification ponds, to physically reduce the amount of metals reaching the Flambeau River. The solids collected in the clarifier periodically could have to be collected, dewatered and disposed of. Because of the high metal concentrations, these wastewater treatment sludges would have to be disposed of at a landfill site licensed to accept such waste.

6.016 Operations of this treatment facility would have to be carried on indefinitely but would significantly reduce the possibility of groundwater contaimination which could.

Defer Development of the Deposit

6.017 Deferment of the development of this deposit for the indeterminate future would delay the impacts of mining, but would not necessarily reduce the adverse impacts or improve the beneficial aspects. Deferment could require that mining take place after more of the surrounding area is developed, and therefore, the adverse impacts could be increased. There is some chance that deferment could compromise the economic viability of this deposit, although in light of domestic mineral shortages, this seems unlikely. The technology of mining may advance to the point that adverse environmental impacts would be reduced further.

6.018 The Flambeau deposit is relatively small and the amount of ore produced annually would be about .65 percent of the domestic production in 1973 (U.S. Department of Interior, 1975). It is doubtful that development of the deposit at this time or deferment of development would have much impact upon the nation's copper supply.

6.019 If this alternative were chosen, it could be assumed that the land would revert to agricultural and forestry uses primarily. Flambeau controls approximately 1,200 acres of agricultural land. Based on the Rusk County average agricultural land utilization, crop yield, and herd size, a total (gross) farm income is estimated to be approximately $178,000 per year. The DNR has estimated that the 773 acres of presently or potentially productive timber stands could yield a mean annual volume of growth valued at about $2,500. Therefore, under forestry and agricultural uses, the Flambeau land would be expected to yield slightly over $180,000 gross income per year. In that the company intends to employ a multiple land use management concept prior to, during, and after mining, it would be expected that at least a portion of the potential agricultural and forestry incomes would be realized whether or not the "Deferment of Development" alternative was selected.

Alternative Mining Methods

6.020 There are two feasible methods of mining the Flambeau deposit, open pit or underground mining. The lower costs of open pit mining would allow the extraction of more of the shallow low grade ores. Underground mining would require that the shallow ore be left in place to support the till overburden and to protect the underground workings from groundwater inflow along the base of the till.

6.021 Open pit mining would provide waste rock and clay material to build the dikes of the waste containment area. The company feels that the traditional method of containing tailings behind dikes built from

the coarse fraction of the tailings themselves is not sufficiently reliable to protect against the possibility of a dike failure. Therefore, if the underground mining method was employed, material to construct the dikes would have to be borrowed from other areas which would not have been disturbed by an open pit mine. The company estimates that between 103 and 130 acres would be disturbed for borrow that would be provided with a surface disruption of 55 acres if the open pit method were used.

6.022 In addition, open pit mining is a physically safer method for the operators, including less risk of exposure to chronic health hazards such as silicosis. Skilled labor supply is more easily obtained for an open pit operation than for an underground operation. However, underground mining would require more employees and therefore more money would enter the local economy.

Alternative Haul Road Routes

6.023 Two alternative haul road routes were considered (exhibit 46). Route B is located 500 feet east of the Flambeau River and is the shortest distance from the pit to the waste containment area. Because of its shorter distance, it would cover up less of the land surface. Traffic along this route would produce less noise and dust pollution with the respect to the homes in Section 16. On the other hand, traffic on this route would be visible from the river and there would be a greater chance of accidental spills entering the river. The route would cross the floodplain of two tributaries near to the river where long, low-level, expensive bridges would be required. The preferred Route A is located 1,500 feet east of the river. Because of extensive existing tree screening, with gaps filled in by recent tree plantings, it would partially be hidden from view both from the river and the highway. An overpass would be provided over County Highway P where the haul road crosses it. The haul road would cross the tributaries where they are narrow, thus providing minimum interference with the stream beds.

Alternative Plant Sites

6.024 There are no serious alternatives to the plant site. The proposed site would be as close as possible to the open pit, thus providing ease of access and supervision. The existing tree screens can be improved so that it would be virtually invisible from the river and only partly visible from State Highway 27. It would be located to the south of the pit rather than to the north so that it would be further removed from the city and the college-hospital complex. Sited roughly midway between State Highway 27 and river, pollution in the form of noise and dust would have minimum impact on either. The exact location of the components within the plant site would be dependent on further soil testing and detailed design work.

Alternative Rail Spurs

6.025 Three alternative railroad plans were considered (exhibit 46):

Plan A - Use the existing Soo Line facility at Ladysmith.

Plan B - Provide a rail siding along the main line in Section 10.

Plan C and D - Provide a rail spur from the Soo Line into the plant site.

6.026 Plan A has merit in that by using existing Soo Line facilities, there would be minimal installation cost, no additiona new disturbance to site or land use in the township and minimal visual impact. The reasons for its rejection were the long haul from the plant site, the increased traffic within the city and the fact that the corporation wishes to maintain close supervision over the transfer of goods and concentrates from the plant. This is to keep corporate control over spills, dust or noise for which the corporation would be liable. Plan B, to provide a rail siding in Section 10, was investigated and rejected as not being a satisfactory total solution. While long truck haulage through Ladysmith would be eliminated, the plant-truck-rail transfer still remained with the attendant difficulty in total control. A sizeable heated storage structure for concentrates would have to be constructed and maintained at a remote location from the plant in addition to the rail trackage.

6.027 Plan C or D would provide a spur from the main line into the plant area. While it was recognized that some additional land would be required for trackage (12.8 acres, 100-foot wide right-of-way), the sizable remote storage facility would not be required. The spur would cross State Highway 27 with an inherent traffic interruption during train movements. However, this cyclic interruption was believed to be superior in safety to the alternative of continuous heavy trucks merging with normal vehicular highway traffic. Plan D is preferred since it is shorter, would disturb less land (11 acres), and would require less cut and fill during its construction. It also provides a safer crossing with better train visability from Highway 27. With all transfer activities confined within the plant, the corporation can better control spills and dust.

Alternatives To Concentrating And Smelting

6.028 There are no competitive alternatives to the on-site process of concentration by flotation. In recent years, metallurgical research has been increasingly focused on hydrometallurgical alternatives to the smelting process of producing metals from concentrates. This is because of the high capital and operating costs of complying with air pollution laws applicable to smelters. To date, however, none has proved competitive.

Accordingly, the concentrates would be shipped out of the State for smelting in existing smelting facilities. The post-concentrating processes are continually being researched by KCC and the position with regard to Flambeau's concentrate would be continually reviewed.

Alternative Industrial Water Supply

6.029 Industrial water supplies are expected to be provided by groundwater inflow into the pit and precipitation into the pit and waste containment area. If is difficult to accurately predict long-term rates of inflow, but during pit operations the rate should not exceed 1,620 gpm. Experience with other pits indicates that this rate would decrease rapidly and may be as low as 320 gpm after hydrostatic stabilization. It is estimated that 73 gpm would be lost through concentrate shipments and in the waste containment area. In addition, 150 gpm would be needed for road wetting, shops and irrigation purposes. Accumulated precipitation and groundwater flow into the pit would supply these needs if the actual groundwater inflow exceeded 146 gpm. If this amount of groundwater inflow was not realized, additional water supply would be obtained from high capacity wells located in the vicinity of the gravel pit.

Alternative Sewerage Disposal and Potable Water

6.030 Several alternatives exist for sewage disposal on site. At a cost of approximately $200,000, a water line and return sewage line could be constructed to municipal lines at Ladysmith. Outside of the cost involved, this alternative involves the construction of a large sewage sump and lift station. A gravity feed sewer is not possible.

6.031 A second alternative would be to install an on-site septic tank, soil absorption system of sufficient capacity to handle an average of 2 gpm. Soil testing in the plant site area has revealed that the soil permeabilities are too low to provide proper functioning of this type of system.

6.032 Because of the high cost of obtaining water from Ladysmith, the company has chosen to get its potable water supply from a well at the mine site.

Reclamation of the Mine Pit

6.033 There are only two principal reclamation schemes possible for the open pit. The pit could be filled with waste material or it could be filled with water.

6.034 The company indicates that because of swell, only three-fourths of the total waste material could be accommodated by the open pit. DNR calculations indicate that the abandoned pit would have a volume in excess of 10,000,000 cubic yards. The proposed mining operation would generate waste material held inside the waste containment area in the following volumes in cubic yards:

	Open Pit Phase	Underground Phase	Totals
Waste Rock	4,109,999	36,344	4,146,343
Tailings	1,744,975	1,870,602	3,615,577
Washing Plant Silt	---	547,051	547,051
Total	5,854,974	2,453,997	8,308,971

6.035 It appears that all material held within the waste containment area could be deposited in the pit. Only the dike walls would remain at the site of the waste area. Relocation of the tailings would expose them to oxygen and would possibly increase acid production. However, the tailings would be held in the solid Precambrian rock basin and acid would be less likely to escape to ground or surface waters. Sealing the tailings at the top of the Precambrian bedrock surface would reduce the possibility of contamination of groundwaters which would flow over the top of the basin. The company has examined this alternative but could not economically justify the combined cost of building the waste containment dikes and then returning the tailings to the pit at mine closing. In addition to the problem of increased acid generation, the planner waste containment area could be only partially excavated, leaving the dikes, waste rock and intermingled tailings in a basin that would be difficult to cover with soil and maintain after operation ceased.

6.036 There would be three different sources of water which could be used to fill the pit for form a lake: groundwater, Flambeau River water, and industrial wastewater remaining in the waste containment area and milling circuit. There are four possible methods of filling the pit lake from the various combinations of water sources:

Alternative 1. Ground water only;
Alternative 2. Ground water and river water;
Alternative 3. Ground water and wastewater;
Alternative 4. Ground water, river water, and wastewater.

These alternatives are discussed below.

6.037 Alternative 1 involves slowly filling the pit by the natural infiltration of groundwater. The rate of infiltration initially could be as high as 1,620 gpm or as low as 320 gpm and would slowly diminish until the water level in the pit is at the same level of the groundwater. It is estimated that it would take between 2 1/4 and 8 years to fill the pit lake using this method. This alternative would require no positive action by the company, and in the absence of any other alternative method of filling the pit, this method would naturally occur.

6.038 Alternative 2 would speed up the process of filling the pit by using water pumped from the Flambeau River as the primary source of water with groundwater also contributing a percentage of the water needed. The time needed to fill the pit would depend on the rate of water withdrawn from the Flambeau River, but would probably be less than one year. For example, at a pumped rate of 5,950 gpm, the pit could be filled in less than 7 months.

6.039 Alternative 3 would involve pumping the wastewater from the waste containment area into the bottom of the pit with the remainder of the pit being filled groundwater. The piping which had been used to convey the wastewater and tailings to the waste containment area would be used as a line through which to pump the wastewater back to the pit. The estimated 135 million gallons of wastewater would constitute only 6.75 percent of the water needed to fill the pit. Groundwater infiltration would be relied upon to fill the remainder. This alternative could take from 2 1/4 to 8 years to create the lake.

6.040 Alternative 4 involves using all three sources of water to fill the pit. This is the method proposed by the company. Initially, wastewater would be pumped into the bottom as described in Alternative 3. Then river water and groundwater would be added to fill the lake completely as described in Alternative 2. This alternative would take the least amount of time, but only slightly less than Alternative 2.

6.041 Preparation of the lake basin would probably commence during the last few years of open pit mining. Waste rock which is relatively free of sulfides would be used to cover sulfide-rich rocks of the ore horizon remaining in the walls at the ends and bottom of the pit. The waste rock, with a low sulfide content, would probably be obtained from the northeastern portion of the pit and would be spread over segments of the ore body on which mining had been completed, instead of being hauled to the waste containment area. This would be done to reduce interaction between the lake waters and sulfide minerals remaining in the pit walls.

6.042 Additional measures such as the application of saprolite or other sealants could be taken if they were found by research to be effective. Should future investigations show that the development of meromixis (nonmixing lake) would be furthered by allowing the lake bottom waters to interact with the sulfide minerals, only the upper portions of the ore horizon exposed at the ends of the pit above the predicted upper limit of the monimolimnion (bottom waters) would be sealed.

6.043 The pit walls below the lake surface would have an overall slope of about 35 degrees, consisting of 35-foot near-vertical steps and horizontal benches. The two upper benches would be approximately 35 feet wide; the lower benches would be somewhat narrower. The 1,085

level bench would be about 7 feet below the lake surface. The shoreline would be gently contoured so that a safe littoral zone would be created. The new lower bench, at the 1,050 level, would be approximately 42 feet below the lake surface, near the predicted base of the mixolimnion. The bench faces would be dressed down to remove loose rock to create a reasonably-smooth surface. To control water chemistry and wind-driven downward water currents, a berm approximately six feet high would be constructed of limestone and waste rock on the edge of the 1,050 level bench.

6.044 Above the lake surface, the pit walls would rise from 10 to 50 feet at an approximate slope of 15 degrees to the original grounds surface. Stabilization of these slopes with vegetation, such as crown vetch and trefoil, would have been in progress before cessation of mining. Tree plantings to provide a wind screen around the circumference of the proposed pit have already begun and would be completed before the commencement of mining. Tree species which can survive the expected lowering of the water table around the pit, and others known to be capable of tolerating modest root-wetting such as would probably occur after the pit is flooded, would be employed.

6.045 Prevailing winds in the Ladysmith area are from the west, southwest and northwest. Available records indicate that the average wind velocity in the windiest month (May) is 11 mph, and that the lowest monthly average wind velocity is 7.9 mph (August). The highest percentage of winds would blow across the short axis of the pit lake from the northwest or southeast, or obliquely from the south, north, east or west, and thus would reduce the wind piling effect on the lake. Winds from the southwest and northeast would sweep along the long axis of the lake for 25 percent of the time. This perspective of the lake would be protected by 50 feet of the pit wall above the water level on the northeast and by the mature tree canopy 50-60 feet high between the pit and the river on the southwest.

6.046 The presence of the 1,085 level bench some seven feet below the water surface, and the 1,050 level bench and berm some 42 feet below the surface would have a combined energy absorbing surface equal to approximately 172 percent of the entire lake surface. Therefore, wave action and wind piling would be diminished at or above the 42-foot depth, effectively promoting stability of any stratification phenomena in the lake. The downward thrust of water masses beyond the 1,050 level bench in a lakeward direction would force upon the next bench, and the mass would be restricted to a narrower horizontal space. The total effect of the stepped pit walls would be to retard downward movements forcing shoreward, and to redirect water masses upward toward the center of the lake.

6.047 Because the groundwater flow in the area of the pit is westerly toward the Flambeau River, the water in the pit lake would flow out through the unconsolidated glacial material toward the river. Therefore, the water near the top of the pit lake would be slowly replaced by groundwater from east of the pit. In addition, leaching of minerals (primarily copper and iron sulfides) would occur from the walls of the pit.

6.048 Regardless of the method of filling the pit, it is likely the lake would eventually become meromictic. The water quality of the mixolimnion would be similar to that of the ground water except possibly for elevated concentrations of sulfate, total dissolved solids, and various metals. The mixolimnion should be highly aerobic so that high concentrations of sulfide should not occur. The water temperature would vary with seasonal changes in air temperature but would be higher than those of the monimolimnion except in winter. Nutrient concentration would not be high enough to cause algae glooms. The mixoliminion should not contain any unusual color, odor, or turbidity. From laboratory studies conducted by the Metal Mining Division Research Center of Kennecott Copper Corporation related to alternative 4, it is concluded that:

1. EPA water quality standards can be met for all toxic metals except possibly for copper in the pit lake.

2. Copper concentrations in the pit lake water may reach a maximum of 0.04 to 0.07 mg/1 after 15 to 30 years. EPA water quality limits of 0.02 mg/1 would be exceeded after 3 years.

3. Periodic lime treatments equivalent to approximately one-half ton slaked lime per annum for the first ten years should be able to decrease the copper content of the lake water to within acceptable limits (0.02 mg/1).

4. Limestone fragments added to the 1,050 level bench of the rehabilitated pit might serve instead of periodic lime additions.

5. It is probable that the copper concentration in solution would be limited to less than 0.02 mg/1 by the precipitation of the basic copper carbonate, azurite.

6. Because the lake is likely to be meromictic, the lower stagnant layer of the lake water would become anaerobic and tend to scavenge toxic metals from the upper aerobic layer.

6.049 The water quality of the monimolimnion can be expected to be quite different from that of the mixolimnion. The monimolimnion would be anaerobic so sulfide minerals which would be leached out of the walls of the pit lake would not be oxidized to sulfate but would remain as sulfide. The water would have a low pH so a large percentage of the sulfide would be in the form of hydrogen sulfide. Most metal sulfides (including copper sulfide) are very insoluble, so the monimolimnion should be low in dissolved metals.

6.050 It is expected that the sulfide concentration of the monimolimnion would be sufficiently high so that copper sulfide (and other metal sulfides) would precipitate out at the interface between the monimolimnion and the mixolimnion. Thus the monimolimnion should act to scavenge copper and other metals from the upper water, keeping their concentration,

below what would otherwise be expected. The temperature of the bottom water would be cold and would not change appreciably throughout the year. Due to the low pH and high sulfide concentration, the water would be highly corrosive and would have an objectionable taste and odor.

6.051 All methods of filling the pit would result in a pit lake which would be aesthetically acceptable. In all cases, the color of the pit lake waters would be acceptable. The aerobic upper water would in all cases not have an odor. However, if the lake were to completely "turn over" (i.e. completely mix from top to bottom), the sulfide contained in the monimolimnion would then be mixed throughout the water and hydrogen sulfide gas would be released from the lake water. The amount of H_2S liberated would probably be small, so any unpleasant odor would probably be detected by people only directly on or very near the pit lake. As mentioned previously, the possibility of a complete lake turnover is very small.

6.052 It is unlikely that nuisance algae blooms which would be aesthetically unpleasant would develop since the lake would contain enough dissolved copper under all circumstances to inhibit algae growth.

6.053 No significant area of nuisance aquatic plant growth would develop due to the small area of the lake which is sufficiently shallow for such plants to take root.

6.054 The water quality of the pit lake would be of sufficient quality to allow for such partial-body contact activities such as boating, sailing, and waterskiing, under all methods of filling the lake. The water pH, hardness and alkalinity of the mixolimnion can be expected to be within a range which would not cause any unusual corrosion or scaling of equipment. However, the small size of the lake as well as its shape present only very limited opportunities for these water-related activities.

6.055 The water quality of the mixolimnion should also be of sufficient quality to allow for swimming diving and other whole-body contact activities under all methods of filling the lake. The mixolimnion of the pit lake would not contain sewage or other domestic wastes so it should be bacteriologically safe. The lake would also contain no appreciable concentrations of toxic metals or toxic chemicals. Even if the copper concentration in the lake reaches levels several times the maximum concentration predicted, the levels would still be quite safe considering the small amounts of water which is normally ingested during such activities. Again, the area of the lake which is shallow enough for swimming and the steep slopes of the lake bottom limit the potential for swimming.

6.056 The quality of the waters in the mixolimnion of the pit lake would not meet the standards set by EPA for public water supplies. It may be possible to treat this water to meet the standards; however, the distance of the pit lake from the nearest public water supply system (the city of Ladysmith) would make using the water as a public water supply economically unattractive in the foreseeable future due to the costs of pumping the water to the city.

6.057 The quality of the water in the monimolimnion would be much poorer and the water would have to be extensively treated for removal of hydrogen sulfide and metals, adjusted to a neutral pH, and possibly aerated as well. This would be very costly. Thus use of the bottom water for a public water supply would be highly unlikely.

6.058 Upon completion of mining, the site could be used for an industrial facility. Ready access to the site by rail and highway give the site some potential for future industrial development.

6.059 Another attractive feature of the site is that an industry developing on the site would find an inexpensive and readily available source of cooling water and/or process water. The pit lake would, in some respects, be ideal as a cooling pond for a user of large volumes of cooling water such as a steam electric power plant. The 55-acre lake would be large enough to provide the cooling needs of a power plant in the range of 50-100 megawatts (MW). If spray cooling modules were added to the pit lake to increase the cooling capacity of the lake, a much larger plant (in the range of 500-1,000 MW or more) could possibly be built on the site.

6.060 Although the water of the monimolimnion would be of poor quality and would have to be treated for most process water uses, it might in many instances be acceptable as cooling water without pretreatment. The upper waters would be of high enough quality so that it could be used as process water or cooling water in most industries without pretreatment.

6.061 Although the water quality of the mixolimnion pit lake would be high enough for such agricultural purposes as irrigation and stock watering, other sources of such water in the area are much more readily available.

6.062 With the possible exception of copper, the water quality of the upper layers would be high enough to allow for the development of a warm water fishery. As mentioned previously, the copper concentration is expected to increase over a period of time to a point where it may be toxic to fish and other aquatic life. Even if copper concentrations which are toxic to aquatic life do not occur, the relative lack of suitable habitat for fish would severely limit the development of a warm water fishery, and since the temperatures in the mixolimnion would be expected during most times of the year to be above those preferred by cold water species, development of a cold water fishery is unlikely.

6.063 Because the monimolimnion would be expected to be anaerobic and have a low pH and contain concentrations of hydrogen sulfide which would be toxic to fish and most other aquatic life, it could not support any fishery.

6.064 Two possible lake management practices are possible to restore the quality of the water in the pit lake if it were to degrade below that determined to be acceptable for any of its uses:

1. Addition of lime to neutralize the acidic wastewaters and to precipitate dissolved copper in the lake;

2. Aeration of the monimolimnion to oxidize the toxic sulfides to sulfates;

6.065 As previously mentioned, the sulfides leached out of the walls would be oxidized in the mixolimnion to sulfates, making the water more acidic in the process. Periodic additions of a neutralizing agent (such as lime or limestone) would neutralize the acidity generated by the oxidation of the sulfides. In addition, the dissolved copper would react with hydroxide and/or carbonates, thus reducing the copper down to levels acceptable for fish and aquatic life.

6.067 The very poor quality water of the bottom of the lake might be improved by aeration. In this method, large compressors would be used to inject compressed air (or pure oxygen) into the monimolimnion. This would aerate the anaerobic bottom water and oxidize the sulfides to sulfates. However, adding enough air to adequately aerate the monimolimnion would probably cause the waters of the lake to mix, with the subsequent release of substantial amounts of hydrogen sulfide gas which would cause objectionable odors on and in the immediate vicinity of the lake when the aeration was first begen. In addition, the oxidation of the sulfides to sulfates would also generate substantial quantities of acid which would have to be neutralized.

6.068 Although aeration on this scale might be technically feasible, the costs of pumping such large volumes of compressed air (or oxygen) may make this alternative economically prohibitive. There would also be tremendous additional costs of adding chemicals (such as lime or limestone) on a continuing basis to neutralize the acidity generated by the oxidation of sulfides. Thus, total treatment of the lake, while it may be technically feasible, is probably not an economically practical alternative.

6.069 Two of the alternative methods of filling the pit lake do not involve the use of the wastewater left over in the Waste Containment Area and the milling ciruit at the end of mining operations. If either of these alternatives were chosen, the wastewater would have to be disposed of. One method would be to discharge the wastewater into the Flambeau River after treatment. Recently EPA has proposed effluent guidelines for new discharges of wastewaters in the Ore Mining and Dressing Industry.

6.070 To meet these limits the company would have to install a treatment system for precipitation of copper and other metals, removal of suspended solids by clarification or filtration, and pH adjustment with acid if necessary to bring the pH of the wastewater to within the range of 6.0 - 9.0.

6.071 The company would have to obtain a WPDES (Wisconsin Pollution Discharge Elimination System) permit before they would be allowed to discharge. The permit would contain at a minimum the effluent limitations shown below 2, as well as requirements for monitoring of the effluent and reporting the results to the DNR.

EFFLUENT LIMITATIONS FOR DISCHARGE OF THE WASTEWATER AT THE END OF MINING OPERATIONS

	Effluent Limitation (in mg/l)	
Parameter	Monthly Average	Daily Maximum
Total Suspended Solids	20	30
Copper	0.05	0.1
Zinc	0.2	0.4
Lead	0.2	0.4
Mercury	0.001	0.002
Cadmium	0.06	0.10
pH	within the range of 6.0 - 9.0 at all times	

6.072 The creation of a pit lake would require a Chapter 30.19 permit since it would be located within 500 feet of navigable water, the Flambeau River. Title to the bed of the lake would be retained by the company. The waters of the lake would become navigable waters of the state.

6.073 Under Alternative 1 no addional permits would be required.

6.074 Under Alternative 2, a Chapter 30.18 permit would be required to divert water from the Flambeau River to fill the lake.

6.075 Under Alternative 3, a discharge permit would be required to dispose of the wastewater in the pit. Under present DNR legal interpretation, the effluent would have to meet the water quality standards of NR 102. It is unlikely that these standards could be achieved even if the best treatment technology was used. Therefore, it appears that this alternative could not be allowed unless an exemption were granted through an amendment of the Wisconsin Administrative Code.

6.076 Likewise, Alternative 4 probably would not be legally permissible at this time. A Chapter 30.18 permit would also be required.

6.077 If the wastewater is not disposed of in the pit lake, the alternative is to discharge it to the Flambeau River. A WPDES discharge permit would be required. It is likely that such a discharge could be permitted if the wastewater was treated to remove suspended solids and if the pH was adjusted to near neutral. Discharge to the river could be permitted, whereas discharge to the lake could not because of the greater assimilative capacity of the river.

In summary, although the water quality of the mixolimnion of the pit lake would be of acceptable quality for most water uses, the location, size and shape of the lake would make it rather unattractive in comparison with other water resources in the nearby area. The bottom waters would be of poor quality and would need substantial pretreatment before they would be acceptable for most consumptive water uses. The large volume of water available might make the site attractive for industrial development, especially one which needs a large volume of cooling water.

7.000 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE OF LONG-TERM PRODUCTIVITY

7.001 Within the space of one generation, the operation would extract an entire mineral deposit. During mine life, a significant economic benefit would accrue to the local municipalities, citizens and, to a lesser extent, to the State. It is characteristic of the mineral extraction process that resources are depleted and that the presence of mining in a locale is short-term. There is no way that the benefits of mineral production can be extended in a single economic setting beyond the physical and economic limits of the deposit.

7.002 With the exception of about 312 acres, the land of the project site would continue to provide agricultural and forest products as has been its history. Of the disturbed acreage, some could be rehabilitated to its previous uses. The pit lake would produce a permanent feature not now available on the site. However, it may require long-term water quality monitoring and periodic treatment to be a usable body of water.

7.003 There is a possibility that seepage from the waste containment area would constitute a long-term problem requiring surveillance for centuries. The question of whose responsibility it would be to maintain the project site in an environmentally acceptable manner cannot be answered at this time. The policy decision on the length of the company's responsibility and the conditions under which that responsibility could be terminated would be made through the regulatory process.

7.004 Unemployment at mine closing may create long-term dislocation for a few, but should not cause major strains on the community's resources since the local economy is not mine dependent.

7.005 The development of this deposit would undoubtedly intensify exploration for and possible expoloitation of other deposits in northern Wisconsin. This could be a significant long-term economic and environmental consequence to the entire State.

8.000 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

8.001 The proposed mining operation would entail irreversible commitments of minerals, land, energy, manpower, and materials. The known copper reserves contained within the project area which are recoverable by open pit mining would be totally exhausted by the proposed mining operation. Approximately 116,000 tons of refined copper metal would be produced from the extraction and processing of these reserves during the anticipated 11-year life of the operation at an average of 11,000 tons per year (except during the last 2 years). Most, if not all, of this copper would enter the domestic economy. With respect to Grant Township, extraction of the copper contained in the Flambeau deposit is a completely irreversible commitment of resources. From a national viewpoint, however, the commitment is not entirely irreversible.

8.002 Copper by its physical properties is one of the more permanent of common industrial metals. Reclamation of copper from scrap sources now provides on the order of 25 percent of the U.S. supply. The company has and continues to support this established practice which is essential to supply and demand of the metal.

8.003 There are two forms of secondary copper recovery, termed "new scrap" and "old scrap". New scrap is generated in the production and fabrication of finished copper products. It is metal that has not yet reached the consumer market. Old scrap is copper and copper alloy products that have been discarded because they are obsolete, damaged or worn-out. It is normally collected and returned to the process flow by dealers not associated with the primary copper producers. The company is a primary producer, or one whose production is primarily from new sources -- ores, and continually recycles the circulating load of new scrap generated in its operations. Old scrap, because of the identification, classification and separation required, is generally treated and returned to market as pure metal or copper alloys by custom smelters and foundries.

8.004 It could be anticipated that about 25 percent of the copper produced by the Flambeau mine would be recycled at least once.

8.005 Potential by-products contained in the copper reserve are gold, silver, zinc and the iron sulfide mineral pyrite. Self-interest would assure optimal recovery of these commodities by Flambeau. At least 60 percent of the gold and silver contained in the ore would be recovered in the processing of the copper concentrates. The remainder would be lost in processing, although some of this may ultimately be recoverable from the mill tailings. The zinc contained in the ore would be recovered if it is found profitable to do so at the time mining reaches the zinc-bearing portion of the ore body. Should zinc recovery prove to be economically unfeasible under those future circumstances, the zinc mineral sphalerite would be left in the tailings. The pyrite-bearing tailings constitute a potential sulfur and iron resource which

would not otherwise be available. Pyrite is not marketable at this time; therefore, it is planned to deposit the pyritic tailings in the waste containment area. Although this material could later be retrieved and reprocessed to recover the pyrite together with a portion of the previously-discarded gold, silver and zinc, the economic and environmental costs of doing so may be prohibitive.

8.006 Extraction of the copper mineralization which will remain below the bottom of the open pit would be contingent upon future circumstances. Yet-to-be determined characteristics of the deposit itself, such as rock strengths and the nature of the ore-to-waste contacts in detail, which would become known as mining progresses, plus future technology and economics, would determine the ultimate extraction. Should steeper-than-planned pit slopes prove feasible, the economical depth of the pit would be greater, thus reducing the amount of mineralization remaining available for underground mining. A commitment on the extraction of this potential resource would be made during the later years of the open pit mining operation, when all of the parameters would be better known.

8.007 Two parcels of land - the 55-acre open pit site and the 156-acre waste containment area - would be irreversibly committed to a new use entailing a permanent change in the contour of the land.

8.008 Excavation of the open pit to its planned depth of 285 feet would destroy 55 acres of land surface now occupied by upland forest and old-field pasture. A new aquatic and shoreland habitat would be created on this acreage when the pit is rehabilitated to a lake upon the cessation of mining. In the human time frame, this change would be permanent.

8.009 Utilization of the waste containment area would destroy 156 acres of surface now occupied by farmland and wetlands. This area would be covered to a depth of at least 20 feet with the tailings to be generated by the mining operation. The entire 156-acre area would be committed to such use from the outset of the operation as the waste containment facility is designed to provide capacity for all waste materials generated by both the open pit and the possible underground mining operations. The surface area to be affected would be the same in all cases; the height of the accumulated waste materials would be dependent upon contingencies related to sales of by-product pyrite and the feasibility of underground mining. When rehabilitated, the waste containment area would form a flat-topped hill from 30 to 50 feet high supporting a vegetation of grasses and shrubs. It would probably never be usable for agriculture because of the potential dangers of bioconcentration of metals by plants grown upon it. All uses of the surface of the waste containment area would be limited to these land uses which would not potentially puncture the impervious cap.

8.010 Should underground mining of the mineralization below the economic depth of the open pit prove feasible, the extraction of gravel to be used as underground fill would destroy approximately 30 acres of land surface now occupied by old-field pasture and upland forest. This acreage, which adjoins the former Rusk County gravel pit, would be

rehabilitated after use to form a smoothly-contoured depression some 15 feet deep and vegetated with local shrubs and grasses.

8.011 Another major commitment of resources would be the energy consumed by the mining operation. Nearly all of the energy used in the operation would be derived from middle-distillate fuels and electric power reserves. On-site energy requirements for the construction period and 11-year open pit operation are estimated to be:

Electric power:	125.4 million KWH
Diesel fuel:	2.7 million gallons
Fuel oil:	1.3 million gallons
Gasoline:	0.5 million gallons

8.012 The commitment of approximately 1,100 man-years of work on the site during the full 2-year construction and start-up period and 11-year operating life of the open pit mine, represent an irreversible commitment of human resources by society at large.

8.013 The capital investment of approximately $15 million by FMC to construct and equip the mine and concentrator would constitute an irreversible commitment of financial resources only if the enterprise should fail. A viable enterprise would not only return the original investment, but would also generate capital for investment in new business activity.

8.014 The commitment of materials required for construction and operation of the mine is not considered to be significant because of the relatively small quantities involved and the fact that much of the material and equipment would have sufficient salvage value to assure its ultimate recovery.

9.000 COORDINATION

9.001 On 13 February 1976 a meeting was held in St. Paul with representatives of Flambeau, the St. Paul District Corps of Engineers, and the Green Bay Office of the U.S. Fish and Wildlife Service (FWS) present. At this meeting representatives of Flambeau outlined their proposed project to the representatives of the Corps and the FWS.

9.002 On 3 March representatives of the Corps and the FWS made a field visit to the project, accompanied by Flambeau representatives. Following the field tour another meeting was held to discuss various aspects of the project.

9.003 On 4 March Corps representatives attended a public hearing held in Ladysmith by the Wisconsin DNR to consider the adequacy of the State EIS.

9.004 On 16 April the Corps issued a public notice stating that Flambeau had applied for a Department of the Army permit and that the Corps was going to prepare this environmental impact statement on the proposal. As of 15 July, the Corps had received 17 letters of comment from private individuals.

9.005 The Corps will hold a public hearing in Ladysmith following the circulation of this draft EIS and before the preparation of the final EIS. The time and place for this hearing has not yet been established. The hearing will be announced at least 30 days before it is held.

9.006 The U.S. Fish and Wildlife Service has stated that they would have no objection to the issuance of a permit to Flambeau with appropriate conditions (exhibit 50).

9.007 In accordance with the Endangered Species Act of 1973 (16 U.S.C. 1536 Supp. III 1973) the U.S. Department of Interior has been consulted to evaluate the potential impacts upon threatened and endangered species of plants and wildlife (exhibit 51).

9.008 The Wisconsin State Historic Preservation Officer has been conducted to determine the potential for impact upon cultural resources (exhibit 48).

9.009 The following agencies, interest groups and individuals are being furnished copies of the draft environmental impact statement for review and comment.

Honorable Gaylord A. Nelson, U.S. Senate
Honorable William S. Proxmire, U.S. Senate
Honorable David R. Obey, U.S. House of Representatives
U.S. Environmental Protection Agency
U.S. Department of Agriculture

U.S. Department of Commerce
U.S. Department of Health, Education and Welfare
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Transportation
Federal Energy Administration
Advisory Council on Historic Preservation
Wisconsin Department of Natural Resources
Wisconsin Department of Agriculture
Wisconsin State Bureau of Planning and Budget
Wisconsin State Archaeologist
Wisconsin State Historical Society
Wisconsin Environmental Information Clearing House
Water Resources Commission
West Central Regional Planning Commission
Soil and Water Conservation District, Eau Claire County
State Board of Soil and Water
Chief, Mine Reclamation Unit, Wisconsin Department of Natural Resources
District Director, Wisconsin Department of Natural Resources
Mayor, Ladysmith, Wisconsin
Rusk County Board of Supervisors
Rusk County Highway Department
Town of Grant
Rusk County Clerk
Flambeau Mining Corporation
Audobon Workshop, Sarona, Wisconsin
Wisconsin Canoe Association
Eau Claire Leader-Telegram
Chippewa Herald Telegram
Ladysmith News
Rice Lake Chronotype
Eau Claire Spectator
Lester C. Tiews
R. Lee McNair
Randall K. Backe
Thomas Galazen
Mrs. John M. Arts
Mr. and Mrs. Leonard J. Gleason
Christine A. Nash
Kevin Hagen
Evelyn Churchill
Mr. and Mrs. Fred Erdman
Mr. and Mrs. Paul Meszaros
Roscoe Churchill
Charles Plantz
Joan Kluctznik
James Saxild
Bee Breen
Bill DeNusa

9.010 Copies are also being sent to the following libraries where they will be available.

Ladysmith City-County Library
Mt. Senario College Library
Cornell Public Library
University of Wisconsin Center - Barron County Library
University of Wisconsin Memorial Library, Madison
Madison Public Library
Chippewa Falls Public Library
Durand Free Library
Eau Claire Public Library
Mabel Tainter Memorial Free Library, Menomonie
University of Wisconsin - Eau Claire Library

GLOSSARY

Benthos - Those organisms which live on the bottom of a body of water.

Coniferous - Pines, cedars, spruces, etc; made up of evergreen trees.

dBA - A "weighted" measure of sound pressure level which provides relatively high correlation with subjective estimates of loudness of certain noises; e.g. 30 dBA = soft whisper; 50 dBA = average home noise; 75 dBA = busy traffic ; 100 dBA = Pneumatic drill.

Evapo-transpiration - Process of water loss to the atmosphere as vapor via evaporation from surfaces or transpiration from plants.

Fauna - The animals of a given area taken collectively.

Flora - The plants of a given area taken collectively.

Moraine - Material deposited by glaciers during advance or retreat.

Overburden - Material, soil and rock, that must be removed to uncover the ore body.

Saprolite - A type of clay formed from rock decomposing in place.

Stopes - Terraces formed in open pit mine as mining operation goes deeper.

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT
PROPOSED OPEN PIT COPPER MINE AND
WASTE CONTAINMENT AREA
FLAMBEAU MINING CORPORATION
LADYSMITH, RUSK COUNTY, WISCONSIN

TECHNICAL APPENDIX

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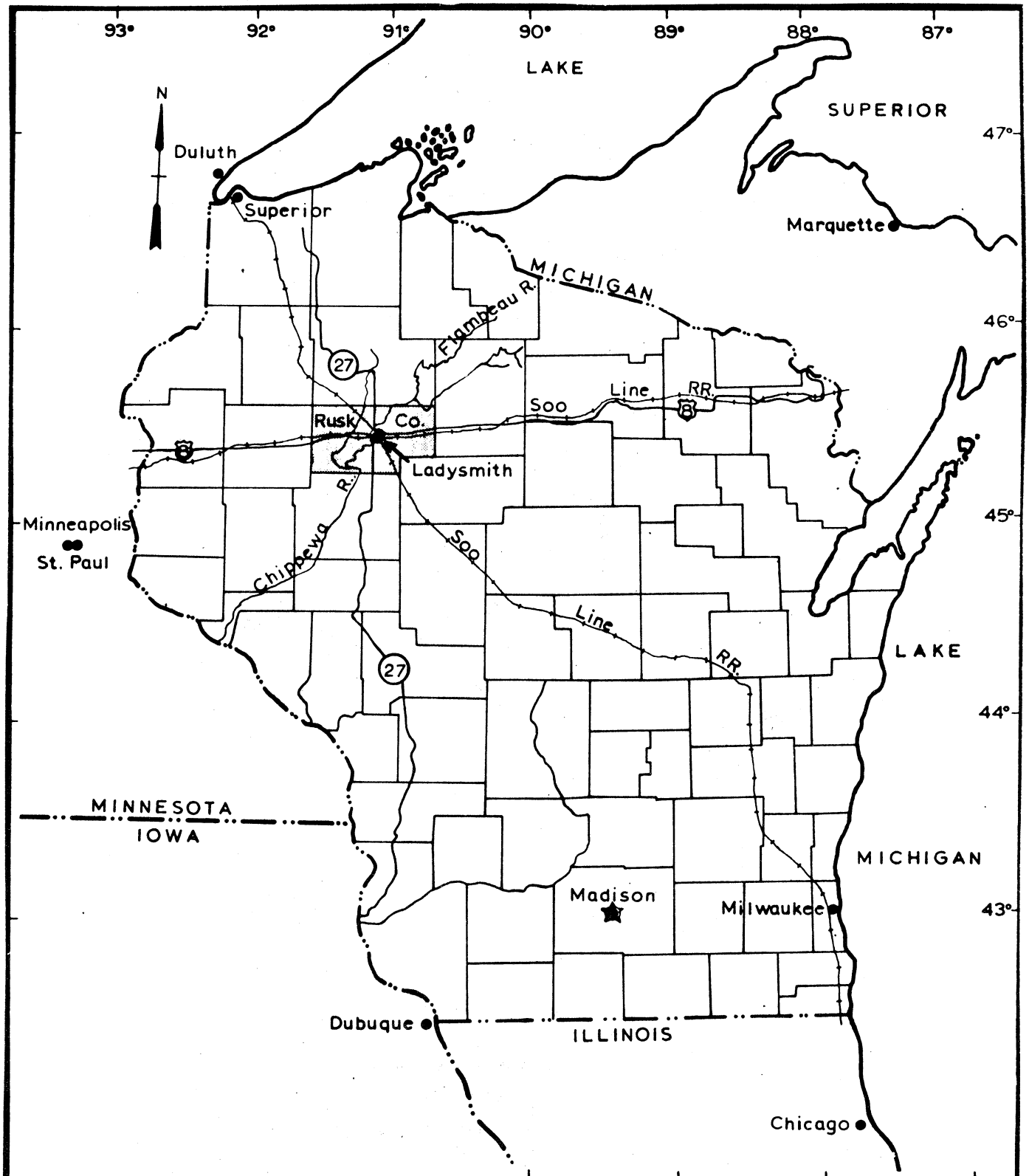
EXHIBITS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Duluth
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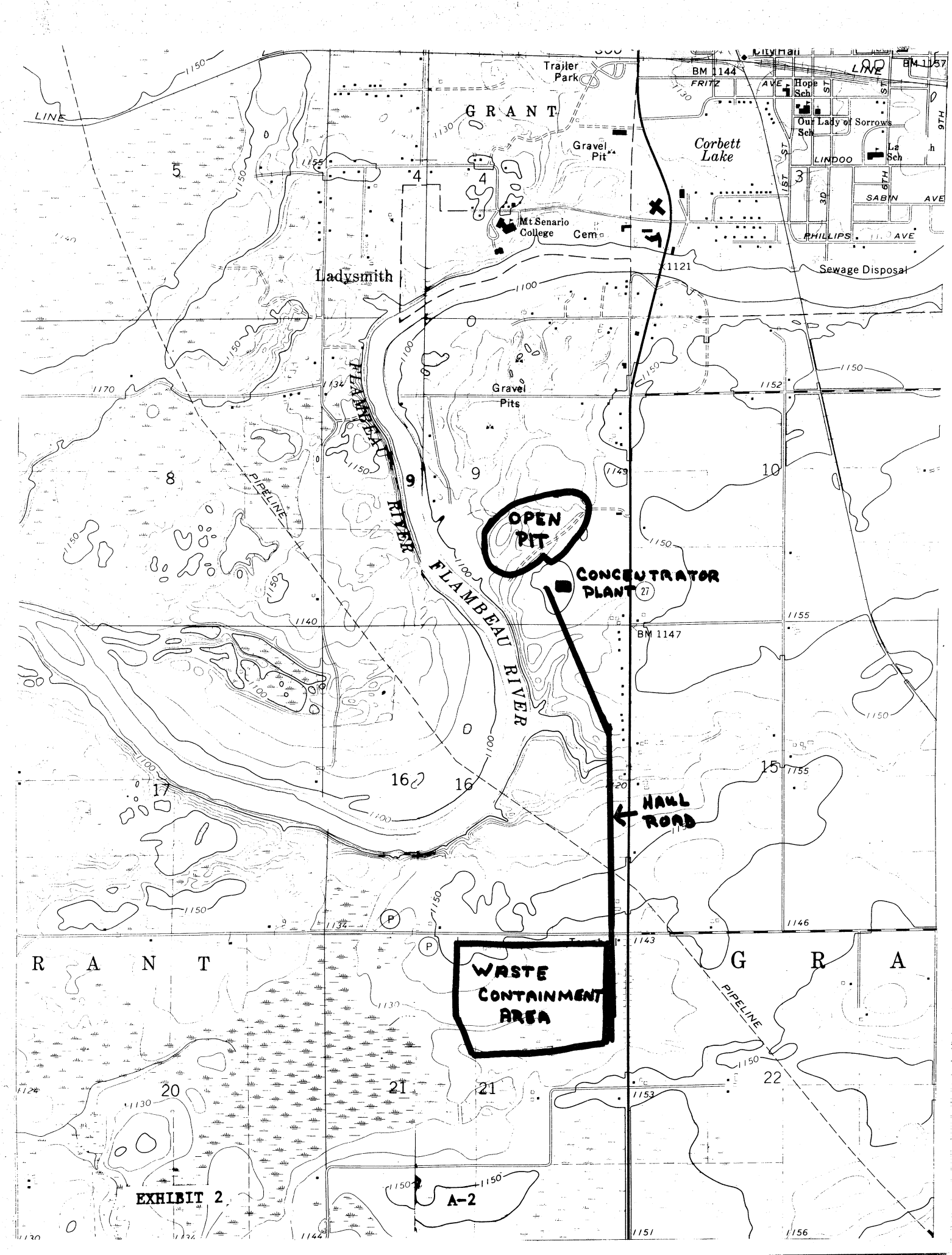
MICHIGAN
Flambeau R.
46°
27
Soo
Line
RR.
8
Rusk
Co.
Ladysmith
Minneapolis
St. Paul
Chippewa R.
45°
Soo
Line
RR
LAKE
27
44°
MINNESOTA
IOWA
MICHIGAN
Madison
Milwaukee
43°
Dubuque
ILLINOIS
Chicago
FLAMBEAU MINING CORP.
WISCONSIN
LOCATION MAP
SCALE 0 25 50 Mi. DATE July 1973
DRAWN BY GLB

EXHIBIT 1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Hope Sch
Our Lady of Sorrows Sch
Corbett Lake
LINDOO
SABIN AVE
PHILLIPS AVE
Gravel Pit
Mt Senario College
Cem
Ladysmith
Sewage Disposal
GRANT
Gravel Pits
FLAMBEAU RIVER
PIPELINE
OPEN PIT
CONCENTRATOR PLANT
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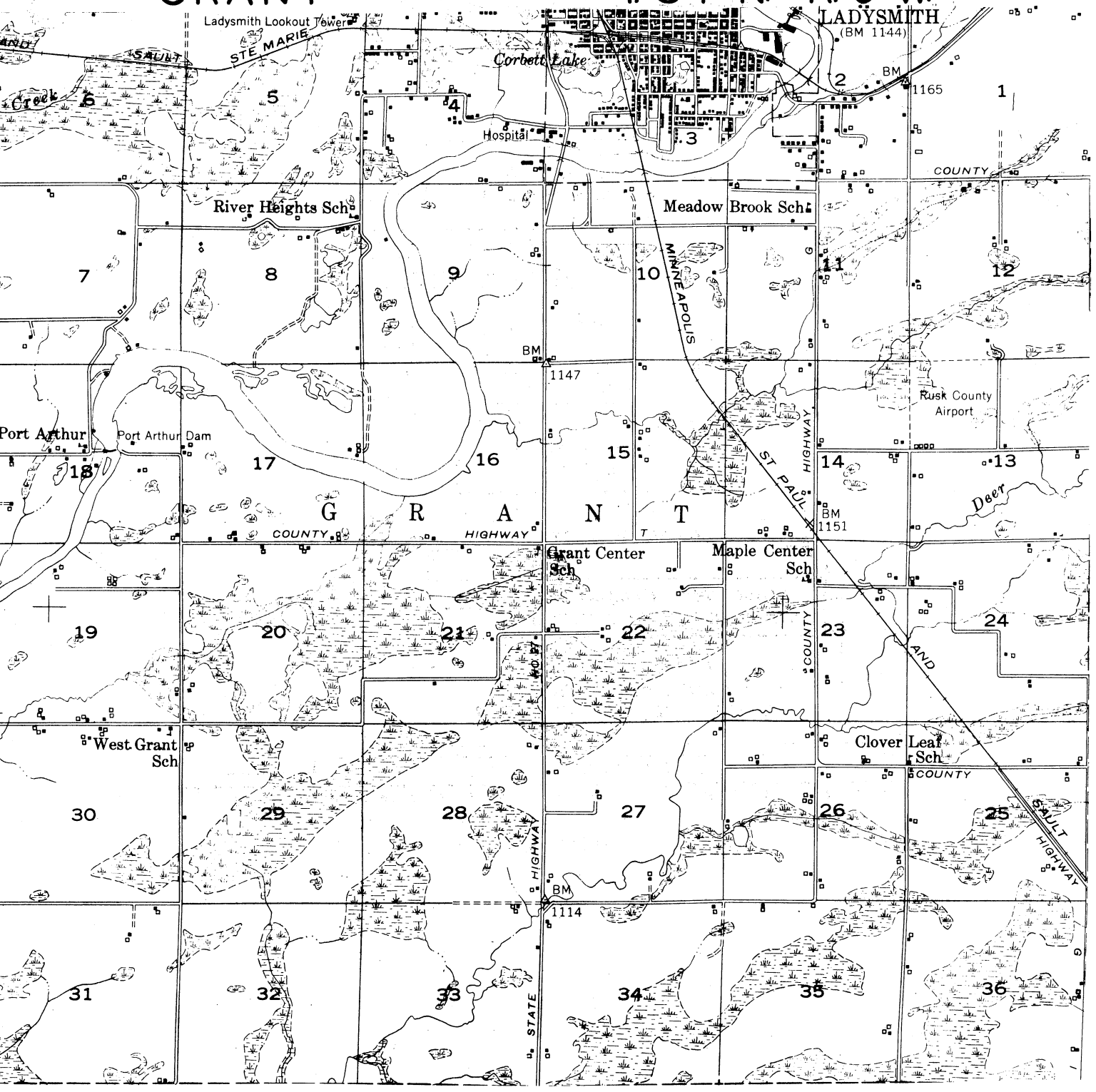
HAUL ROAD
WASTE CONTAINMENT AREA
PIPELINE
EXHIBIT 2
A-2



GRANT TOWNSHIP
LOCATION MAP

EXHIBIT 3

PLANT AND FACILITIES LABOR FORCE

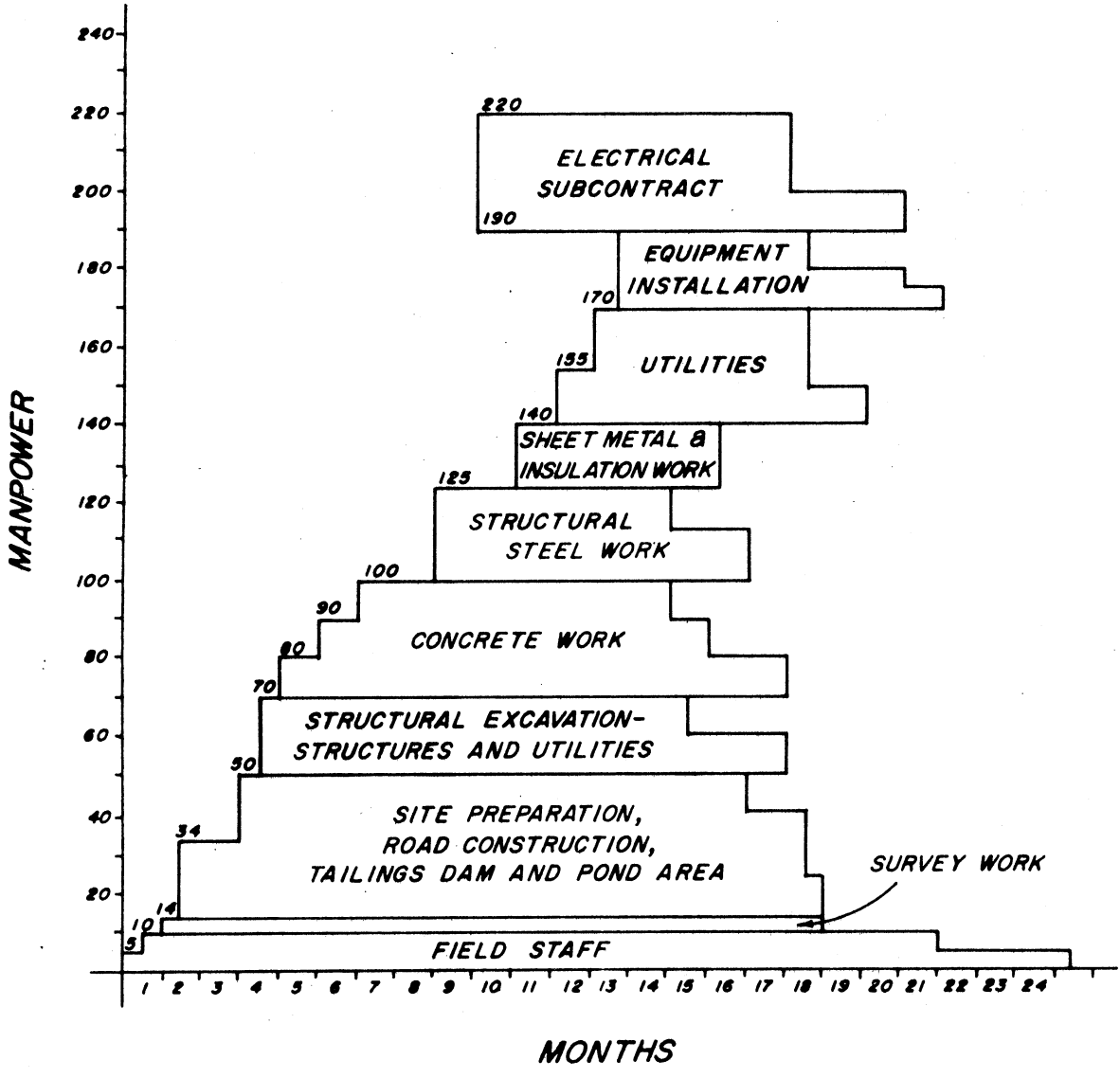


EXHIBIT 4

FLAMBEAU MINING OPERATION
WASTE MATERIALS PRODUCTION SCHEDULE
300,000 TPY OPERATION

	Mine Waste		Till		Total Mine		Concentrator Tailings		Washing Plant Silt		Total Tailings and Silt	
	Tons	Cu Yds	Tons	Cu Yds	Tons	Cu Yds	Tons	Cu Yds	Tons	Cu Yds	Tons	Cu Yds
Open Pit Operation												
Pre-Production Period	844,370	594,000	729,562	485,000	1,573,932	1,079,000	--	--	--	--	--	--
Production Period												
Year												
1	412,000	289,926	824,000	547,402	1,236,000	837,928	232,713	155,142			232,713	155,142
2	618,000	434,889	618,000	410,552	1,236,000	845,441	242,104	161,403			242,104	161,403
3	752,212	529,333	487,788	324,048	1,236,000	853,381	239,318	159,545			239,318	159,545
4	1,236,000	833,148			1,236,000	833,148	244,169	162,779			244,169	162,779
5	1,236,000	833,148			1,236,000	833,148	257,172	171,448			257,172	171,448
6	1,236,000	833,148			1,236,000	833,148	247,060	164,707			247,060	164,707
7	1,236,000	833,148			1,236,000	833,148	253,337	168,891			253,337	168,891
8	1,236,000	833,148			1,236,000	833,148	256,320	170,880			256,320	170,880
9	1,236,000	833,148			1,236,000	833,148	268,678	179,119			268,678	179,119
10	1,236,000	833,148			1,236,000	833,148	277,947	185,298			277,947	185,298
11	418,910	235,815			418,910	235,815	98,645	65,763			98,645	65,763
Subtotal	10,853,122	7,321,999	1,929,788	1,282,002	12,778,910	8,604,001	2,617,463	1,744,975	--	--	2,617,463	1,744,975
Underground Operation												
Pre-Production Period												
8 - 11	64,487	36,344	--	--	64,487	36,344	--	--	--	--	--	--
Production Period												
11							176,051	114,010	43,442	32,179	219,493	146,189
12							268,777	174,207	66,493	49,254	335,270	223,461
13							264,954	171,729	66,493	49,254	331,447	220,983
14							267,715	173,519	66,493	49,254	334,208	222,773
15							270,052	175,034	66,493	49,254	336,545	224,287
16							269,414	174,620	66,493	49,254	335,907	223,874
17							267,397	173,313	66,493	49,254	333,890	222,567
18							267,397	173,313	66,493	49,254	333,890	222,567
19							262,193	169,940	66,493	49,254	328,686	219,194
20							257,945	167,187	66,493	49,254	324,438	216,440
21							219,607	142,338	66,493	49,254	286,100	191,592
22							94,719	61,392	30,149	22,332	124,868	83,724
Subtotal	64,487	36,344	--	--	64,487	36,344	2,886,221	1,870,602	738,521	547,051	3,624,742	2,417,651
TOTAL	11,761,479	7,952,343	2,658,562	1,767,002	14,417,329	9,719,345	5,503,684	3,615,577	738,521	547,051	6,242,205	4,162,628

Notes:
1. Silt from stope backfill washing plant to be stored in tailings pond.
2. Underground pre-production development mine waste to be produced in last four years of open pit operation.
3. Underground waste during production period, years 11 - 22, to be retained in the mine.

EXHIBIT 5

EXHIBIT 5

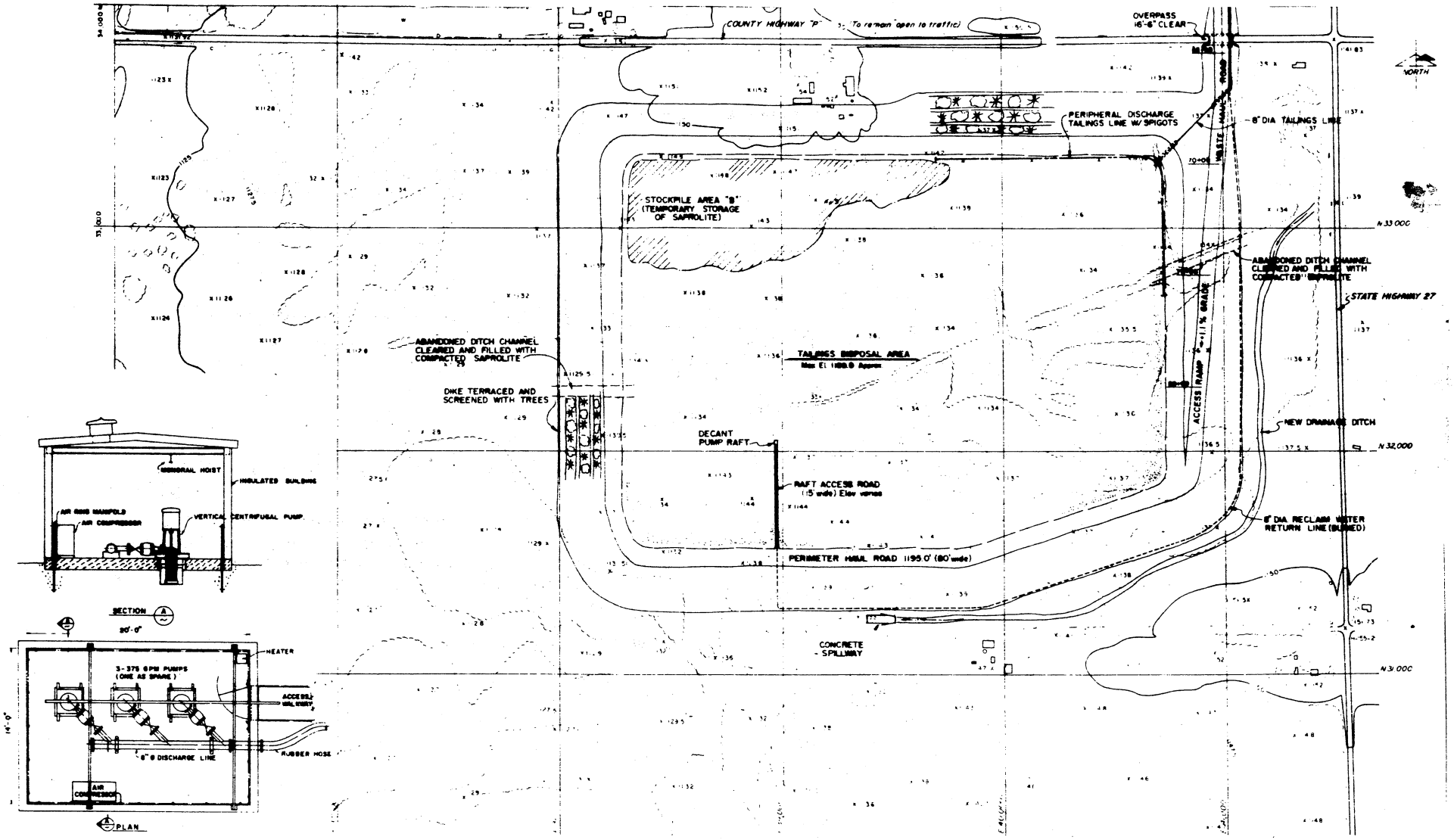
WASTE MATERIAL PRODUCTION AND DEPOSITION SCHEDULE

	Pre-Production Period			Production Period			Post Production Period		
Cubic Yards	Produced	Used in Const.	Net to Storage	Produced	Used In Const.	Net to Storage	Net in Storage	Used Reclaim	Total Storage
TOPSOIL									
Pit Area	22,000	--	22,000						
Dike Foundation Area	131,000	--	131,000						
Plant Area	All reused at site		--						
Subtotal	153,000	--	153,000	--	--	--	153,000	153,000	--
TILL									
Open Pit Material	485,000			1,282,002					
Haulage Roads		160,000							
Outer Dike Surface		143,000			952,000				
Subtotal	485,000	303,000	182,000	1,282,002	952,000	330,002	512,002	512,002	--
WASTE ROCK									
Common Open Pit Material	200,000			6,677,999					
Dike Wall		200,000	--		2,669,000				
Subtotal	200,000	200,000	--	6,677,999	2,669,000	4,008,999	4,008,999	--	4,008,999
Saprolite Open Pit Material	394,000			664,000					
Dike Core		114,344			799,656				
Trench Lining		22,000							
Ditch Lining		1,000							
Subtotal	394,000	137,344	256,656	664,000	799,656	(155,656)	101,000	--	101,000
Underground Development Rock	--	--	--	36,344	--	36,344			
Subtotal	--	--	--	36,344	--	36,344	36,344	--	36,344
TOTAL WASTE ROCK	594,000	337,344	256,656	7,358,343	3,468,656	3,889,687	4,146,343	--	4,146,343
CONCENTRATOR TAILINGS									
Subtotal	--	--	--	3,615,577	--	3,615,577	3,615,577	--	3,615,577
WASHING PLANT SILT									
Subtotal	--	--	--	547,051	--	547,051	547,051	--	547,051
TOTALS	1,232,000	640,344	591,656	12,802,973	4,420,656	8,382,317	8,973,973	665,002	8,308,971

Total Waste Material Produced	14,034,973
Material Not Stored - Road Construction	160,000
Net Contained or in Construction of Waste Containment Site	13,874,973

Waste Containment Site	186 acres, 14,000,000 cu yds capacity. Site covered and revegetated during post production period.
Stockpile "A"	8.5 acres for 153,000 cu yds of topsoil. restored to original state during post production period.
Stockpile "B"	27.5 acres for 512,002 cu yds of till. Restored to original state during post production period.
Stockpile "C"	Temporary storage of 256,656 cu yds of saprolite from pre-production period within permanent waste containment site.

PRELIMINARY PLOT PLAN, WASTE CONTAINMENT AREA



DECANT PUMP RAFT

DESCRIPTION	REVISIONS	REVISIONS	BY	DATE
DRAWING 33-05 SITE PLAN SHEET NO 1		Jan 74 Added Decant Tower Detail		
SHEET NO 2		Jan 74 Revised New Sur		
SHEET NO 3				

	BY	DATE
DESIGN		
DRAWN		March 1974
CHK'D		
DES ENGR		
SCALE		

KENNECOTT COPPER CORPORATION
ENGINEERING CENTER
METAL MINING DIVISION
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH

FLAMBEAU MINING CORP

PRELIMINARY
PLOT PLAN
WASTE CONTAINMENT AREA
SHEET 4 OF 4

MICROFILM	ECHO JOB
	506
ECHO DRAWING	REV
BCM 82-00-106	2
DIVISION DRAWING NO	

A-7

EXHIBIT 6

SEEPAGE ANALYSIS, WASTE CONTAINMENT AREA

✱ SEEPAGE ANALYSIS:

AVE. LOSS THROUGH ELEMENT 1 = 0.05958 $\frac{ft^3}{day}$ / ft dam

" " " " 2 = 0.02890

" " " " 3 = 0.00007

" " " " 4 = 0.00006

" " " " 5 = 0.00805

" " " " 9 = 0.00833

TOTAL = 0.10499 $\frac{ft^3}{day}$ / ft dam

= 0.78 $\frac{gal}{day}$ / ft dam

gal/day

= 6.3 gal/min

✱ Derived from finite element model assuming 10 foot wide cutoff trench & 57 foot high imponded water level.

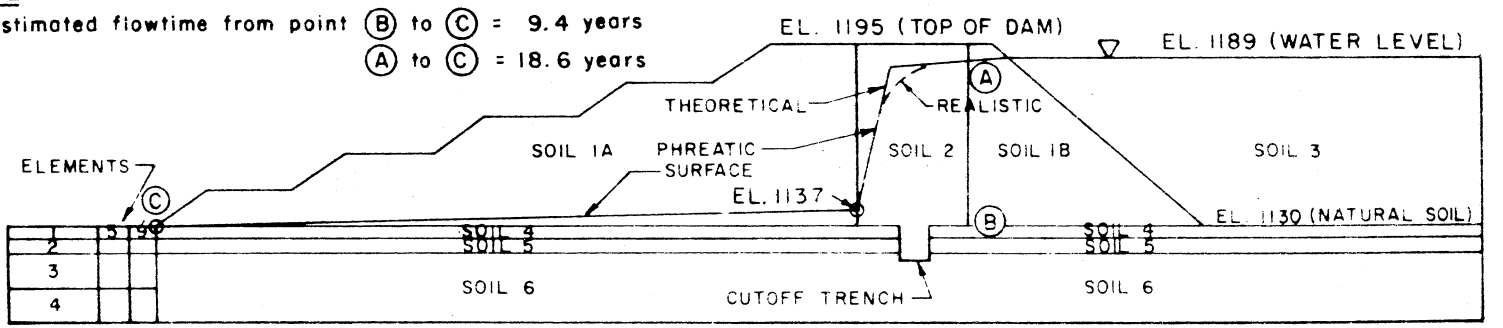
NOTE:

Estimated flowtime from point (B) to (C) = 9.4 years

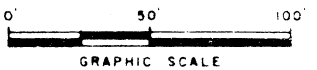
(A) to (C) = 18.6 years

SOIL DATA	PERMEABILITY CM/SEC
SOIL 1A, SANDSTONE AND MINE ROCK W/o PYRITE	1×10^{-2}
" 1B, WASTE MINE ROCK WITH PYRITE	1×10^{-2}
" 2, SAPROLITE (ML)	1.1×10^{-6}
" 3, TAILINGS	3.5×10^{-4}
" 4, SILT (ML)	1.0×10^{-6}
" 5, SAND MEDIUM DENSE (SM)	1.0×10^{-3}
" 6, SILTY SAND DENSE (SM)	1.0×10^{-6}

( ) Unified soil classification system



(DATA TAKEN FROM REPORT BY SOIL TESTING SERVICES OF WISCONSIN, INC., DATED SEPT. 27, 1973.)



FACTORS INFLUENCING SLOPE STABILITY

SOIL CLASSIFICATION	STRENGTH VALUE PSF	DENSITY PCF
SOIL 1. SAND OR MINE ROCK	Ø'= 32° C= 0	125
SOIL 2. SAPROLITE (ML)	Ø'= 30° C=300	110
SOIL 3. TAILINGS	Ø'= 0° C= 0	120
SOIL 4. SILT (ML)	Ø'= 0° C=1000	125
SOIL 5. SAND-MED. DENSE (SP)	Ø'= 32° C= 0	125
SOIL 6. SILTY SAND DENSE (SM/ML)	Ø'= 30° C=1000	130

( ) UNIFIED SOIL CLASSIFICATION SYSTEM

Ø' = ANGLE OF INTERNAL FRICTION
C = COHESION

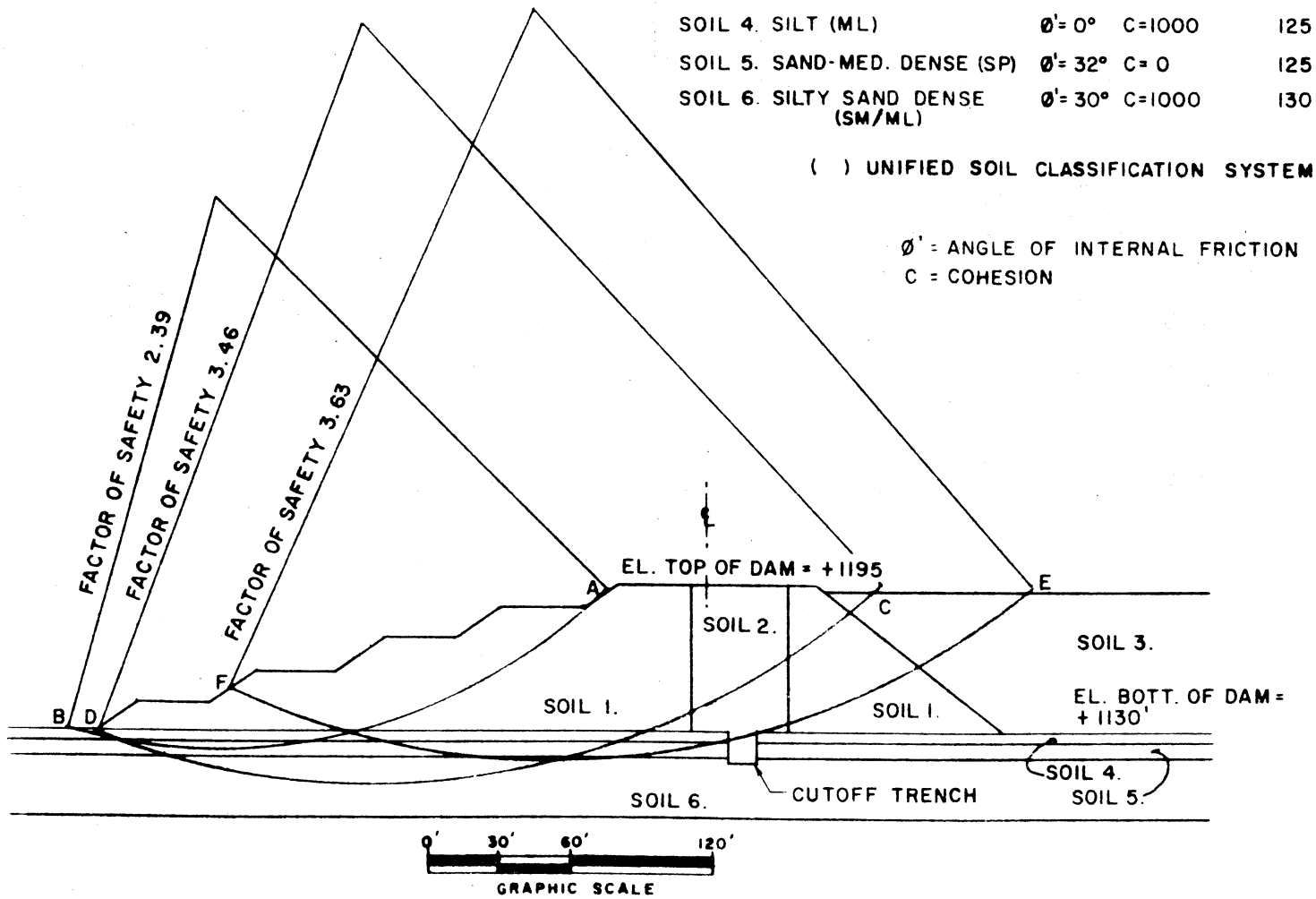
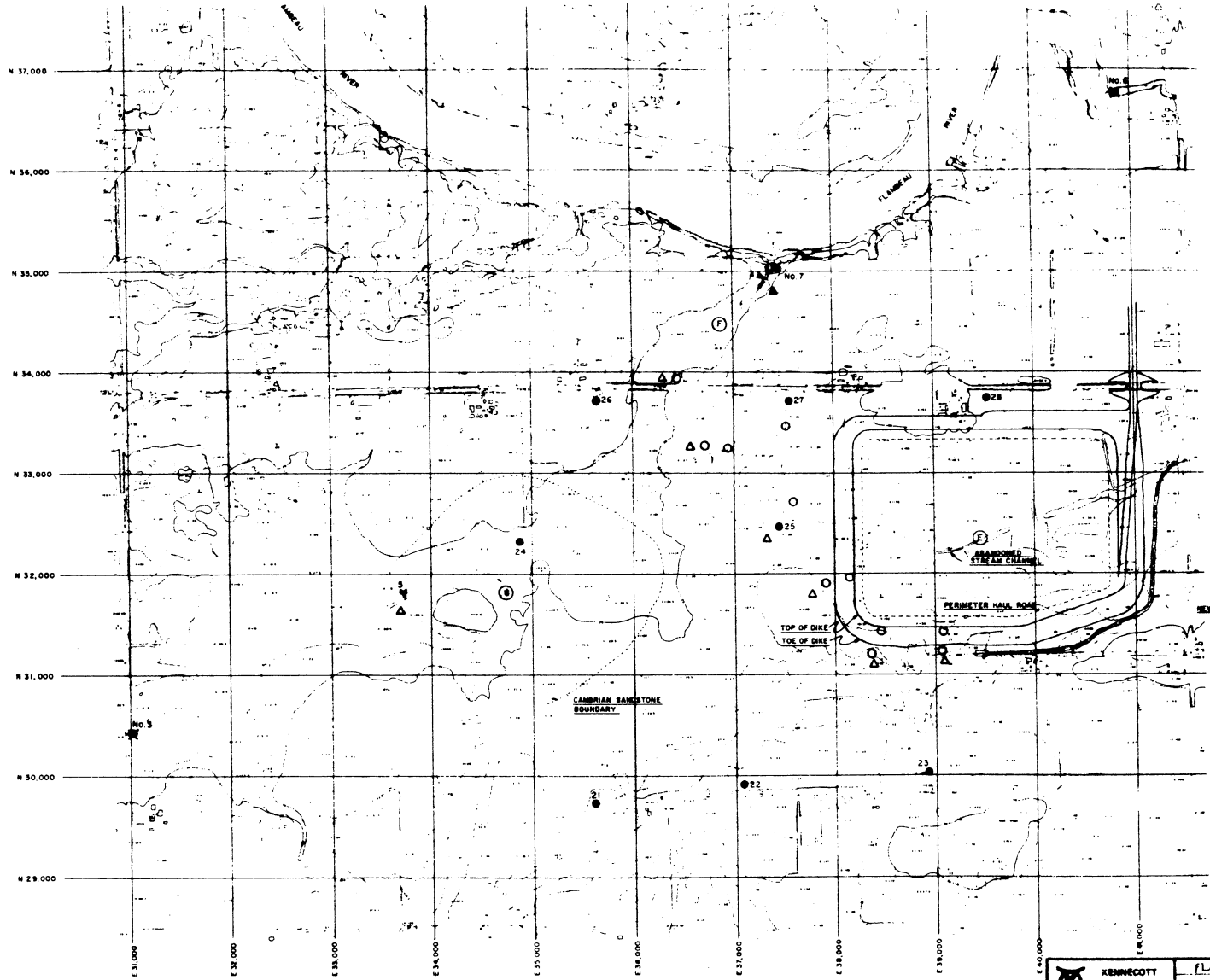


EXHIBIT 9

MONITOR WELLS LOCATION



REVISIONS	Dwg. No.	DESCRIPTION

REVISIONS	Dwg. No.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'G	CH. ENG.	NO.	DATE	REVISIONS	BY	CHK'D	ENG'G	CH. ENG.

	BY	DATE
DEPT. ENGR.		
C. ENG. ENGR.		
PROJ. ENGR.		
SAFETY ENGR.		
CHIEF ENGR.		

	BY	DATE
DESIGN		
DRAWN		
CHK'D		
ENG'D		
SCALE	AS NOTED	

KENNECOTT COPPER CORPORATION
ENGINEERING CENTER
METAL MINING DIVISION
1515 GENERAL SQUARE
SALT LAKE CITY, UTAH

FLAMBEAU MINING CORP

MONITOR WELLS LOCATIONS
WASTE CONTAINMENT AREA

DRAWING NO. 506
DRAWING NO. BCM82-00-208
REV. 1

A-10

HAUL ROAD, COUNTY HIGHWAY "P" CROSSING

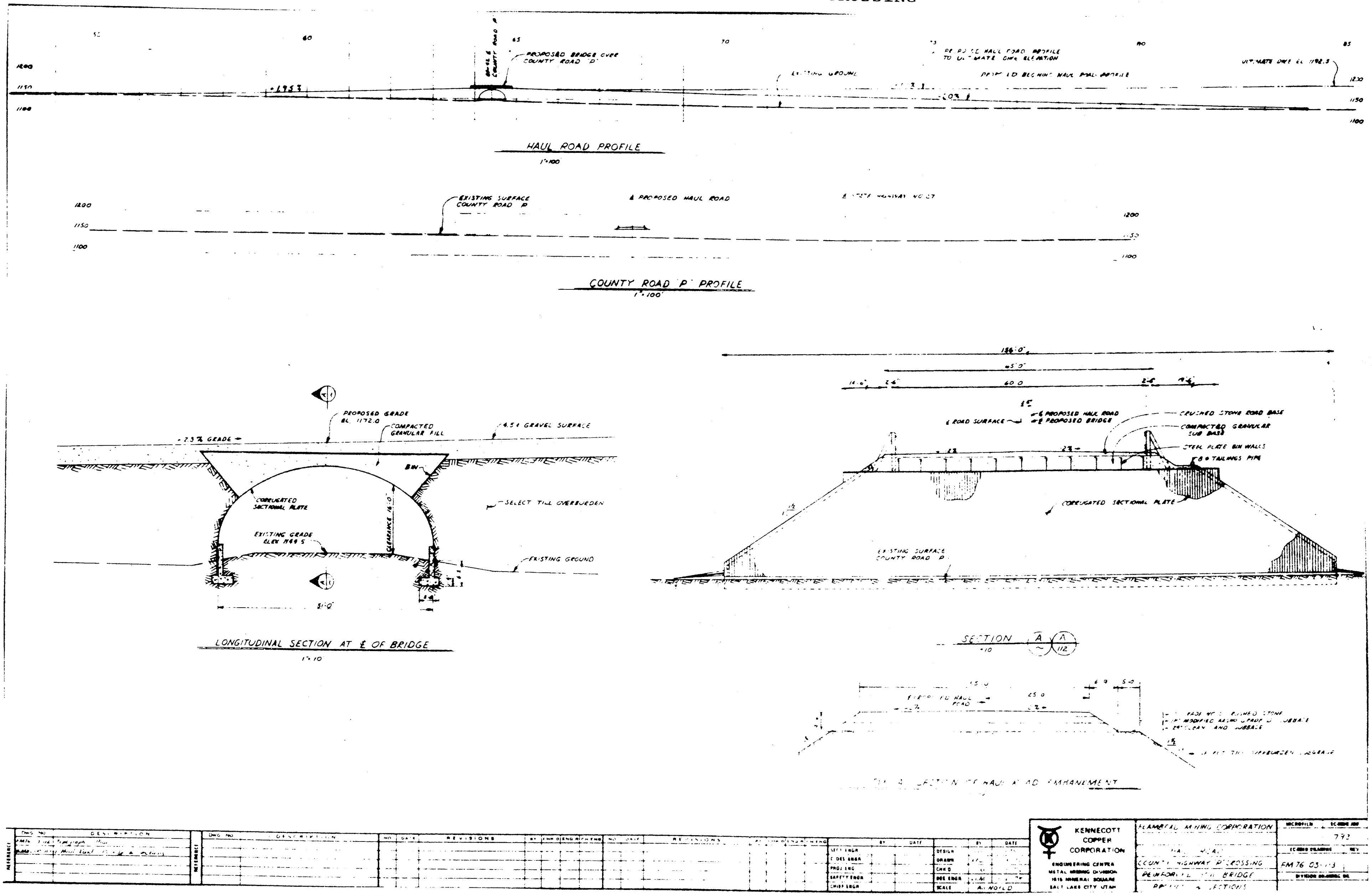


EXHIBIT 10

A collection ditch would be installed inside the pit perimeter at the top of the clay saprolite layer, approximately at the 1,085-foot elevation. This ditch would collect groundwater inflow and precipitation falling on the adjacent surface and the uppermost pit slopes to prevent their contact with sulfide-bearing bedrock. The collected water would be used for industrial purposes. Any excess would be pumped to the gravel pit for settling and return by percolation to the groundwater system. Waters escaping from the upper collection system, and those entering directly as precipitation below the 1,085 level would be collected in the pit bottom and pumped to the waste containment area for storage and subsequent industrial use. If necessary, additional water supply to meet industrial needs would be obtained from wells located in the vicinity of the gravel pit.

In order to predict water supply and disposal conditions during the various stages of mine development and process operations, a water balance study was made by the company. Water flow rates during construction, initial production, yearly average operation, summer and winter operations, and during storms were developed using both the calculated theoretical and the expected rates of groundwater flow into the pit. Theoretical flow rates are shown on Figures L-1 through L-6 and are explained below. Expected flow rates are shown in Figures L-7 through L-10.

During the construction phase (Figure L-1), sufficient prestripping would be done to expose a three months' supply of ore. Groundwater inflow to the pit from the glacial tills and the sandstone, estimated to average 1,620 gpm, would be collected in the 1,085 level ditch and gravitated to sump B. Precipitation above the 1,085 level estimated to average a net 96 gpm after evaporation, would be collected in the same ditch. Thus, sump B would receive an average of 1,716 gpm. Of this, 50 gpm would be diverted for sundry uses, such as road sprinkling, and the remaining 1,666 gpm pumped to the gravel pit for disposal. Precipitation below the 1,085 level, estimated to average 29 gpm after evaporation, would be collected in sump A at the center of the new pit and pumped to the gravel pit also. The gravel pit would thus receive an average of 1,695 gpm from the mine in the final stage of the construction period.

The water flows during the initial production phase are shown on Figure L-2. Process water required for operation of the concentrator (mill) would be taken from the Flambeau River at the rate of 492 gpm until, together with 1,544 gpm pumped to the waste containment area from the pit, a total reserve of 40 million gallons would be accumulated in the waste containment area (tailings pond). This is estimated to take 14 days, during which time a total of 10 million gallons would have been taken from the river. No water would be disposed of in the gravel pit during this period.

The pit sumps would continue to receive 1,744 gpm, as during the construction phase. Of this, 200 gpm would be diverted for sundry uses and the remaining 1,544 gpm would be pumped to the waste containment area. An additional 488 gpm would be pumped from the mill (4 gpm of the 492 gpm entering the mill from the river is retained as moisture in the copper concentrates shipped out), making a total flow of 2,032 gpm into the waste containment area. Of this total, an estimated 44 gpm would remain entrained in the tailings, and an estimated maximum of 25 gpm would escape by seepage through the dikes and the floor of the pond. It is assumed that evaporation from the pond will equal precipitation. Thus, available water would accumulate in the waste containment area at the rate of 1,963 gpm.

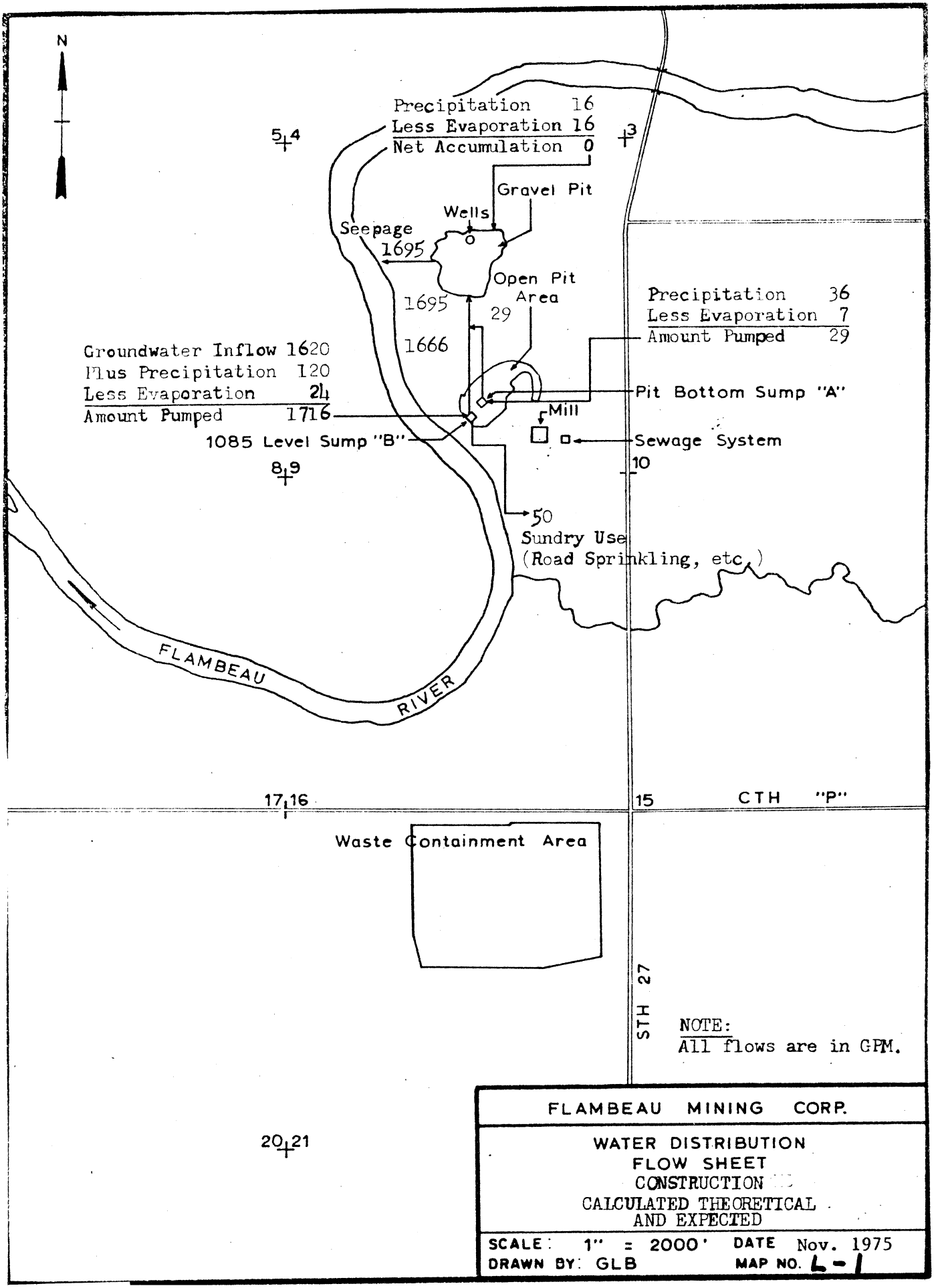
During yearly average operations, an essentially closed system would be maintained and the average yearly net accumulation of available water in the waste containment area would be zero as shown in Figure L-3. Except for potable water, no outside source of water would be required if groundwater inflow to the pit exceeds 146 gpm. Water collected in sump B in excess of that required for industrial use would be disposed of in the gravel pit. If the calculated theoretical groundwater inflow of 1,620 gpm is realized, the excess to be disposed of would be 950 gpm.

To secure an increased operating reserve for the winter months, flows would be adjusted during the six summer months to allow 6.2 million gallons to accumulate in the waste containment area at an average rate of 24 gpm as shown in Figure L-4. Excess water from sump B to be disposed of in the gravel pit would average 1,442 gpm.

During the six winter months, the 6.2 million gallon reserve accumulated in the waste containment area during the summer would be depleted at an average rate of 24 gpm as shown in Figure L-5. Excess water from sump B to be disposed of in the gravel pit would average 458 gpm. Should it be found in practice that pond icing in winter interferes with decant recovery, it may be necessary to increase the accumulated reserve in the waste containment area by diverting additional flow from sump B to the waste containment area.

Water flows during storm conditions are presented in Figure L-6. These estimates are based on a rainfall intensity of 4.06 inches in 6 hours. A net accumulation of 6,877 gpm would be expected in the waste containment area. Significant increases of flows to the gravel pit would also be expected.

Upon the cessation of mining, the open pit may be flooded with water. Approximately 2 billion gallons of water would be required to fill the pit to the 1,092 level. Various alternative methods of filling the open pit are discussed in the Alternative Section of this document.


N
Precipitation 16
Less Evaporation 16
Net Accumulation 0
Gravel Pit
Wells
Seepage
1695
Open Pit Area
1695
29
1666
Precipitation 36
Less Evaporation 7
Amount Pumped 29
Groundwater Inflow 1620
Plus Precipitation 120
Less Evaporation 24
Amount Pumped 1716
Pit Bottom Sump "A"
Mill
1085 Level Sump "B"
Sewage System
50
Sundry Use
(Road Sprinkling, etc.)
FLAMBEAU RIVER
CTH "P"
Waste Containment Area
STH 27
NOTE:
All flows are in GPM.
FLAMBEAU MINING CORP.
WATER DISTRIBUTION
FLOW SHEET
CONSTRUCTION
CALCULATED THEORETICAL
AND EXPECTED
SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-1

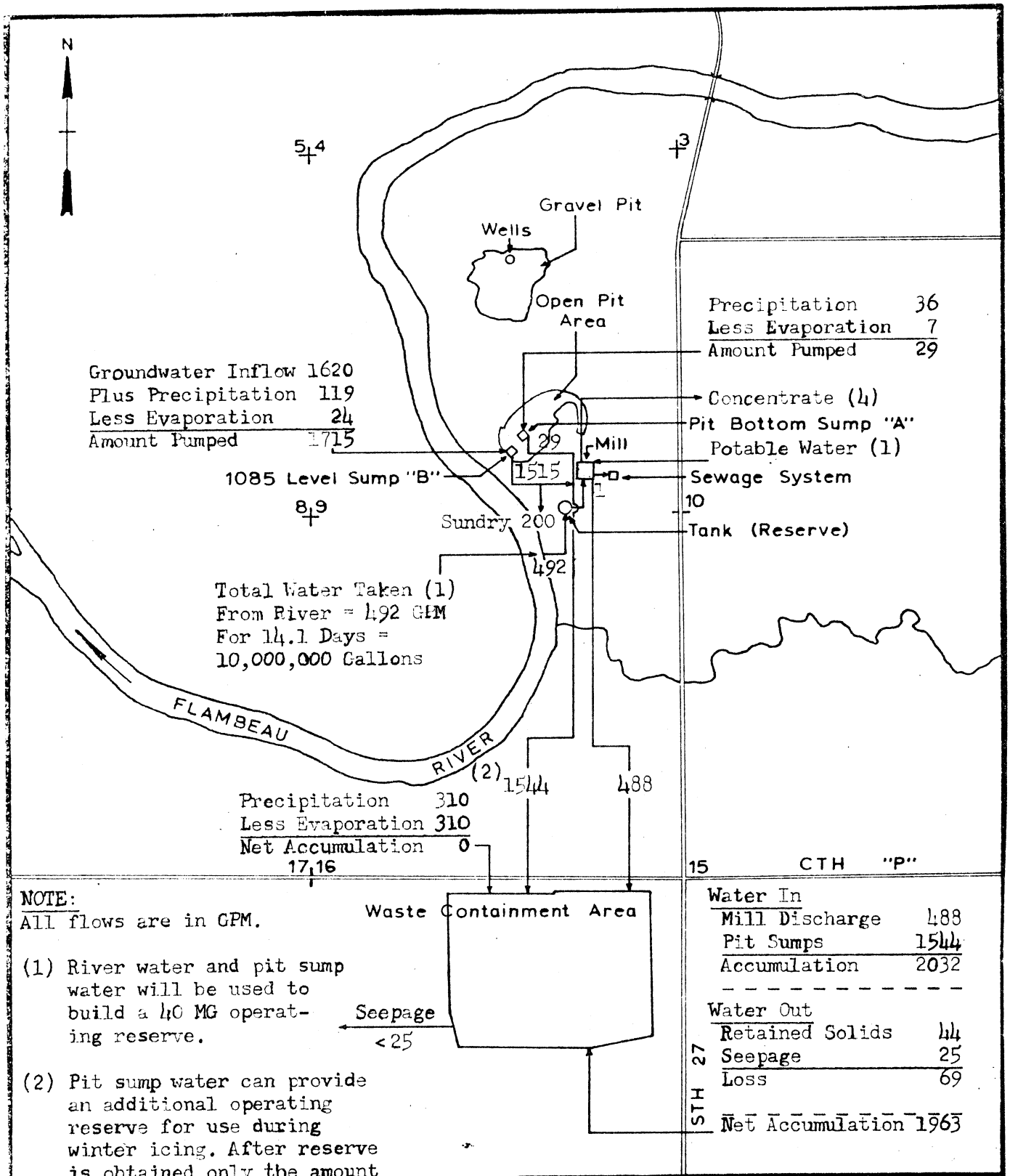
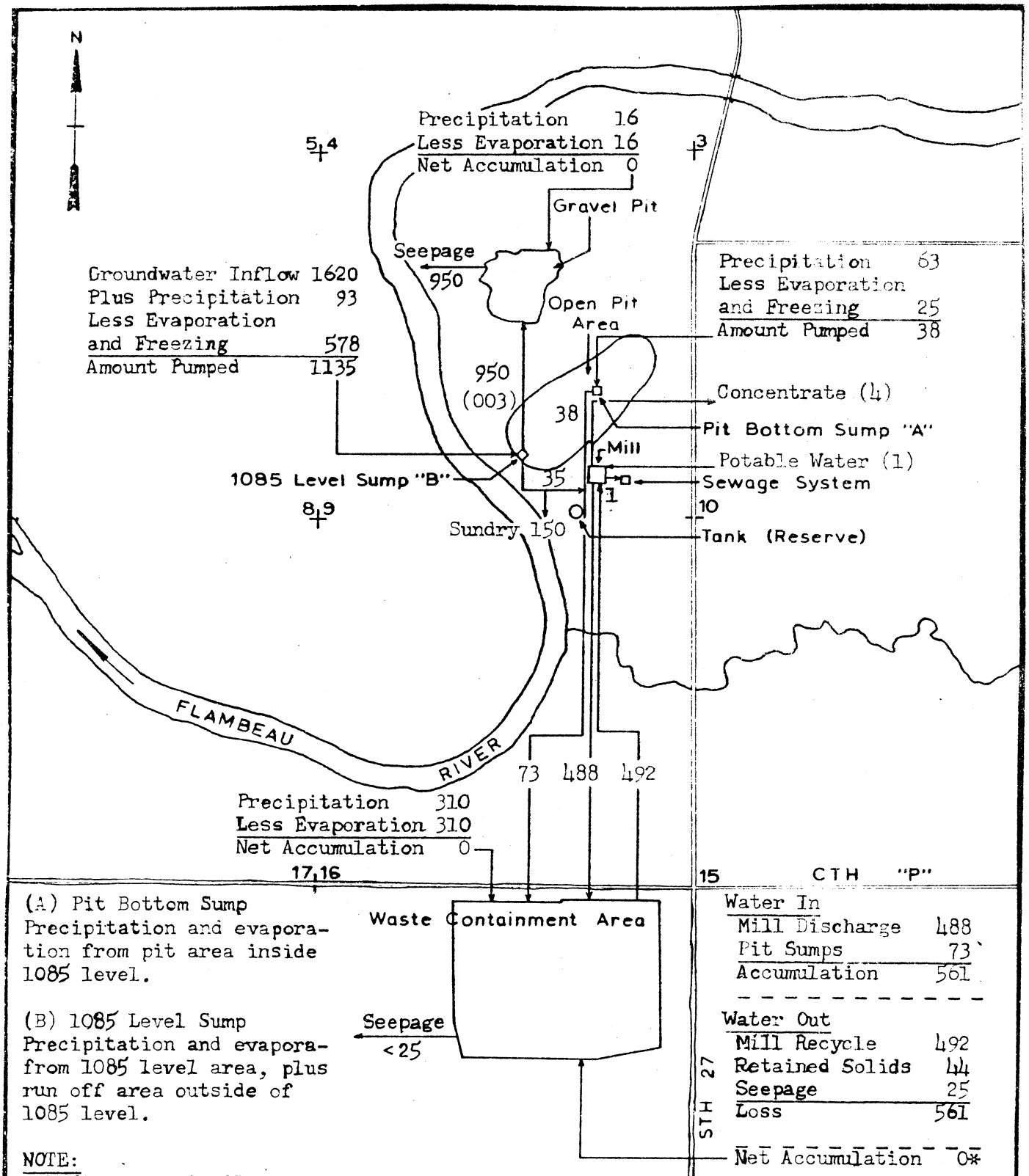

N
5
4
3
Gravel Pit
Wells
Open Pit Area
Precipitation 36
Less Evaporation 7
Amount Pumped 29
Groundwater Inflow 1620
Plus Precipitation 119
Less Evaporation 24
Amount Pumped 1715
Concentrate (4)
Pit Bottom Sump "A"
Potable Water (1)
Sewage System
Tank (Reserve)
Mill
129
1515
1085 Level Sump "B"
8
9
10
Sundry 200
492
Total Water Taken (1)
From River = 492 GPM
For 14.1 Days =
10,000,000 Gallons
FLAMBEAU RIVER
(2) 1544
488
Precipitation 310
Less Evaporation 310
Net Accumulation 0
17
16
15
CTH "P"
Waste Containment Area
Seepage
< 25
STH 27
Water In
Mill Discharge 488
Pit Sumps 1544
Accumulation 2032
Water Out
Retained Solids 44
Seepage 25
Loss 69
Net Accumulation 1963
NOTE:
All flows are in GPM.
(1) River water and pit sump water will be used to build a 40 MG operating reserve.
(2) Pit sump water can provide an additional operating reserve for use during winter icing. After reserve is obtained only the amount of water required for make-up will be taken from 1085 sump.
20
21
FLAMBEAU MINING CORP.
WATER DISTRIBUTION
FLOW SHEET
INITIAL PRODUCTION
CALCULATED THEORETICAL
SCALE: 1" = 2000'
DATE Nov. 1975
DRAWN BY: GLB
MAP NO. L-2

EXHIBIT 11



(A) Pit Bottom Sump
Precipitation and evaporation from pit area inside 1085 level.

(B) 1085 Level Sump
Precipitation and evaporation from 1085 level area, plus run off area outside of 1085 level.

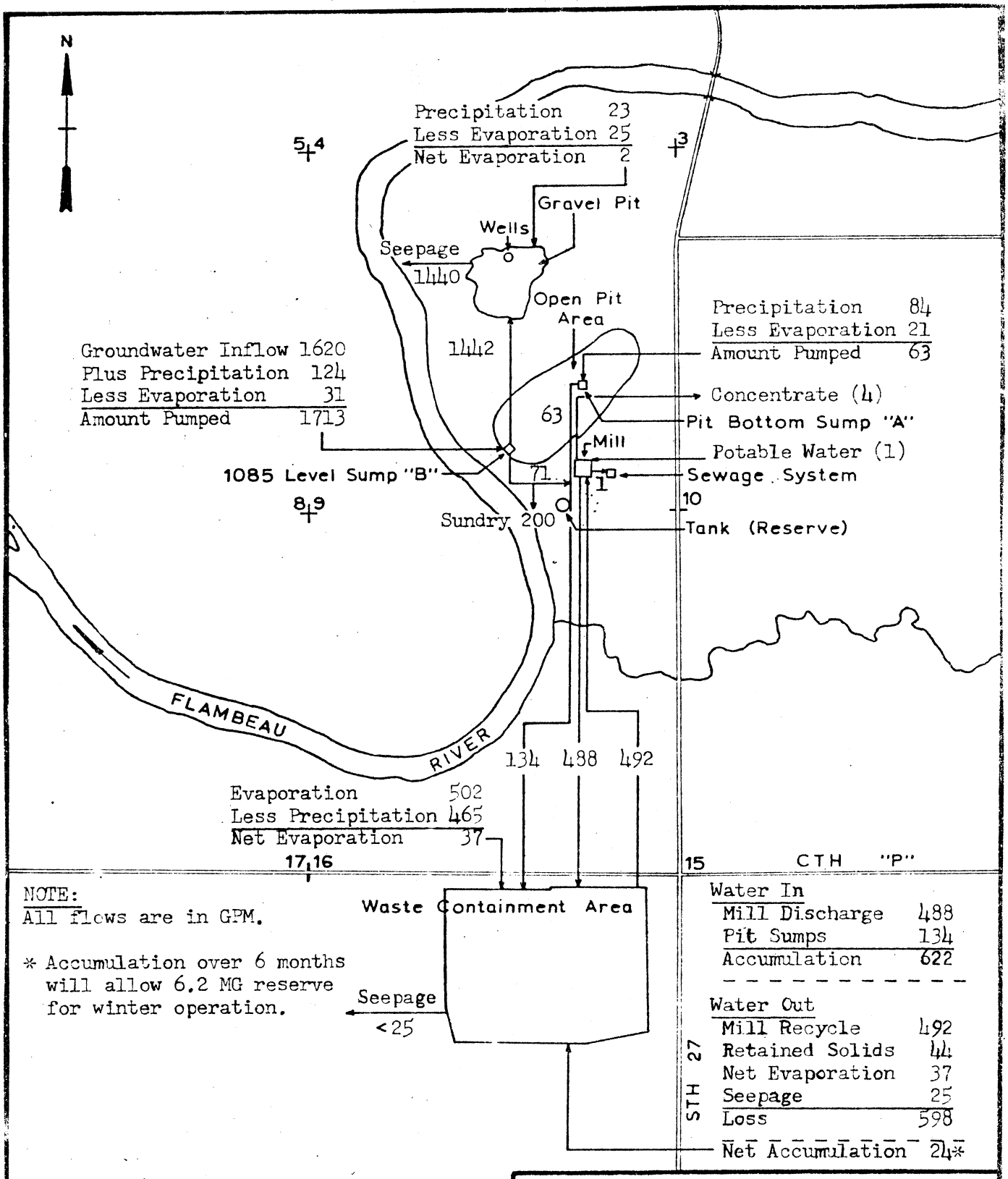
NOTE:
All flows are in GPM.

* Short - term positive or negative fluctuations may be experienced. Overall accumulation will be zero.

FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
YEARLY AVERAGE-OVER PRODUCTIVE LIFE
CALCULATED THEORETICAL
Grant Township, Rusk County, Wisconsin

SCALE 1" = 2000' DATE Nov. 1975
DRAWN BY GLB MAP NO. L-3



NOTE:
All flows are in GPM.

* Accumulation over 6 months will allow 6.2 MG reserve for winter operation.

FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
OPERATIONS
SUMMER
CALCULATED THEORETICAL

SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-4

EXHIBIT 11

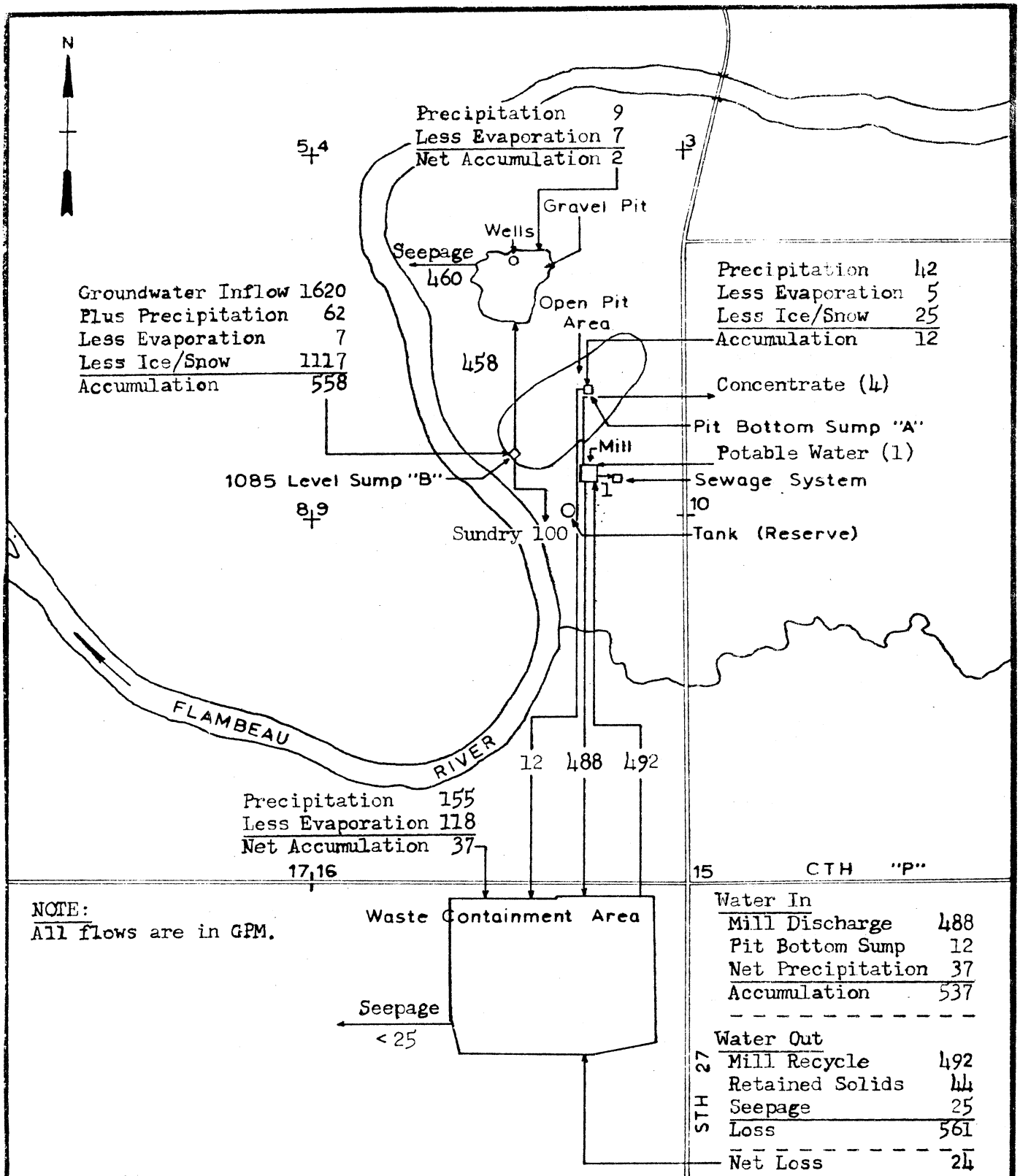
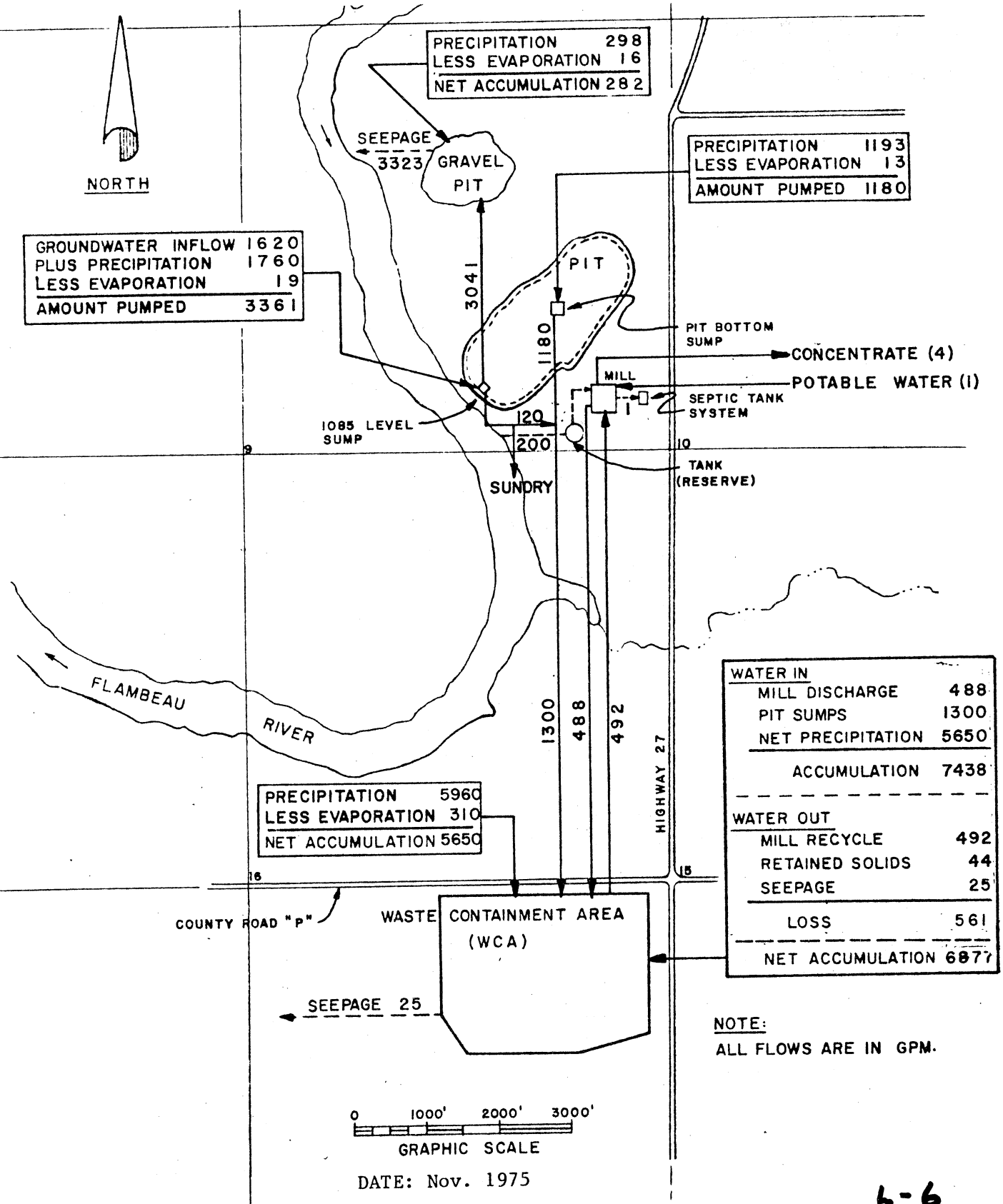

N
Precipitation 9
Less Evaporation 7
Net Accumulation 2
Gravel Pit
Wells
Seepage
460
Open Pit Area
458
Groundwater Inflow 1620
Plus Precipitation 62
Less Evaporation 7
Less Ice/Snow 1117
Accumulation 558
1085 Level Sump "B"
Sundry 100
Precipitation 42
Less Evaporation 5
Less Ice/Snow 25
Accumulation 12
Concentrate (4)
Pit Bottom Sump "A"
Potable Water (1)
Mill
Sewage System
Tank (Reserve)
FLAMBEAU RIVER
12 488 492
Precipitation 155
Less Evaporation 118
Net Accumulation 37
CTH "P"
STH 27
Waste Containment Area
Seepage
< 25
NOTE:
All flows are in GPM.
Water In
Mill Discharge 488
Pit Bottom Sump 12
Net Precipitation 37
Accumulation 537
Water Out
Mill Recycle 492
Retained Solids 44
Seepage 25
Loss 561
Net Loss 24
FLAMBEAU MINING CORP.
WATER DISTRIBUTION
FLOW SHEET
OPERATIONS
WINTER
CALCULATED THEORETICAL
SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-5

EXHIBIT 11

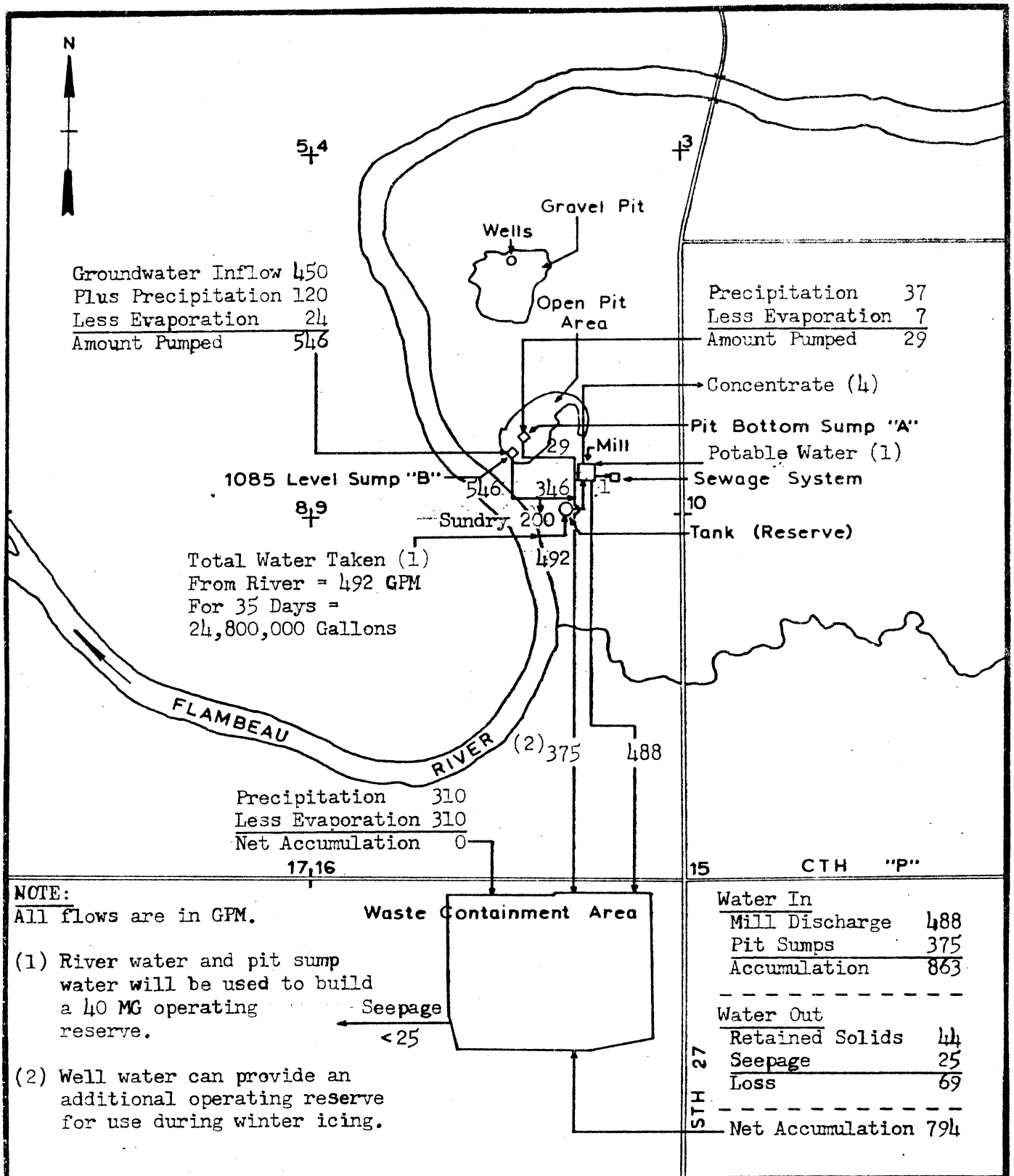


DATE: Nov. 1975

L-6

KENNECOTT COPPER CORPORATION METAL MINING DIVISION ENGINEERING DEPARTMENT SALT LAKE CITY, UTAH	FLAMBEAU MINING CORP. WATER DISTRIBUTION FLOW SHEET OPERATIONS STORM	MICROFILM / MMD JOB MMD DRAWING / REV. DIV. DRAWING NO.

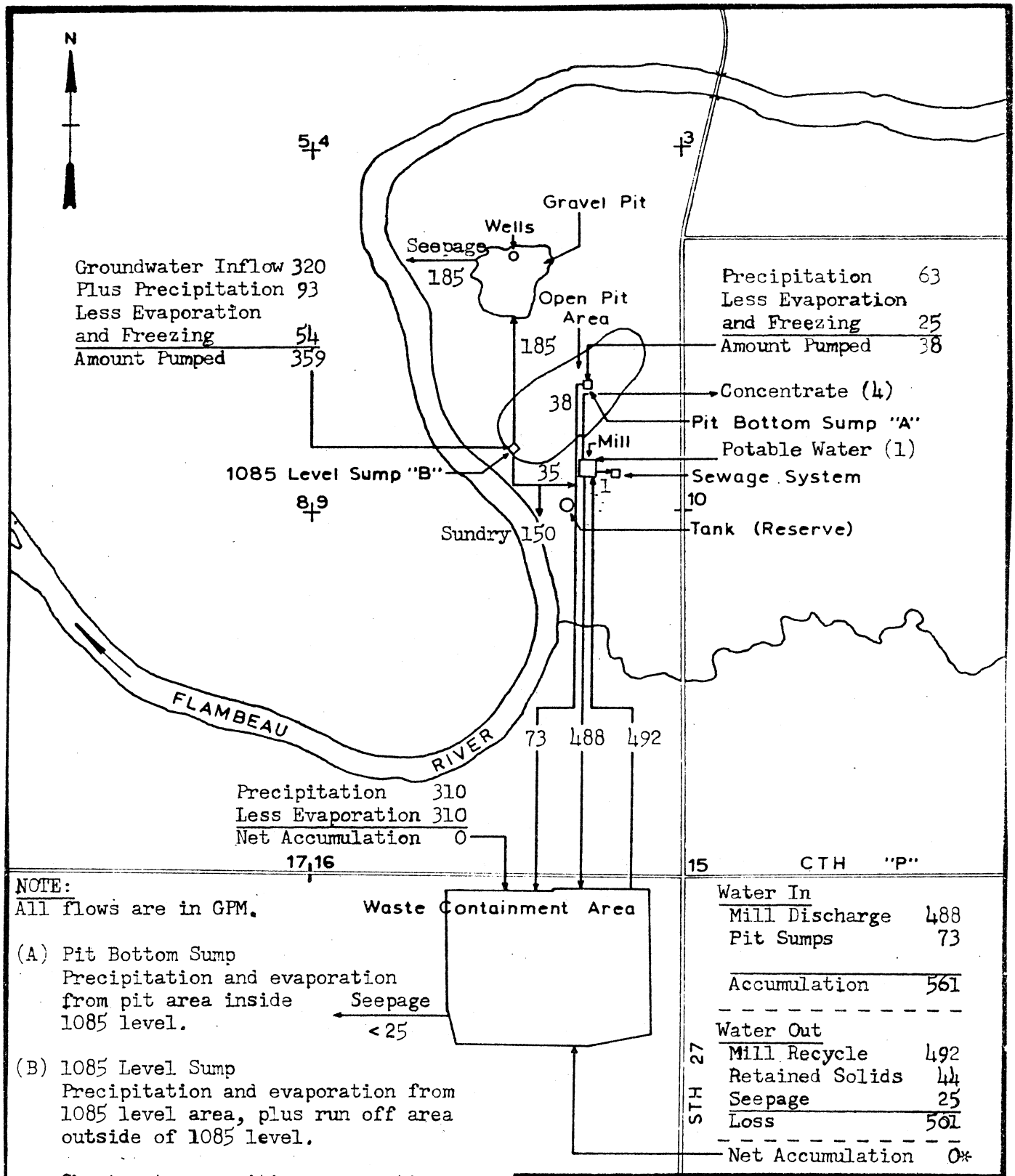
EXHIBIT 11



FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
INITIAL PRODUCTION
(Expected)

SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-7



NOTE:
All flows are in GPM.

(A) Pit Bottom Sump
Precipitation and evaporation from pit area inside 1085 level.

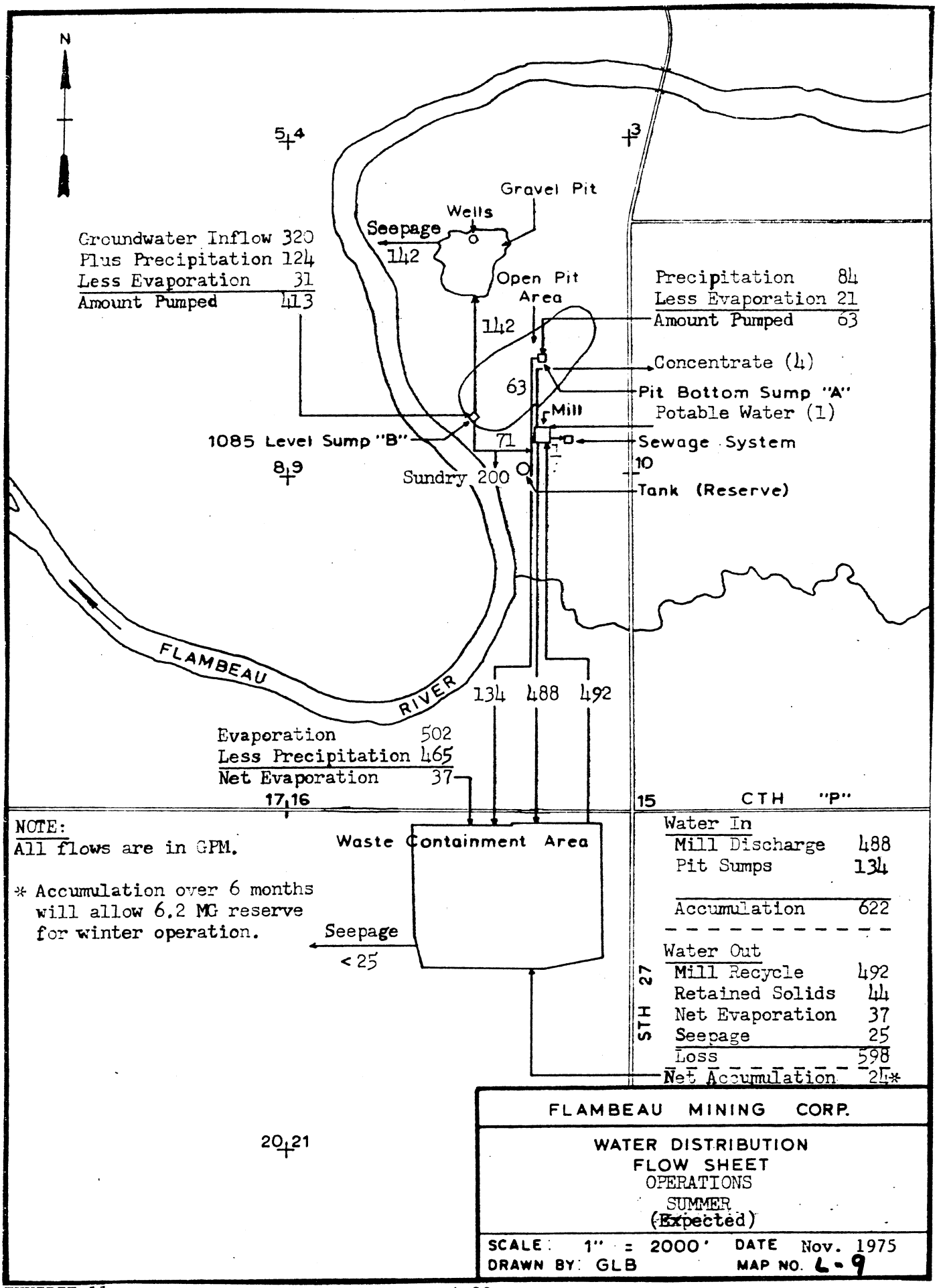
(B) 1085 Level Sump
Precipitation and evaporation from 1085 level area, plus run off area outside of 1085 level.

* Short - term positive or negative fluctuations may be experienced. Overall accumulation will be zero.

FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
YEARLY AVERAGE
OVER PRODUCTIVE LIFE
(Expected)

SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-8



NOTE:
All flows are in GPM.

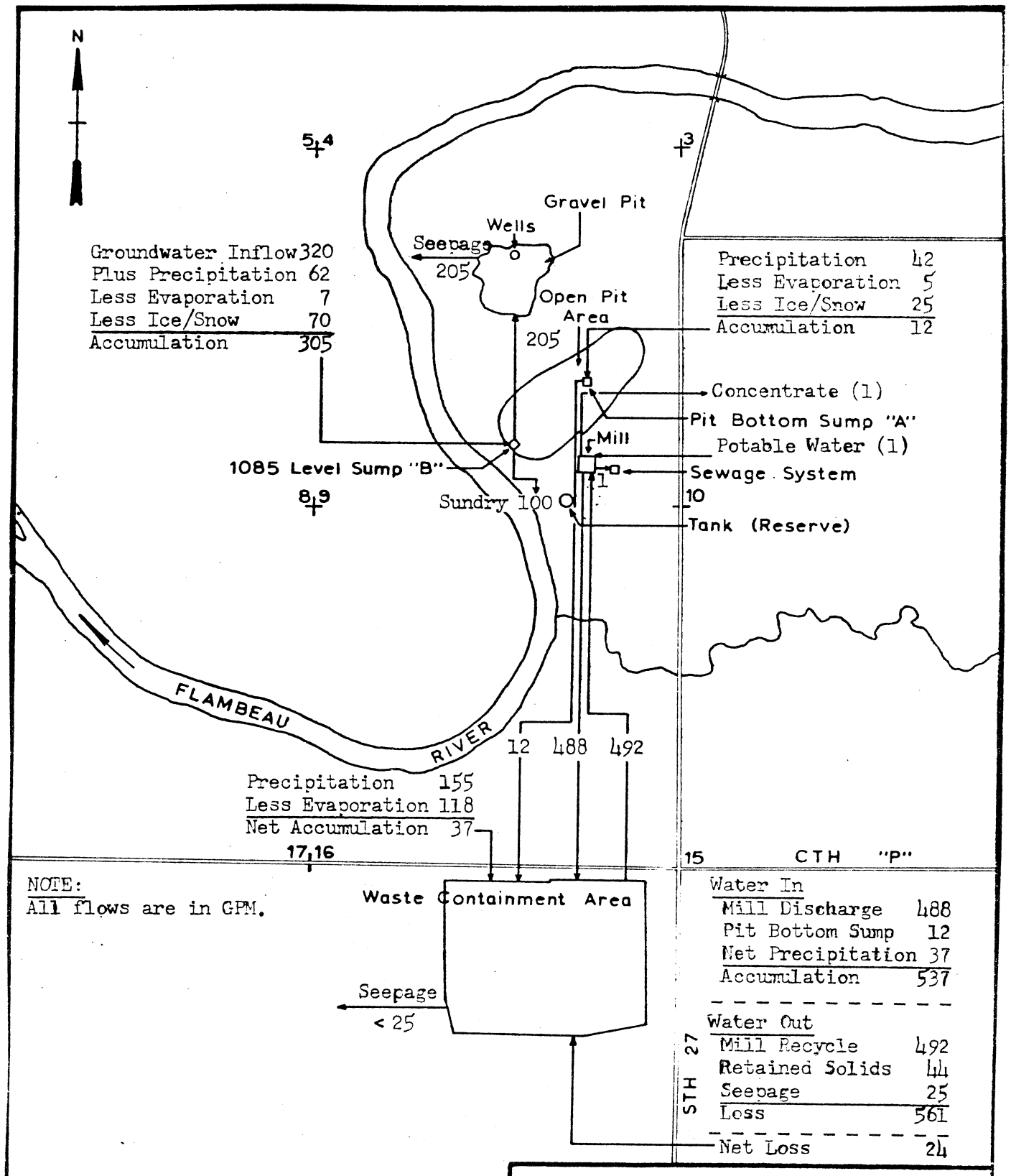
* Accumulation over 6 months will allow 6.2 MG reserve for winter operation.

Water In	
Mill Discharge	488
Pit Sumps	134
Accumulation	622
Water Out	
Mill Recycle	492
Retained Solids	44
Net Evaporation	37
Seepage	25
Loss	598
Net Accumulation	24*

FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
OPERATIONS
SUMMER
(~~Expected~~)

SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. L-9



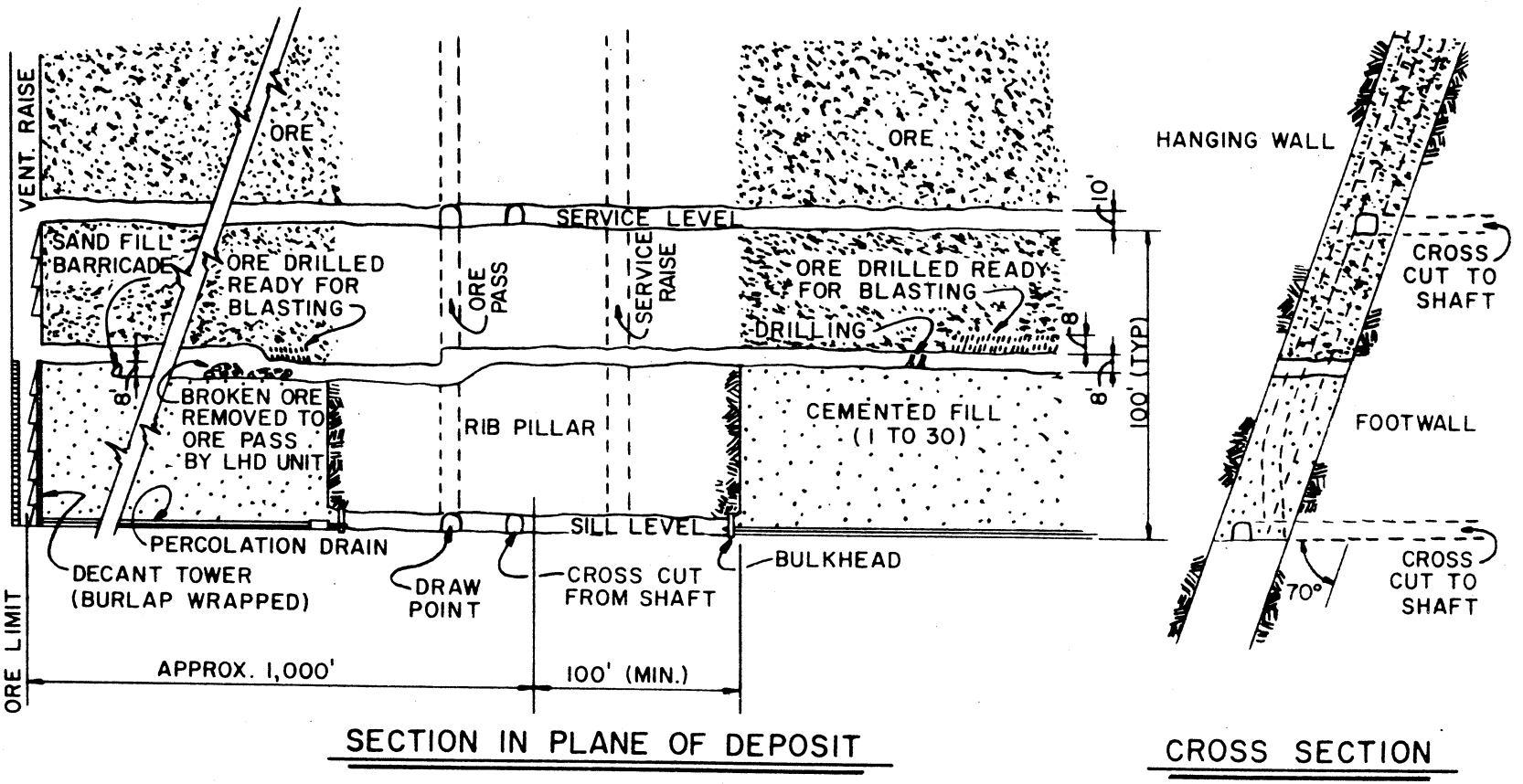
FLAMBEAU MINING CORP.

WATER DISTRIBUTION
FLOW SHEET
OPERATIONS
WINTER
(Expected)

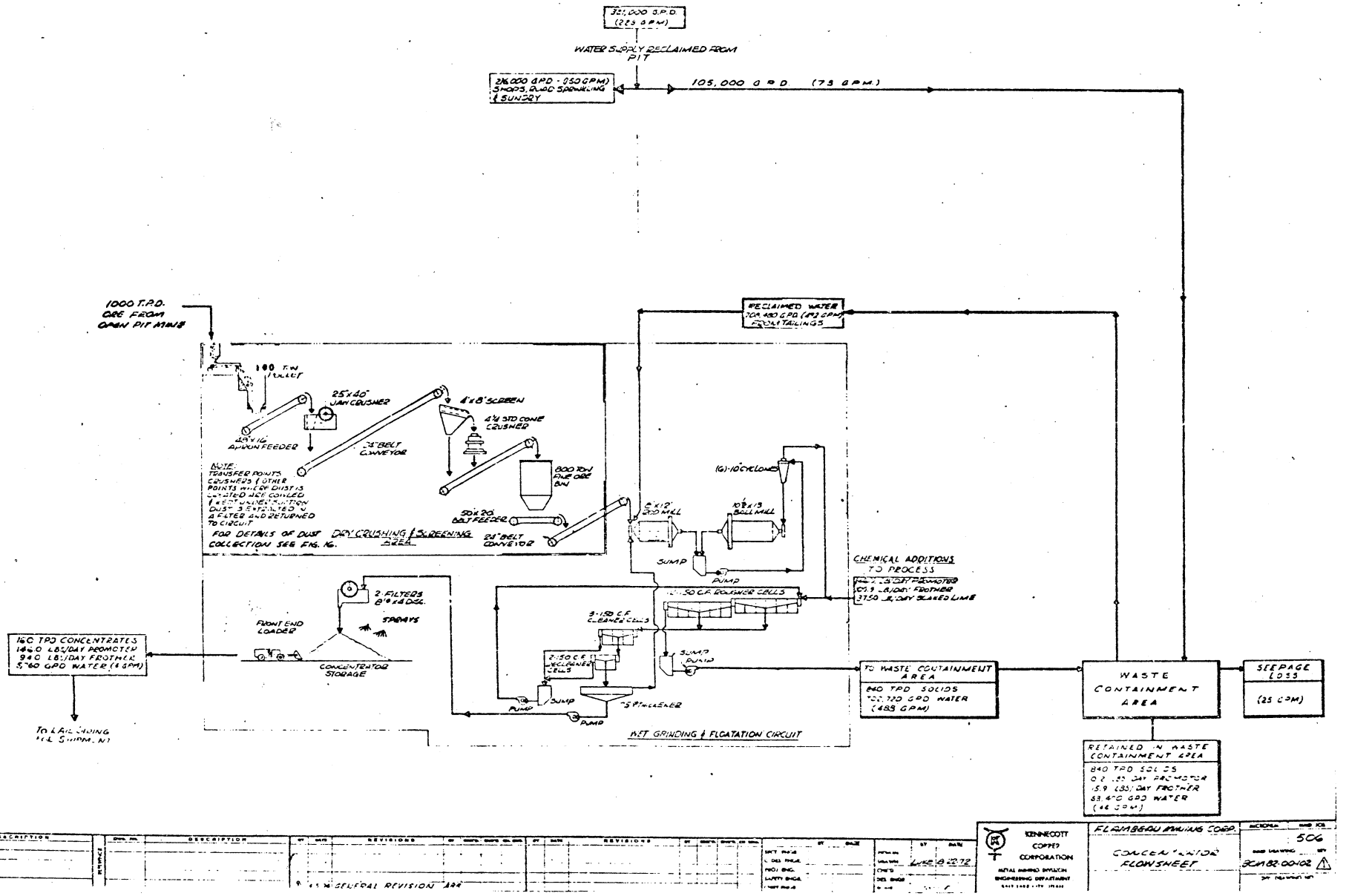
SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO. 2-10

EXHIBIT 11

MECHANIZED CUT AND FILL STOPING DETAILS



CONCENTRATOR FLOW SHEET



KENNECOTT COPPER CORPORATION
METAL MINING DIVISION
ENGINEERING DEPARTMENT

FLAMBEAU MINING CORP.

CONCENTRATOR FLOWSHEET

506

SCM 82-00-02

LUKE 8-12-72

GENERAL REVISION

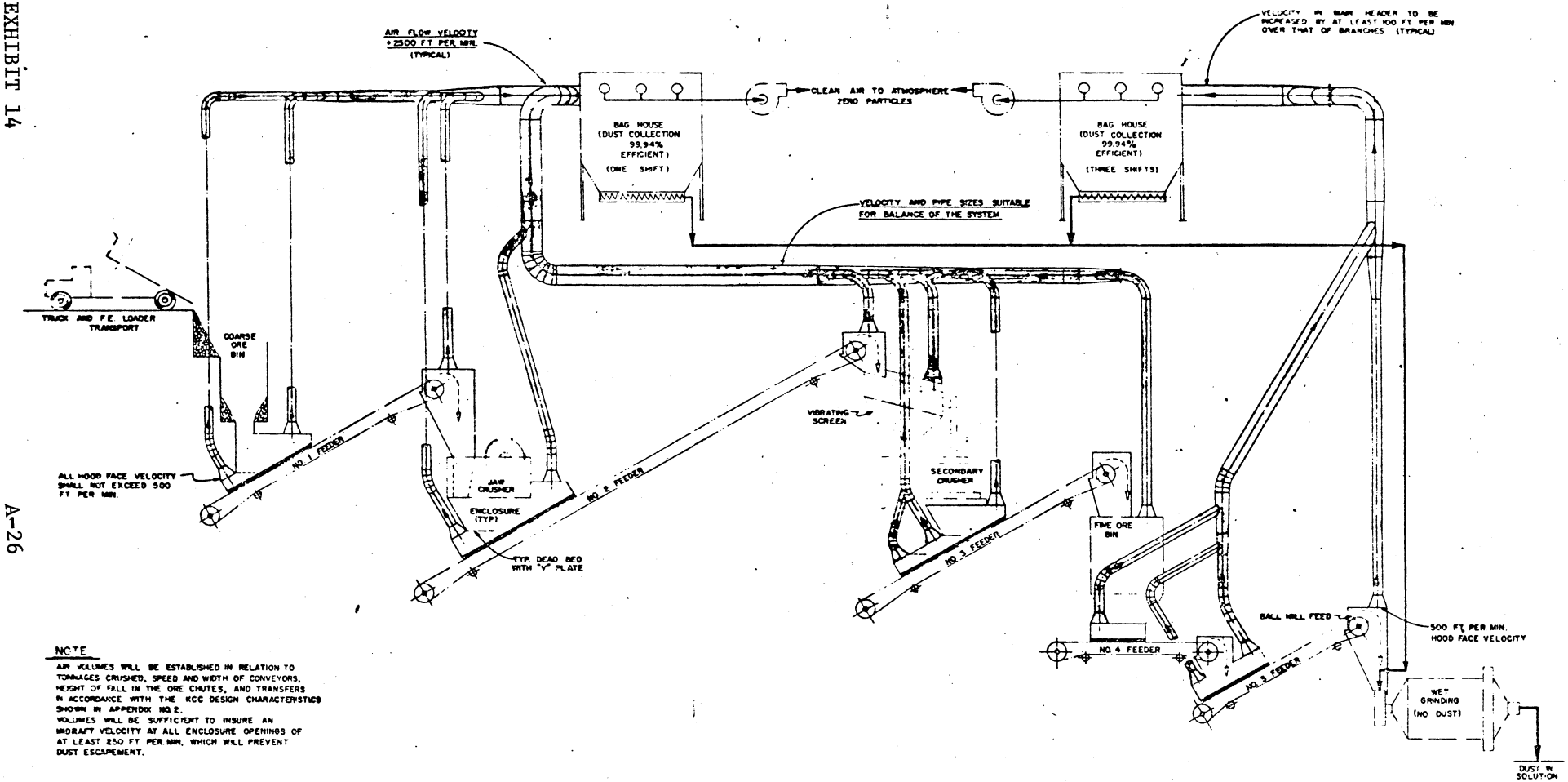
EXHIBIT 13

A-25

EXHIBIT 14

A-26

INFLUENCE OF PIT EXCAVATION ON GROUNDWATER GRADIENT AND ESTIMATED DRAWDOWN HALO



NOTE

AIR VOLUMES WILL BE ESTABLISHED IN RELATION TO TONNAGES CRUSHED, SPEED AND WIDTH OF CONVEYORS, HEIGHT OF FALL IN THE ORE CHUTES, AND TRANSFERS IN ACCORDANCE WITH THE KCC DESIGN CHARACTERISTICS SHOWN IN APPENDIX NO. 2.
VOLUMES WILL BE SUFFICIENT TO INSURE AN INDRAFT VELOCITY AT ALL ENCLOSURE OPENINGS OF AT LEAST 250 FT. PER MIN. WHICH WILL PREVENT DUST ESCAPEMENT.

DESCRIPTION	DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHK'D	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	CHK'D

REFERENCE

	BY	DATE
SECT. ENGR.		
E. MECH. ENGR.		
PROJ. ENG.		
SAFETY ENGR.		
CHIEF ENGR.		

	BY	DATE
DESIGN		
DRAWN	HEK	MARCH 73
CHK'D		
MET. ENGR.		
SCALE	NONE	

KENNECOTT COPPER CORPORATION
ENGINEERING CENTER
METAL MINING DIVISION
SALT LAKE CITY, UTAH

PLAMBEAU MINING CORP.
CRUSHING PLANT
PRELIMINARY DESIGN
DUST COLLECTION SYSTEM

DRAWING NO. 506
SPEC. NO. 3CM62-00-107

AIR QUALITY AT EAU CLAIRE AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Primary Standard**[3]	Secondary Standard**[4]	(Eau Claire ($\mu g/m^3$) 1974	1973
Particulate matter	Annual (Geometric Mean)	75 μg	60 μg[1]	25.66	25.38
	24 hour	260 μg*	150 μg*	82.40	61.70
Sulfur Oxides (SO_x) (measured at SO_2)	Annual (Arithmetic Mean)	80 μg (0.03 ppm)	--------	8.19	4.28
	24 hour	365 μg (0.14 ppm)*	--------	76.30	34.90
	3 hour	---------	1,300 μg (0.05 ppm)*	-----	-----
Carbon Monoxide (CO)	8 hour	10 mg (9 ppm)*	Same as primary	-----	-----
	1 hour	40 mg (35 ppm)*	Same as primary	-----	-----
Hydrocarbons (HC) (nonmethane measured as CH_4)	3 hour (6 to 9 a.m.)	160 μg (0.24 ppm)*[2]	Same as primary	-----	-----
Nitrogen Dioxide (NO_2)	Annual (Arithmetic Mean)	100 μg (0.05 ppm)	Same as primary	25.20	-----
Photochemical Oxidants (O_x) (measured as O_3)	1 hour	160 μg (0.08 ppm)*	Same as primary	44.80	-----

**Concentration in weight per cubic meter (corrected to 25° C and 760 mm of Hg)

*Concentration not to be exceeded more than once per year

[1]As a guide to be used in assessing implementation plans in achieving the 24-hour STD.

[2]As a guide in devising implementation plans to achieve oxidant standards

[3]Primary standards are designed to protect public health

[4]Secondary standards are designed to protect public welfare

Source: Air Quality Data Summary
Wisconsin Department of Natural Resources
1973, 1974

BACKGROUND COMMUNITY NOISE DATA

Reading No.	Location	See Footnotes: 1. dBC	2. dBC	3. dBC	1. dBA	2. dBA
1	Rest Home Parking Lot	68.3	72.7	73.0	51.3	55.3
2	Southeast Corner of Hospital Bldg.	72.7	82.3	74.0	56.0	60.7
2A	West end of Hospital Bldg.	69.5	76.3	71.3	48.5	54.3
3	Northeast of College Bldg.	73.3	71.0	68.0	48.7	48.7
4	South of College Bldg.	72.0	82.0	72.3	51.3	62.0
4A	North of College Bldg.	60.0	78.7	72.7	40.0	45.7
4B	West of College Bldg.		76.7	74.0		50.0
5	Northwest of College Dormitory	73.3	79.0	73.3	52.3	59.0
5A	STH 27 - South end of Bridge	63.5	71.3	70.3	46.5	54.7
5B	North of local Sand & Gravel Co.'s Ready Mix Plant		87.7	72.3		69.7
5C	East of local Sand & Gravel Co. crusher - Behind Tree Screen		64.3	66.0		61.3
6	Northeast of Gravel Screen	74.7	86.7	76.7	59.0	77.3
7	East of Gravel Screen	72.7	85.7	78.0	56.3	80.7
8	East of Gravel Crusher	73.3	90.7	87.0	52.7	83.3
9	South of Gravel Crusher	69.0	83.3	82.7	46.7	72.3
10	West of Gravel Crusher	66.0	91.3	91.7	46.7	88.0
10A	STH 27 - Northeast of Proposed Pit	69.0	72.3	62.6	46.0	54.7
11	North end of former Rusk Co. Gravel Pit	70.0	77.3	70.0	46.7	50.3
12	South end of former Rusk Co. Gravel Pit	65.3	68.7	58.7	47.3	44.0
13	STH 27 - North end of Proposed Pit	73.0	75.7	64.0	52.0	52.3
14	STH 27 - Plant Access Road	76.0	71.7	73.3	53.0	45.7
15	Haul Road - 1000 feet South of Proposed Pit	54.0	51.7	50.3	41.7	40.0
16	Haul Road - 3000 feet South of Proposed Pit	57.7	47.3	52.0	44.0	40.0
16A	STH 27 - East of Haul Road	69.0	69.7	66.7	53.0	49.7
17	CTH "P" - East Side of Haul Road Crossing	75.0	72.7	70.0	53.0	48.0
18	CTH "P" - West Side of Haul Road Crossing	75.0	72.7	72.7	52.3	45.0
19	CTH "P" NW Corner of Proposed Waste Containment Area	67.0	55.3	58.7	47.3	40.0
20	South Side of Proposed Waste Containment Area	69.0	64.7	62.3	47.0	41.7
21	STH 27 - East Side of Proposed Waste Containment Area	66.3	57.7	54.3	47.3	43.3
22	Town Road and Soo Line R.R. Tracks N.E. of Proposed Pit (Without Train)	68.7	66.0	62.0	44.0	46.7
22A	Town Road and Soo Line R.R. Tracks N.E. of Proposed Pit (With Train)	84.0			55.0	
23	STH 27 East of Proposed Haul Road			60.3		
24	STH 27 East of Proposed Pit			59.0		
25	West Bank of Flambeau River Across from local Sand & Gravel Co.			48.0		
26	West Bank of Flambeau River Across from West end of Proposed Pit			51.7		
27	STH 27 at Hospital (without traffic)			62.0		
28	STH 27 at Hospital (with traffic)			99.0		

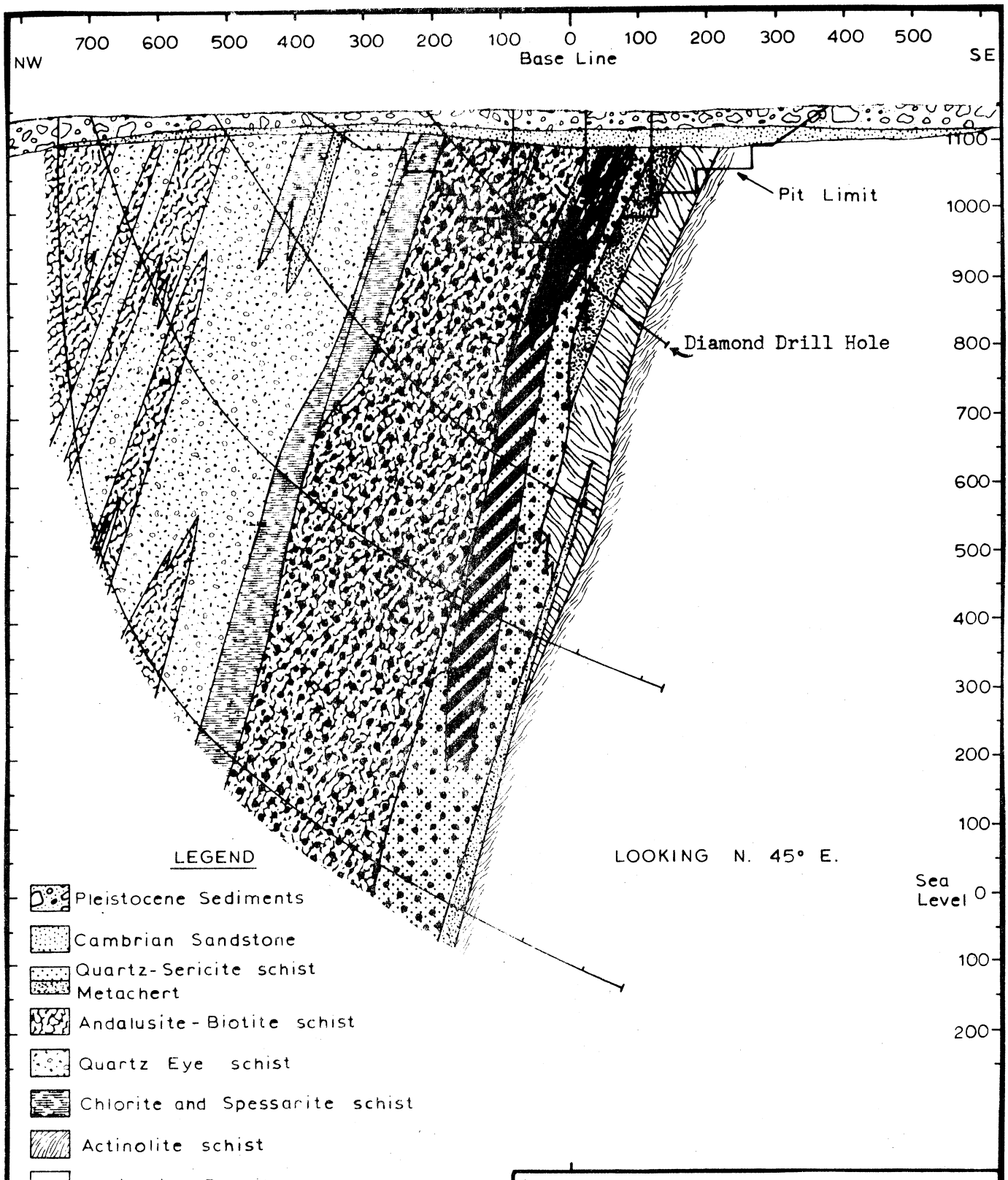
FOOTNOTES:

1. All readings taken without local Sand and Gravel Co.'s Crusher Running and without tree leaves.
   Reading Dates: April 4, 1973 and April 5, 1973
2. All readings taken with local Sand and Gravel Co.'s Crusher running and without tree leaves.
   Reading Dates: May 10, 1973 and May 11, 1973.
3. All readings taken with local Sand and Gravel Co.'s Crusher running and with tree leaves.
   Reading Dates: June 21, 1973 and June 22, 1973.

NOTE: Wind screen was not used on meter and wind speeds varied from 8 mph to 17 mph.

NOTE: dBC and dBA readings listed under columns 1, 2 and 3 are an average of three (3) readings taken at separate times.

NOTE: dBA is a weighted measurement which closely reflects the human ear's perception of sound. dBC is a measurement of peak levels of noise.



FLAMBEAU MINING CORP.

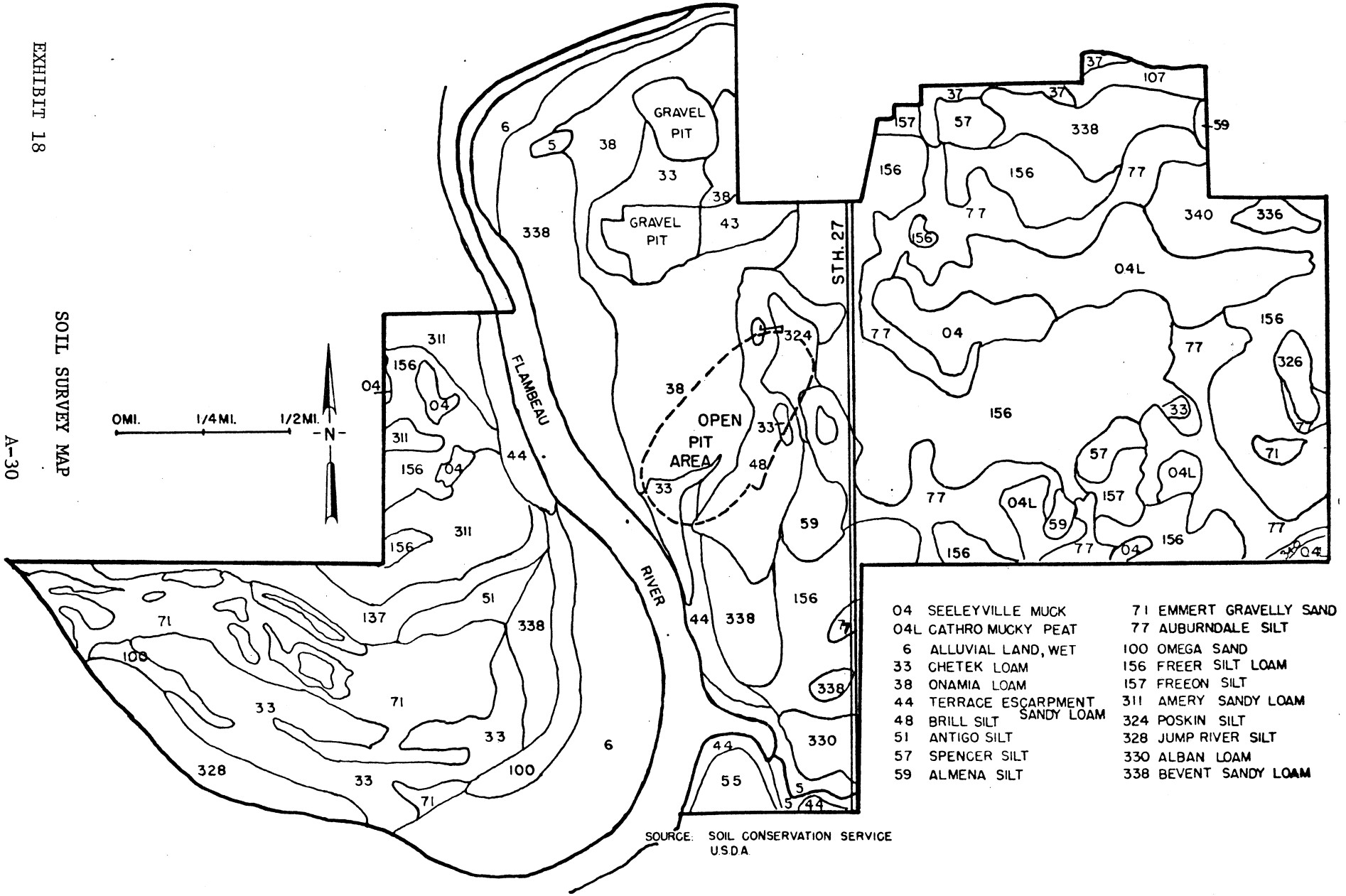
GEOLOGY CROSS SECTION
of the
FLAMBEAU DEPOSIT

SCALE 1" = 200' DATE Aug. 1973
DRAWN BY GLB MAP NO

EXHIBIT 17

EXHIBIT 18

SOIL SURVEY MAP



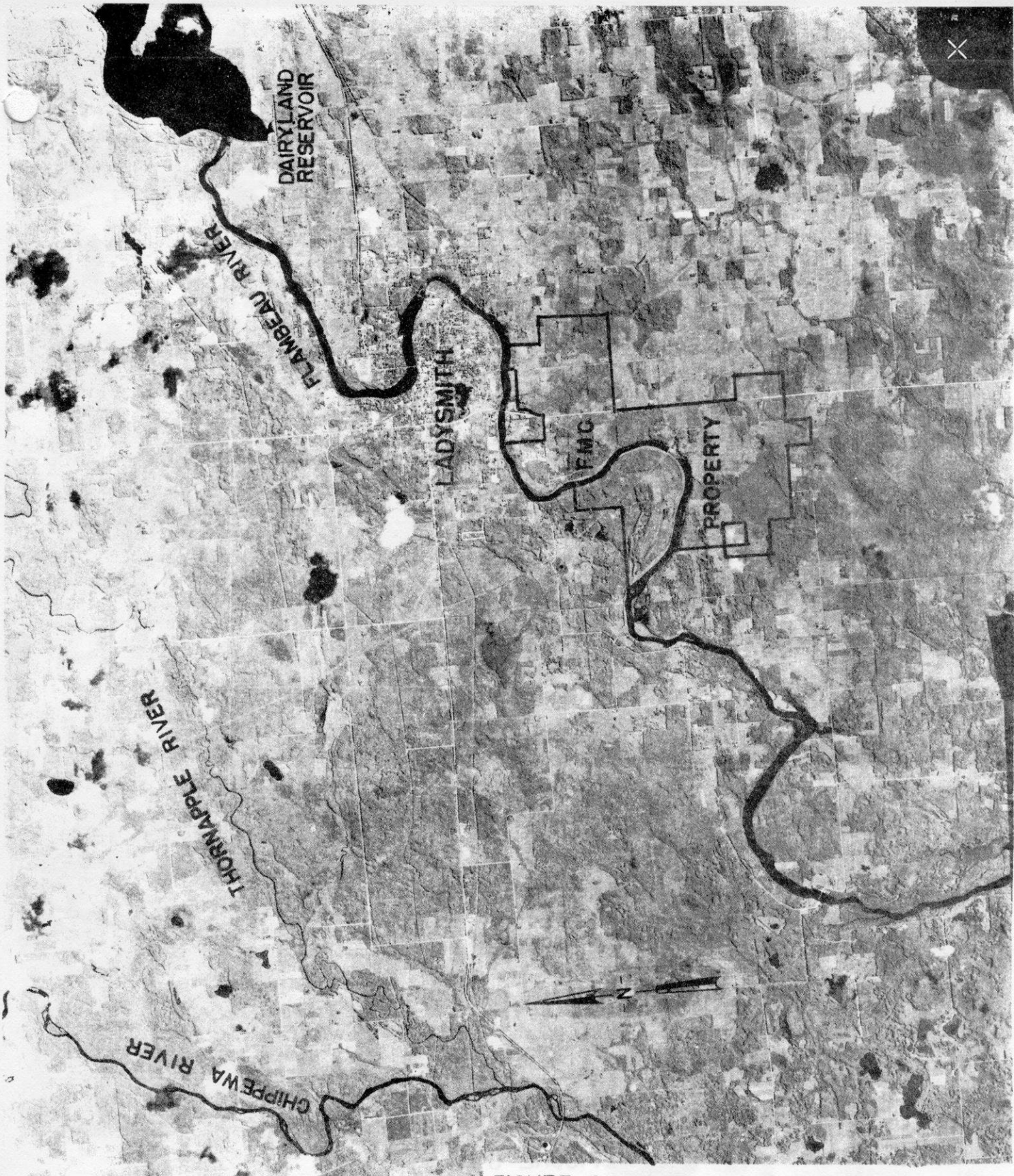


FIGURE 6
FLAMBEAU MINING CORPORATION
FLAMBEAU RIVER
SCALE 1"=7543'

EXHIBIT 19

FIGURE 8
FLAMBEAU MINING CORPORATION
TRIBUTARY STREAMS &
SURFACE WATER QUALITY STATIONS
SCALE 1"=7543'

EXHIBIT 20

STATE WATER QUALITY STANDARDS FOR FLAMBEAU RIVER

The Flambeau River is required to meet the water quality standards for recreation, and fish and aquatic life of Chapter NR 102 of the Wisconsin Administrative Code. The applicable standards are as follows:

NR 102.02

(3) STANDARDS FOR FISH AND AQUATIC LIFE. Except for natural conditions, all waters classified for fish and aquatic life shall meet the following criteria:
(a) Dissolved oxygen: Except for waters classified as trout streams in Wisconsin Trout Streams, Publication 213-72, the dissolved oxygen content in surface waters shall not be lowered to less than 5 mg/l at any time.
(b) Temperature: 1. There shall be no temperature changes that may adversely affect aquatic life.
2. Natural daily and seasonal temperature fluctuations shall be maintained.
3. The maximum temperature rise at the edge of the mixing zone above the existing natural temperature shall not exceed $5^{o}F$ for streams and $3^{o}F$ for lakes.
4. The temperature shall not exceed $89^{o}F$ ($31.7^{o}C$) for warm water fish.
(c) pH: The pH shall be within the range of 6.0 to 9.0, with no change greater than 0.5 units outside the estimated natural seasonal maximum and minimum.
(d) Unauthorized concentrations of substances are not permitted that alone or in combination with other materials present are toxic to fish or other aquatic life. Questions concerning the permissible levels, or changes in the same, of a substance, or combination of substances, of undefined toxicity to fish and other biota shall be resolved in accordance with the methods specified in "Water Quality Criteria," Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1968. The committee's recommendations will also be used as guidelines in other aspects where recommendations may be applicable.

(4) STANDARDS FOR RECREATIONAL USE. A sanitary survey and/or evaluation to assure protection from fecal contamination is the chief criterion in determining the suitability of a surface water for recreational use. In addition, the following bacteriological guidelines are set forth:
(a) The membrane filter fecal coliform count shall not exceed 200 per 100 ml as geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 ml in more than 10% of all samples during any month.

EXHIBIT 21

MAJOR DISCHARGE IN THE FLAMBEAU RIVER BASIN

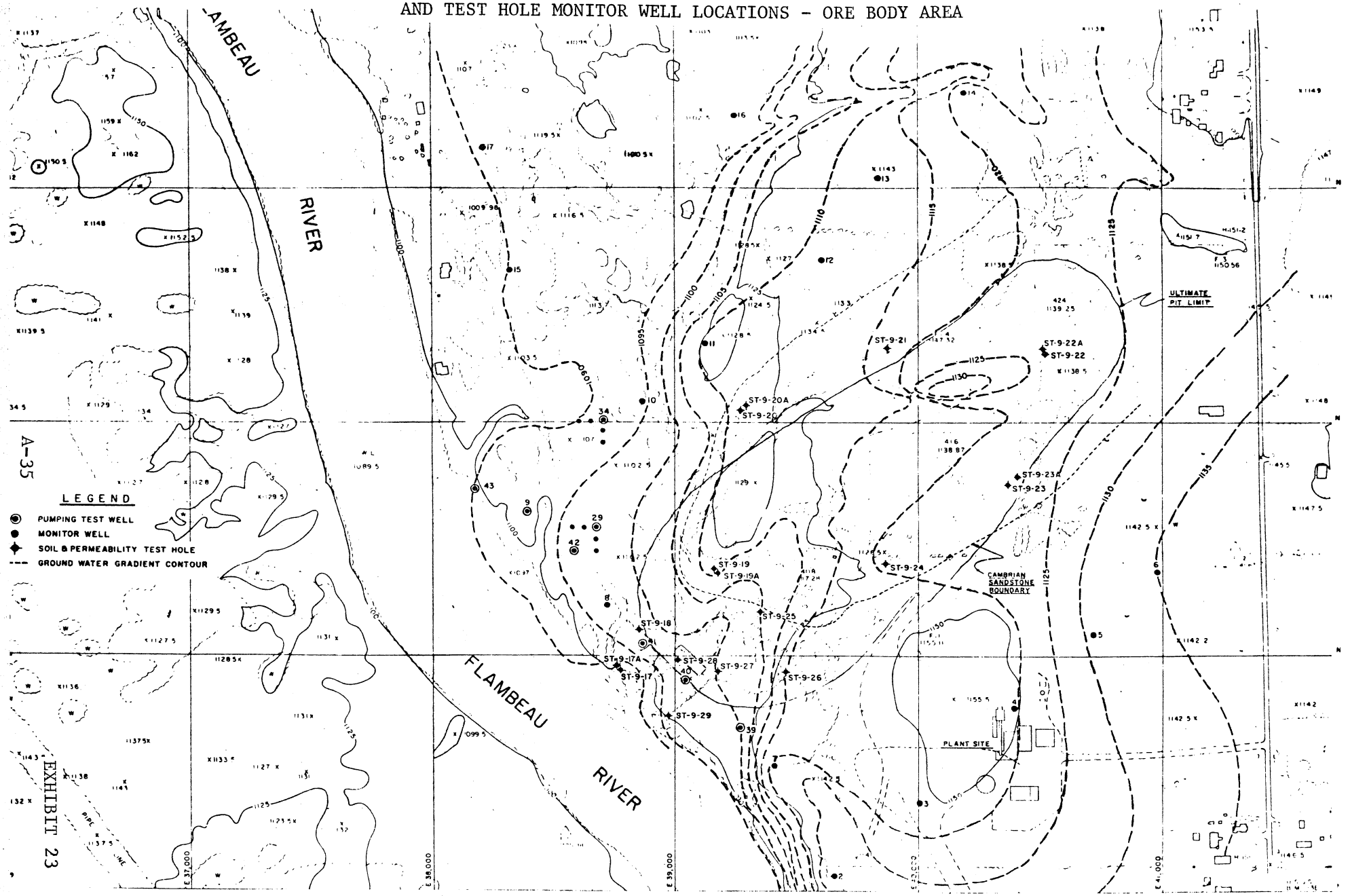
Source	Type of Waste	Treatment	Average Daily Discharge Gal./ Day	BOD_5 (lbs.)	T.S.S.* (lbs.)	Date
City of Ladysmith	Sewage	Secondary	541,000	125	103	4/75
Peavey Paper Mills	Paper	Fiber Recovery	1,612,000	1,765	1,905	3/75
City of Park Falls	Sewage	Secondary	614,000	133	---	4/75 10/69
Flambeau Paper Company	Sulfite Pulp and Paper	Fiber Recovery, Evaporation & Disposal	6,650,000	17,051	10,808	3/75
Mercer S.D. #1	Sewage	Secondary	38,000	14	---	10/69
Village of Butternut	Sewage	Lagoon	190,000	30	33	10/69 4/75
City of Phillips	Sewage	Secondary	281,700	79	95	4/75

*Total Suspended Solids

Source: Upper Chippewa River Pollution Investigation Survey - DNR - 1970; Unpublished Self Monitoring Reports, 1975

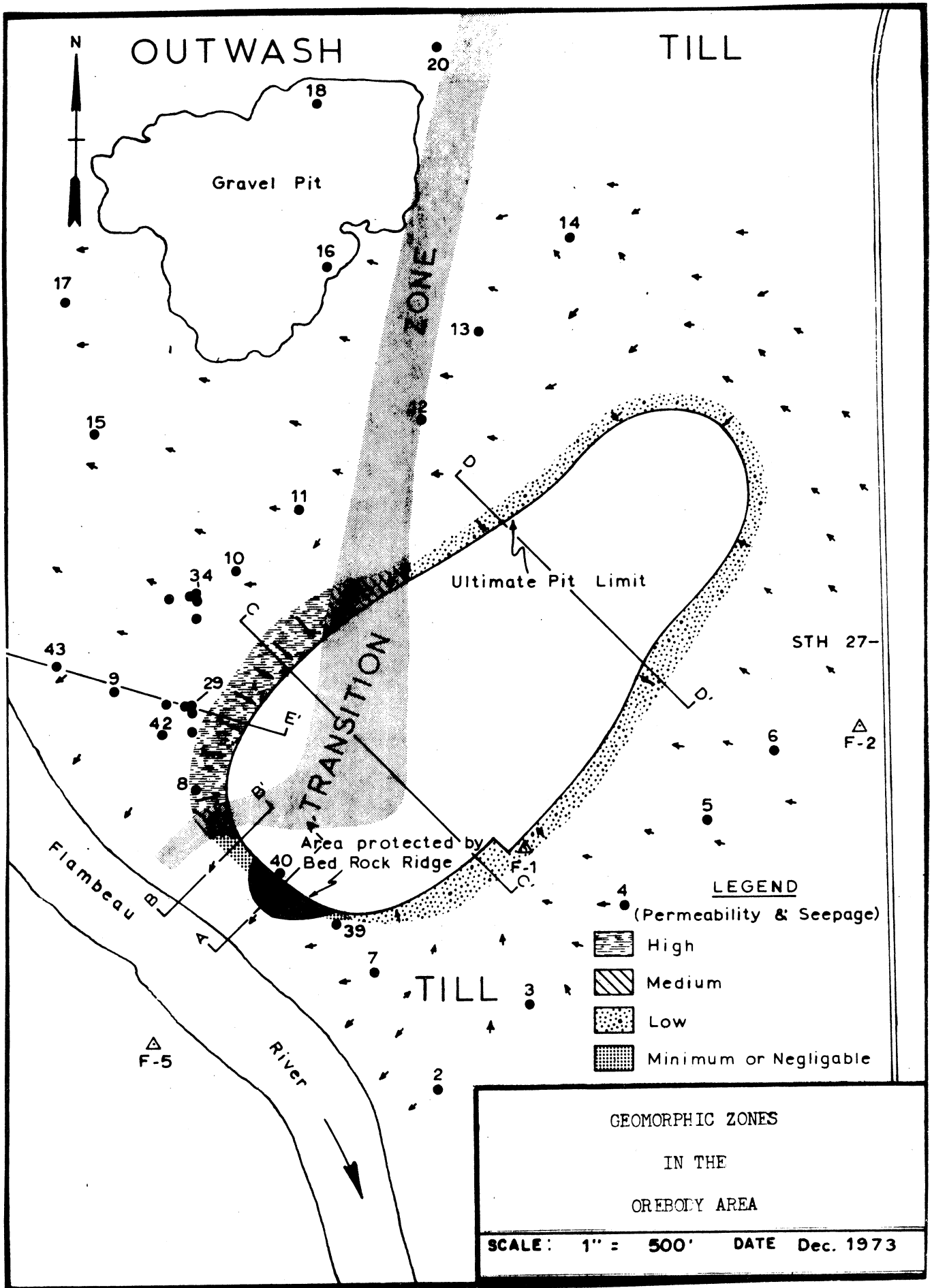
EXHIBIT 22

GROUNDWATER GRADIENT CONTOUR MAP
AND TEST HOLE MONITOR WELL LOCATIONS - ORE BODY AREA

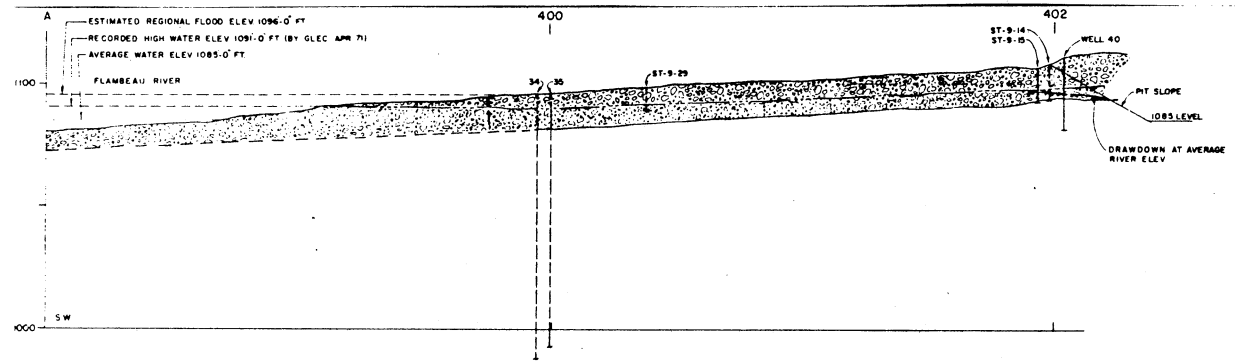


A-35

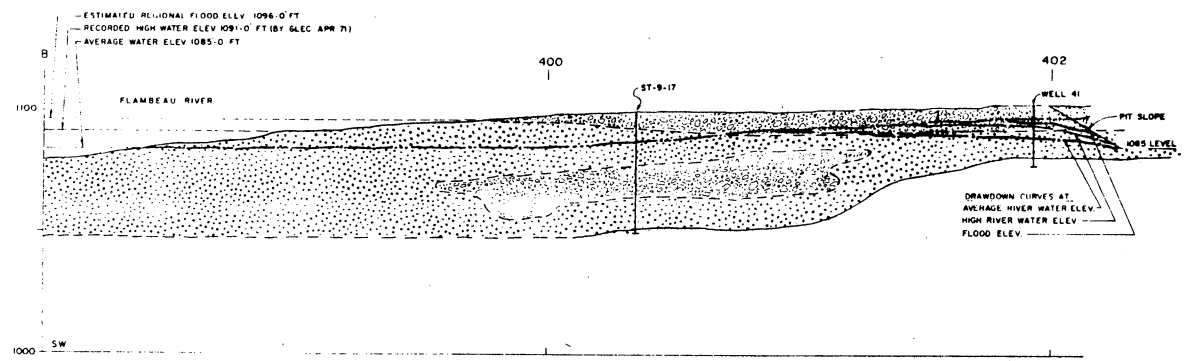
EXHIBIT 23


N
OUTWASH
TILL
Gravel Pit
TRANSITION ZONE
Ultimate Pit Limit
STH 27
Area protected by Bed Rock Ridge
Flambeau River
TILL
F-1
F-2
F-5
A
A'
B
B'
C
C'
D
D'
E
E'
LEGEND
(Permeability & Seepage)
High
Medium
Low
Minimum or Negligable
GEOMORPHIC ZONES
IN THE
OREBODY AREA
SCALE: 1" = 500' DATE Dec. 1973

HYDROGEOLOGIC CROSS-SECTIONS OF THE ORE BODY AREA



SECTION A-A' (LOOKING N 45°W)



SECTION B-B' (LOOKING N 45°W)

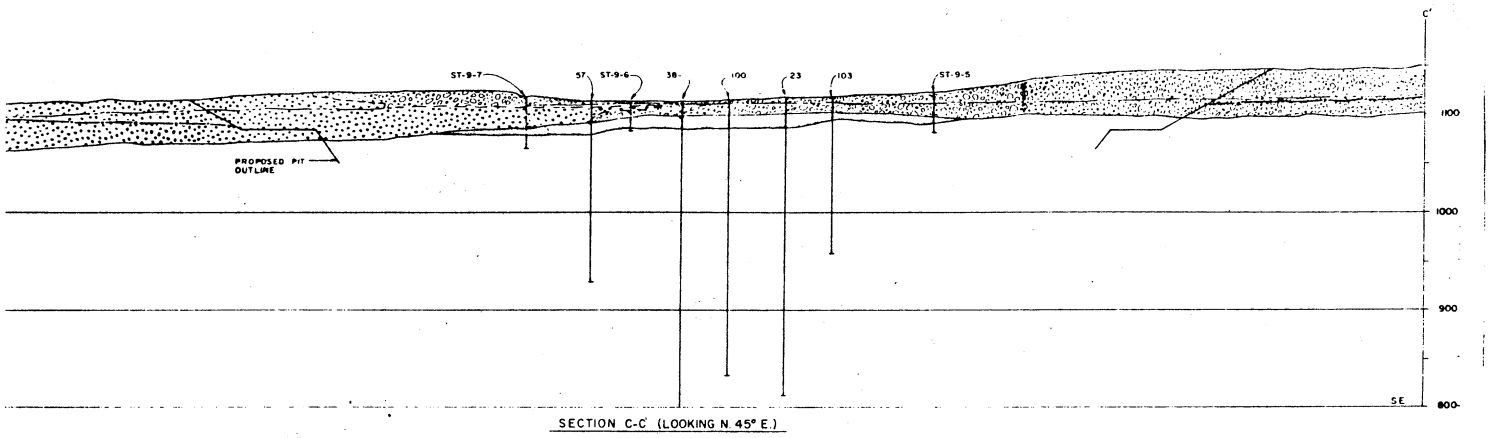
LEGEND

- PLEISTOCENE TILL
- PLEISTOCENE OUTWASH
- CAMBRIAN SANDSTONE
- GROUNDWATER LEVEL (PIEZOMETRIC SURFACE)
- ESTIMATED SOIL STRATA CONTACTS
- ST-9-22 SOIL TEST/PERMEABILITY TEST HOLE
- WELL 12 PUMPING TEST WELL
- 20 OREBODY EXPLORATION CORE HOLE
- ESTIMATED GROUNDWATER LEVEL DRAWDOWN AFTER PIT EXCAVATION

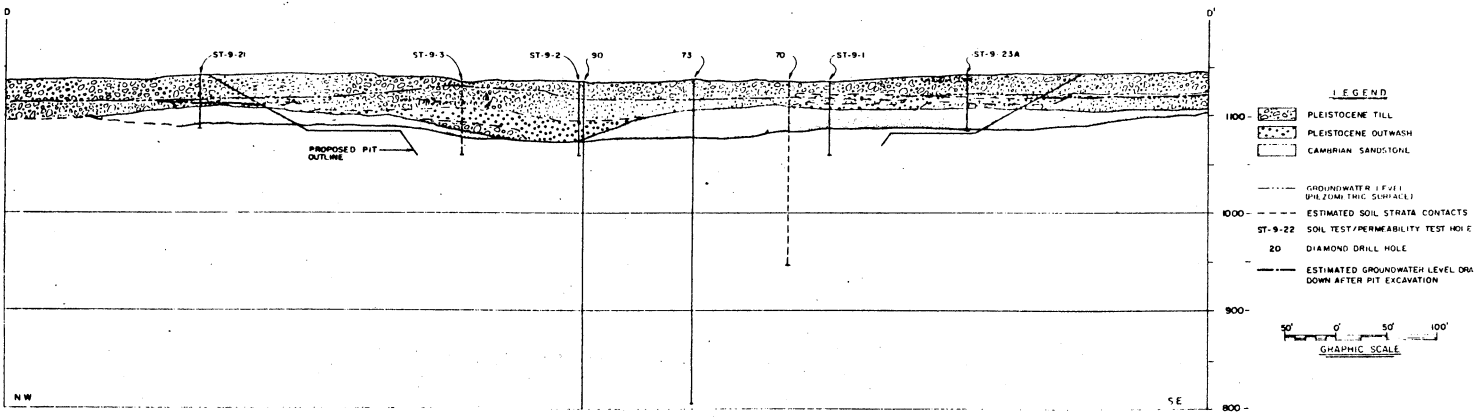
20 0 20 40
GRAPHIC SCALE

KENNECOTT COPPER CORPORATION	FLAMBEAU MINING CORP		
	SECTIONS A-A' B-B'		506
	PIT AREA		
	PLOT PLAN		RCMB2 00 204

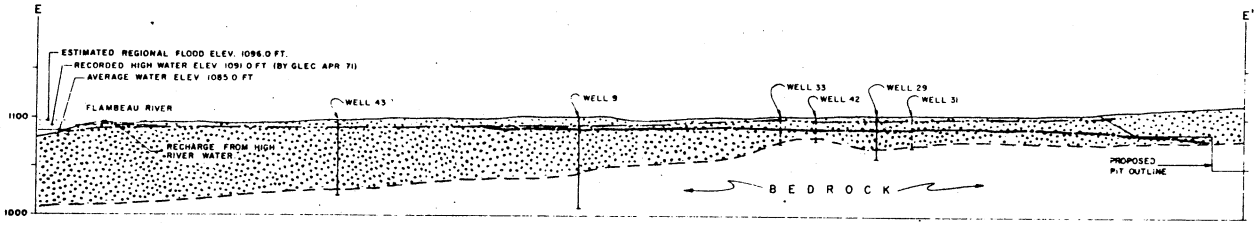
HYDROGEOLOGIC CROSS-SECTIONS OF THE ORE BODY AREA



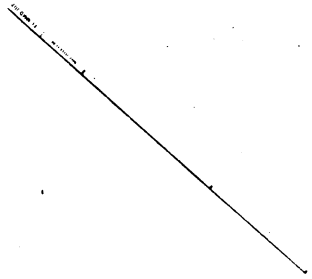
SECTION C-C' (LOOKING N 45° E.)



SECTION D-D' (LOOKING N 45° E.)



SECTION E-E' (LOOKING N. 17° E.)



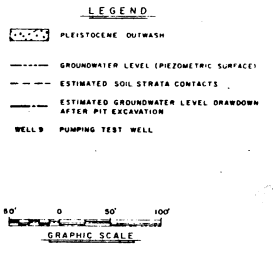


EXHIBIT 25

SUMMARY OF FIELD PERMEABILITY TESTS
ORE BODY AREA

Test No. (Exhibit 23)	Permeability Ft/Day	Permeability GPD/Ft^2	Material Tested
T.W. 8	7.15	53.48	Outwash (SW)
9	5.07	37.92	Outwash (SW)
29	7.06	52.80	Outwash (SW)
34	0.53	3.96	Outwash (SW) (?)
39	1.47	11.00	Till (SM)
42	3.51	26.25	Outwash (SW)
43	136.2	1018.8	Outwash (SW)
ST-9-17 A	3.96	29.4	Outwash (SW)
18	5.57×10^{-6}	4.17×10^{-5}	Till (SM)
19	5.66	42.34	Bedrock - Sandstone
19A	10.63	79.51	Outwash (SW)
20A	4.42×10^{-3}	3.31×10^{-2}	Bedrock - Sandstone
21	1.32	9.87	Bedrock - Sandstone
22	7.94×10^{-5}	5.94×10^{-4}	Bedrock - Sandstone
22A	2.66	19.90	Till (SM)
23	2.85	21.32	Bedrock - Sandstone
23A	4.25	31.79	Till (SM)
24	3.19	23.86	Bedrock - Sandstone
25	2.06	15.41	Till (SM)
26	1.46×10^{-2}	0.11	Till (SM)
27B	4.83×10^{-2}	0.36	Till (SM)
28B	1.13	8.45	Till (SM)
29	1.16×10^{-1}	0.87	Till (SM)

Permeabilities: By Lithology

Soils - SW	20 to 80 gpd/ft^2	50 Avg.
Soils - SM	0.1 to 20 gpd/ft^2	5 Avg.
Bedrock-Sandstone	10 to 50 gpd/ft^2	20 Avg.
Till Section		20 Avg.

By Pit Sector (in till - sandstone section)

West Side	50 gpd/ft^2 (approx. from ST-9-18 to 20)
Southwest Side	10 gpd/ft^2 (approx. from ST-9-26 to 18)
Remainder	20 gpd/ft^2

EXHIBIT 26

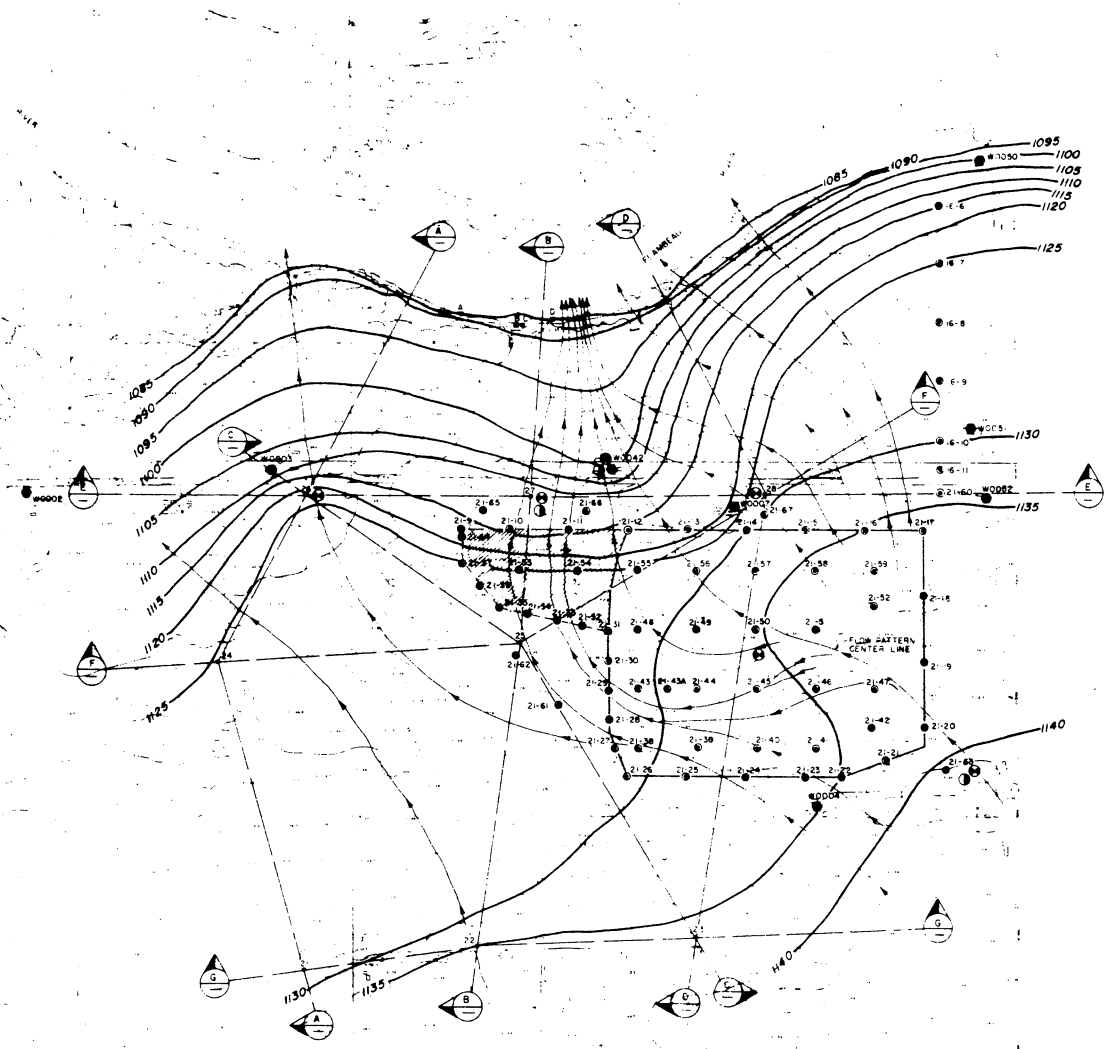
EXHIBIT 27

ANALYSES OF GROUNDWATER WELLS, MINE SITE, FLAMBEAU DEVELOPMENT PROJECT, LADYSMITH, WISCONSIN

ANALYSIS[6]	TEST WELL NUMBERS						
	6[1]	14[1]	17[3]	18[4]	29[2]	40[5]	41[5]
pH (Standard Units)	7.1 6.9-7.2	6.2 5.8-6.7	6.7 6.5-6.9	6.7 6.3-6.9	6.4 6.0-6.6	6.2 6.1-6.4	6.2 5.9-6.3
pH (S.U. - Laboratory)	7.2 6.9-7.6	6.5 6.0-7.6	7.1 6.6-7.6	6.6 6.3-7.0	6.6 6.1-7.2	6.8 6.1-7.6	6.4 6.1-6.7
Total Hardness ($CaCo_3$)	191 170-206	43 28-72	99 92-110	90 80-112	54 40-92	63 44-104	76 62-88
Total Solids	250 170-330	110 20-320	165 15-550	124 80-176	105 60-195	101 10-143	146 65-250
Nitrate Nitrogen (N)	0.6 0.2-2.3	0.2 0.1-0.5	0.3 0.3-1.2	1.4 0.8-1.8	0.5 0.3-0.8	0.7 0.4-1.0	0.4 0.1-0.8
Sulphates	4.2 <1-11	3.8 0.1-10	3.5 2-5	4.4 0.2-12	16.2 0.1-9.0	16.5 8-32	11.32
Aluminum ug/l	<1-<6	<1-<6	<6	<1-<6	<1-<6	<0.5-<6	<0.5-<6
Arsenic	<.01-<.05	<.01-<.05	<.05	<.01-<.05	<.01-<.05	<0.01	<0.01
Barium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron	<.02-.06	<.02-.04	<.02	<.02-.02	<.02-.03	.14 .02-.24	.13 .06-.24
Cadmium	<.001-<.02	<.001-<.02	<.01-<.02	<.001-<.02	<.001-<.02	<.001-<.02	<.001-<.02
Chromium	<.02	<.02	<.02	<.02	<.02	<.02-0.2	<.02-.15
Copper	<.025-<.05	<.025-<.05	<.025-<.05	<.025-<.05	<.025-<.05	1.01 .025- 2.35	1.17 .025-4.35
Fluoride	<.02-.14	<.02-<.08	<.02	<.02-<.08	<.02-<.08	0.09 .02-.14	0.10 .02-.14
Iron	8.4 1.1-12	5.5 1.1-13	<.025-8	1.3 1.5-3.5	11.6 7.4-18.5	33.3 31-100	21.1 10-48
Lead	<.001-<.1	<.001-<.1	<.001-<.05	<.001-<.05	<.001-<.1	.250 .001-1.000	0.100 .001-.400
Magnesium	17.8 15.3-42	4.4 1.2-14	6.6 4.5-10	9.8 6-17	8.7 .3-42	9 7-16	9 6-10
Manganese	<.025- .51	<.025-0.7	<.025- .18	<.02- .06	<.025- .5	<.03- .63	0.99 .78-1.29
Mercury ug/l	<1	<1	<1	<1	<1	<1	<1
Molybdenum	<.001-<.4	<.001-<.4	<.001-<.4	<.001-<.4	<.001-<.4	<.001	<.001
Nickel	<.01-<.05	<.01-<.05	<.01-<.05	<.01-<.05	<.01-<.05	<.01-.18	<.01-.15
Selenium	<.01-<.3	<.01-<.3	<.01-<.3	<.01-<.3	<.01-<.3	<.01	<.01
Silver	<.01-<1	<.01-<1	<.01-<1	<.01-<1	<.01-<1	<.01	<.01
Zinc	.86 .17-1.32	<.025- .06	<.005-<.01	<.025- .06	<.005-2.3	.14 .07-.23	0.20 .09-.51

[1]Sampling commenced July 1971 [2]Sampling commenced September 1971 [3]Sampled July 1971 to December 1971
[4]Sampling commenced January 1972 [5]Sampling commenced December 1972 [6]All values are in mg/l unless indicated otherwise
[7]The lower values are the range. The upper values are the mean. In some cases; mean values are not applicable since some true values were below the detection limits of the applicable tests.

WASTE CONTAINMENT AREA - GROUNDWATER CONTOUR AND FLOW PATHS



LEGEND

- SEEPS
- PRIVATE WELLS
- EXISTING MONITOR WELLS
- SOIL TEST - PERMEABILITY TEST HOLES
- PROPOSED NEW MONITOR WELLS TO BEDROCK TO DETERMINE SOIL PROFILE, VERTICAL GRADIENT, WATER QUALITY)
- PROPOSED NEW MONITOR WELLS TO UPPER AQUIFER
- GROUNDWATER CONTOURS (SEPT. 1972)
- GROUNDWATER FLOW PATHS

NOTE
HATCHED AREA HAS BEEN REMOVED FROM WASTE CONTAINMENT AREA DESIGN TO AVOID THE MORE PERMEABLE SOILS IN THE AREA

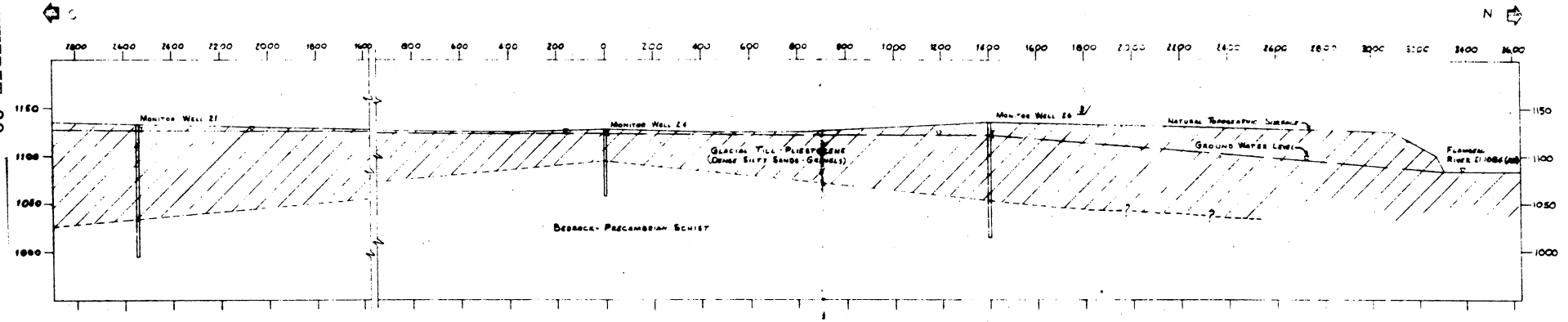
BASE MAP
PREPARED FOR
FLAMBEAU MINING COMPANY
BY
SURDEX CORP., WESTERN ELEC. MO
SCALE 1" = 500'
CONTOUR INTERVAL

NOTE
DASHED CONTOURS ARE APPROXIMATE

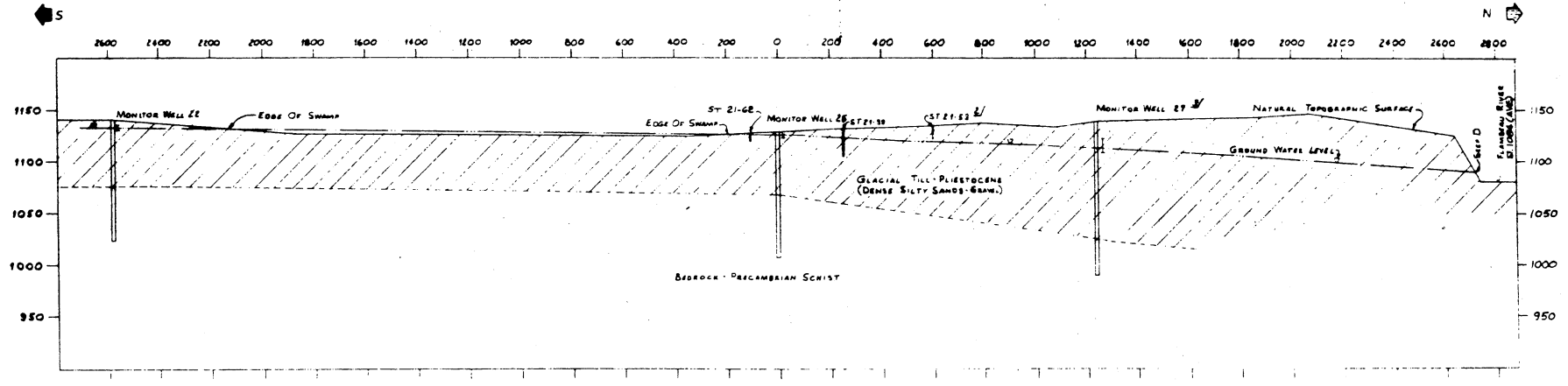
EXHIBIT 28

HYDROGEOLOGIC CROSS-SECTIONS OF THE WASTE CONTAINMENT AREA

EXHIBIT 29



SECTION A-A



SECTION B-B

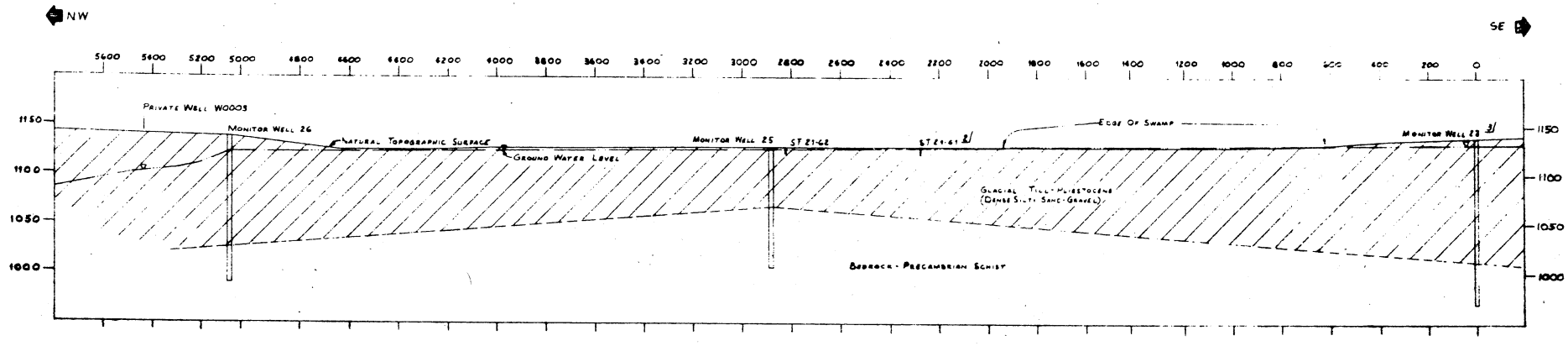
I Groundwater Level Fluctuation Range (1970-75).

1/ Groundwater Level (Piezometric Surface) represents the 5-year average.

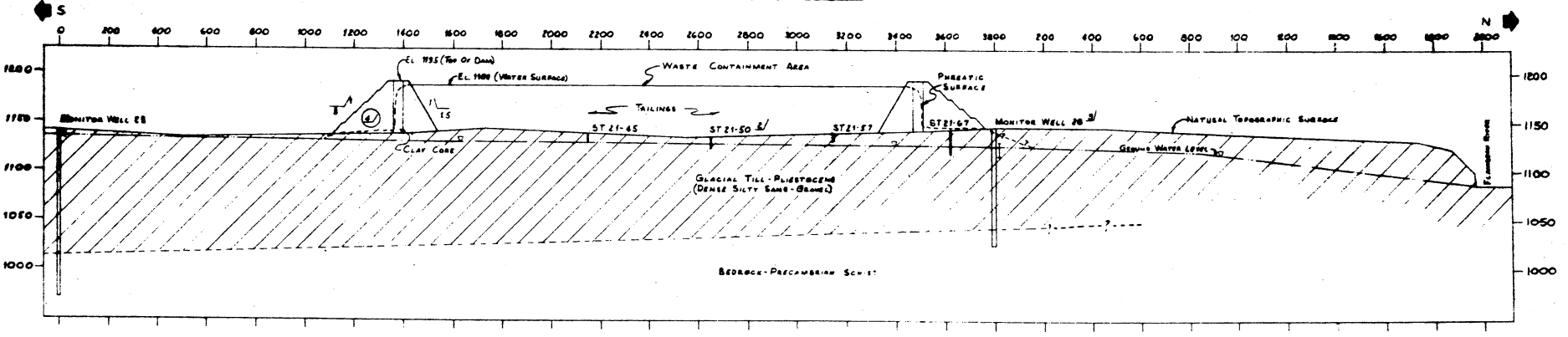
2/ Soil Permeability Test Boring.

3/ Monitor Wells (4-in. diameter slotted casing from W. L. to Bedrock).

HYDROGEOLOGIC CROSS-SECTIONS OF THE WASTE CONTAINMENT AREA



SECTION C-C



SECTION D-D

T Instrumental Level Fluctuation Range (1970-75).

1/ Groundwater Level (Piezometric Surface) represents the 5-year average.

2/ Soil Permeability Test Boring.

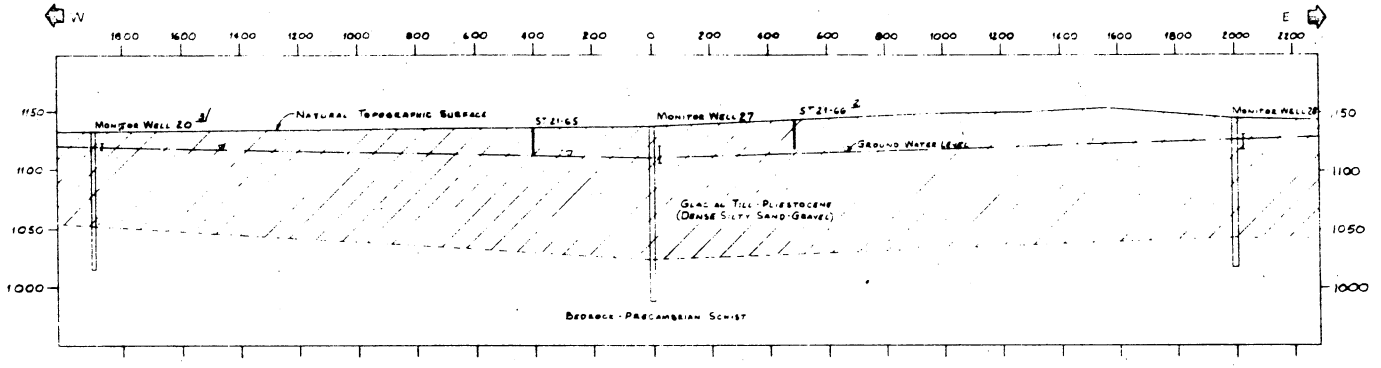
3/ Observation Wells (4-in. dia. slotted casing from W. L. to bedrock).

(4) Number in section on Description of Proposed Action for detailed dam design.

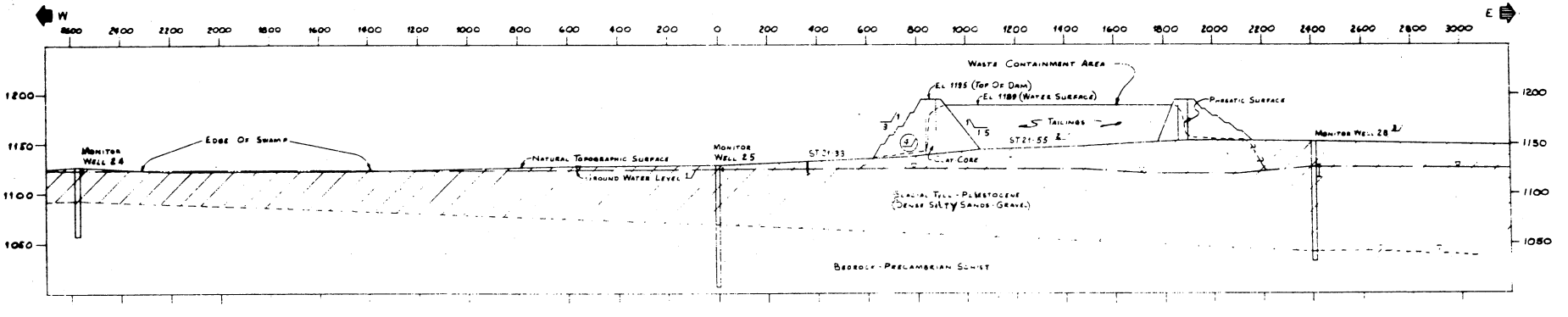
EXHIBIT 29

EXHIBIT 29

HYDROGEOLOGIC CROSS-SECTIONS OF THE WASTE CONTAINMENT AREA



SECTION E-E



SECTION F-F

I Groundwater Level Fluctuation Range (1970-75).

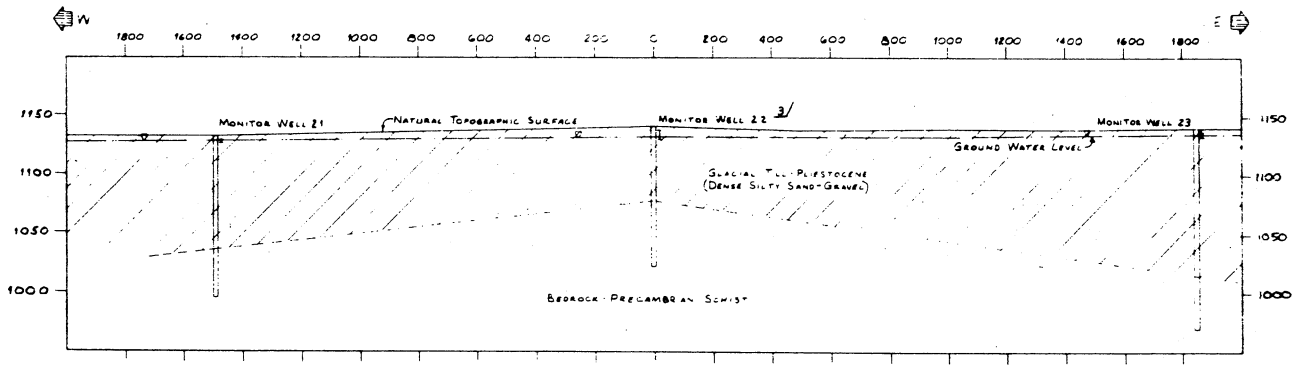
1/ Groundwater Level (Piezometric Surface) represents the 5-year average.

2/ Soil Permeability Test Boring.

3/ Monitor Wells (4-in. diameter slotted casing from W. L. to Bedrock).

4/ Refer to section on "Description of Proposed Action for detailed dam design

HYDROGEOLOGIC CROSS-SECTION OF THE WASTE CONTAINMENT AREA



SECTION G-G

I Groundwater Level Fluctuation Range (1970-75).

1/ Groundwater Level (Piezometric Surface) represents the 5-year average.

2/ Soil/Permeability Test Boring.

3/ Monitor wells (6-in. dia. slotted casing from W. L. to bedrock).

PERMEABILITIES OF SELECTED BASE SOILS UNDER THE WASTE CONTAINMENT AREA

Sampling Station	Depth & Thickness of Soil Tested (ft)	Soil Type	Average Permeabilities (feet/year)
21-27	6.0-7.0	Silt over silty sand	0.67
21-33	2.0-3.5	Clayey silt over silty sand	1.13
21-38	0.0-8.0	Silt over silty sand	1.74
21-53	2.0-5.0	Silt over silty sand	0.07
21-40	0.0-11.5	Silt over silty sand	0.93

Source: Soil Testing Services of Wisconsin, Inc. 1973

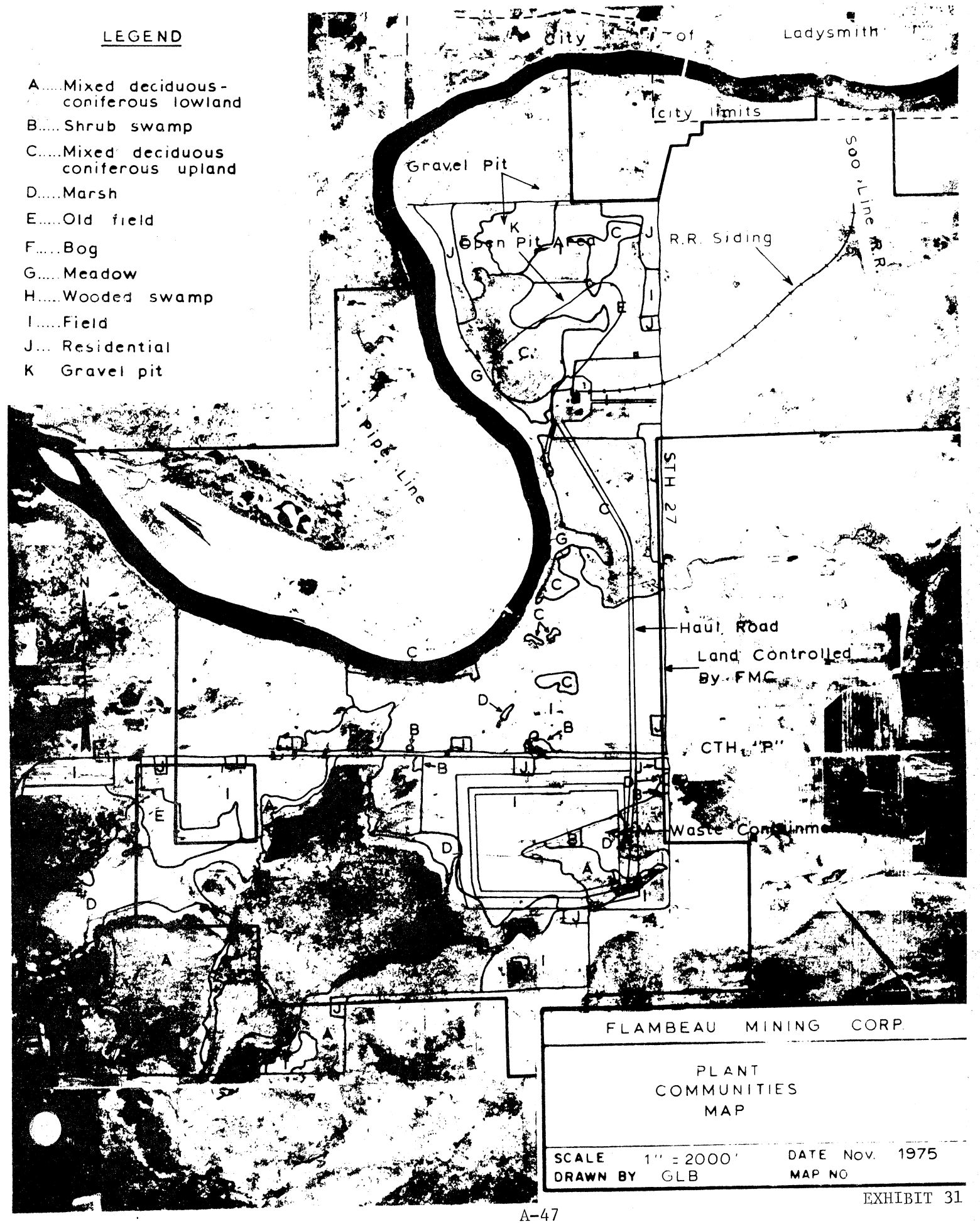

LEGEND
A.....Mixed deciduous-coniferous lowland
B.....Shrub swamp
C.....Mixed deciduous coniferous upland
D.....Marsh
E.....Old field
F.....Bog
G.....Meadow
H.....Wooded swamp
I.....Field
J... Residential
K Gravel pit
City of Ladysmith
City Limits
Gravel Pit
Open Pit Area
R.R. Siding
Soo Line R.R.
Pipe Line
STH 27
Haul Road
Land Controlled By FMC
CTH "P"
Waste Containment
N
FLAMBEAU MINING CORP
PLANT COMMUNITIES MAP
SCALE 1" = 2000'
DRAWN BY GLB
DATE Nov. 1975
MAP NO

EXHIBIT 31

DESCRIPTION AND DISTRIBUTION OF PLANT COMMUNITIES

Map Symbol	Name	Major Species	Acreage	Percent of Total Area	Percent of Major Communities
A	Mixed deciduous-coniferous lowland	Aspen, red maple, ash, elm, white birch	282	16.6	28.2
B	Shrub swamp	Alder, willow, dogwood	262	15.4	26.2
C	Mixed deciduous-coniferous upland	White birch, red maple, aspen, sugar maple, black ash, basswood, elm, hemlock, bur oak, butternut	176	10.3	17.6
D	Sedge meadow	Sedges, cattails, grasses, rushes	111	6.5	11.1
E	Old field	Grasses	103	6.1	10.3
F	Bog	Sphagnum mat, ericads	28	1.6	2.8
G	River Basin Community	Grasses, sedges, willow, silver maple	23	1.3	2.3
H	Wooded swamp	Tamarack	15	.9	1.5
			1,000	58.7	100
		OTHER REGIONS WITHIN AREA (not studied)			
I	Field	Disturbed annually	618	36.3	
J	Residential	Disturbed continuously	60	3.5	
K	Gravel pit	Disturbed recently	23	1.3	
			1,701	99.8	

EXHIBIT 32

WOODY SPECIES WITHIN THE OPEN PIT AREA

FALL SURVEY

GYMNOSPERMAE

PINACEAE
- Pinus rosinosa - red pine
- Pinus strobus - white pine
- Larix larcicina - tamarack
- Abies balsamea - balsam fir
- Tsuga canadensis - hemlock

TAXACEAE
- Taxus canadensis - American yew

ANGIOSPERMAE

ACERACEAE
- Acer rubrum - red maple
- Acer saccharum - sugar maple
- Acer saccharinum - silver maple
- Acer spicatum - mountain maple

ANACARDIACEAE
- Rhus radicans - poison ivy
- Rhus typhina - staghorn sumac

AQUIFOLIACEAE
- Ilex verticillata - black alder
- Nemopanthus mucronata - mountain holly

BETULACEAE
- Corylus americana - American hazelnut
- Corylus cornuta - beaked hazelnut
- Ostrya virginiana - ironwood
- Carpinus caroliniana - bluebeech
- Betula lutea - yellow birch
- Betula papyrifera - white birch
- Alnus rugosa - alder

CAPRIFOLIACEAE
- Diervilla lonicera - bush honeysuckle
- Lonicera canadensis - American fly honeysuckle
- Lonicera tatarica - tartarian honeysuckle
- Sambucus canadensis - common elder
- Viburnum lentago - nannyberry

CORNACEAE
- Cornus alternifolia - pagoda dogwood
- Cornus racemosa - gray dogwood
- Cornus stolonifera - red-osier dogwood

ERICACEAE
- Gaultheria procumbens - wintergreen

FAGACEAE
- Quercus macrocarpa - bur oak
- Quercus rubra - red oak

JUGLANDACEAE
- Juglans cincerea - butternut
- Carya cordiformis - bitternut hickory

OLEACEAE
- Fraxinus nigra - black ash
- Fraxinus pennsylvanica - green ash

ROSACEAE
- Spirea alba - meadow sweet
- Crataegus sp. - thornapple
- Rubus allegheniensis - blackberry
- Rubus idaeus - red raspberry
- Rubus oxidentalis - black raspberry
- Prunus americana - American plum
- Prunus pennsylvanica - pin cherry
- Prunus serotina - wild black cherry
- Prunus virginiana - choke cherry

RUBIACEAE
- Mitchella repens - partridgeberry

RUTACEAE
- Xanthoxylum americanum - prickly ash

SALICACEAE
- Salix Bebbiana -
- Salix discolor - pussy willow
- Salix fragilis - crack willow
- Salix rigida -
- Populus grandidentata - large-toothed aspen
- Populus tremuloides - quaking aspen

SAXIFRAGACEAE
- Ribes cyanosbati -
- Ribes hirtellum - smooth gooseberry
- Ribes rotundifolium -

THYMELACEA
- Dirca palustris - leatherwood

TILIACEAE
- Tilia americana - basswood

ULMACEAE
- Ulmus americana - American elm
- Ulmus rubra - slippery elm
- Ulmus thomasii - cork elm

VITACEAE
- Parthenocissus quinquenfolia - Virginia creeper

EXHIBIT 33

FERNS AND FERN ALLIES OF THE OPEN PIT AREA

POLYPODIACEAE
- Pteridium aquilinum - bracken fern
- Adiantum pedatum - maidenhair fern
- Atherium Felix - femina - lady fern
- Dryopteris cristata - crested fern
- Dryopteris spinulosa - florist fern
- Dryopteris phegopteris - long beech fern
- Dryopteris disjuncta - oak fern
- Onoclea sensibilis - sensitive fern
- Pteretis pennsylvanica - ostrich fern

OSMUNDACEAE
- Osmunda claytoniana - interrupted fern
- Osmunda cinnamomea - cinnamon fern

OPHIOGLOSSACEAE
- Botrychium virginianum - rattlesnake fern

LYCOPODIACEAE
- Lycopodium lucidulum - shining clubmoss
- Lycopodium obscurum - groundpine (flatbranch)
- Lycopodium annotinum - bristly clubmoss
- Lycopodium complanatum - groundpine

EQUISETACEAE
- Equisetum hymelae - tall scouring-rush

EXHIBIT 34

AVERAGE METAL CONCENTRATIONS IN VEGETATION
DOWN GRADIENT OF THE WASTE CONTAINMENT AREA

Plant Species	Transect Number I			II			III			IV			V			VI		
	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn	Cu	Pb	Zn
Canada thistle	110	42	300							70	47	306						
Dandelion	134	63	515															
Cattail				47	47	249	52	48	266				48	37	273	72	36	244
Alder				249	95	1083	132	114	1010	279	47	749	153	92	870	196	105	1139
Red-Osier Dogwood				42	68	231	46	52	282	41	60	182	35	60	182	85	67	356

Note: All concentrations in parts per million.

EXHIBIT 35

SPECIES LIST
ALL MAMMALS OBSERVED AND/OR TRAPPED
Interval 9-16-72 - 6-10-73

Family	Common Name	
Canidae	Red fox	Vulpes fulva
Castoridae	Beaver	Castor canadensis
Cervidae	White-tailed deer	Odocoileus virginianus
Cricetidae	Deer mouse	Peromyscus sp.
	Meadow vole	Microtus pennsylvanicus
	Muskrat	Ondatra zibethica
	Red-backed vole	Cletherionomys grapperi
	White-footed mouse	Peromyscus leucopus
Felidae	Bobcat	Lynx rufus
Leporidae	Snowshoe hare	Lepus americanus
Mustelidae	Badger	Taxidea taxus
	Mink	Mustela vison
	River otter	Lutra canadensis
	Striped skunk	Mephitis mephitis
	Weasel	Probably three species but Mustela erminea positive
Procyonidae	Raccoon	Procyon lotor
Sciuridae	Eastern chipmunk	Tamias striatus
	Least chipmunk	Eutamias minimus
	Franklin's ground squirrel	Citellus franklinii
	Thirteen-lined squirrel	Citellus tridecemlineatus
	Northern flying squirrel	Glaucomys sabrinus
	Southern flying squirrel	Glaucomys volans
	Eastern gray squirrel	Sciurus carolinensis
	Red squirrel	Tamisciurius hudsonicus
	Woodchuck	Marmota monax
Soricidae	Masked shrew	Sorex cinaerious
	Short-tailed shrew	Blarina brevicauda
Talpidae	Starnose mole	Condylura cristata
Zapodidae	Meadow jumping mouse	Zapus hudsonius
	Woodland jumping mouse	Napaeozapus insignis

EXHIBIT 36

COMPOSITE BIRD SITING LIST
(and where observed)

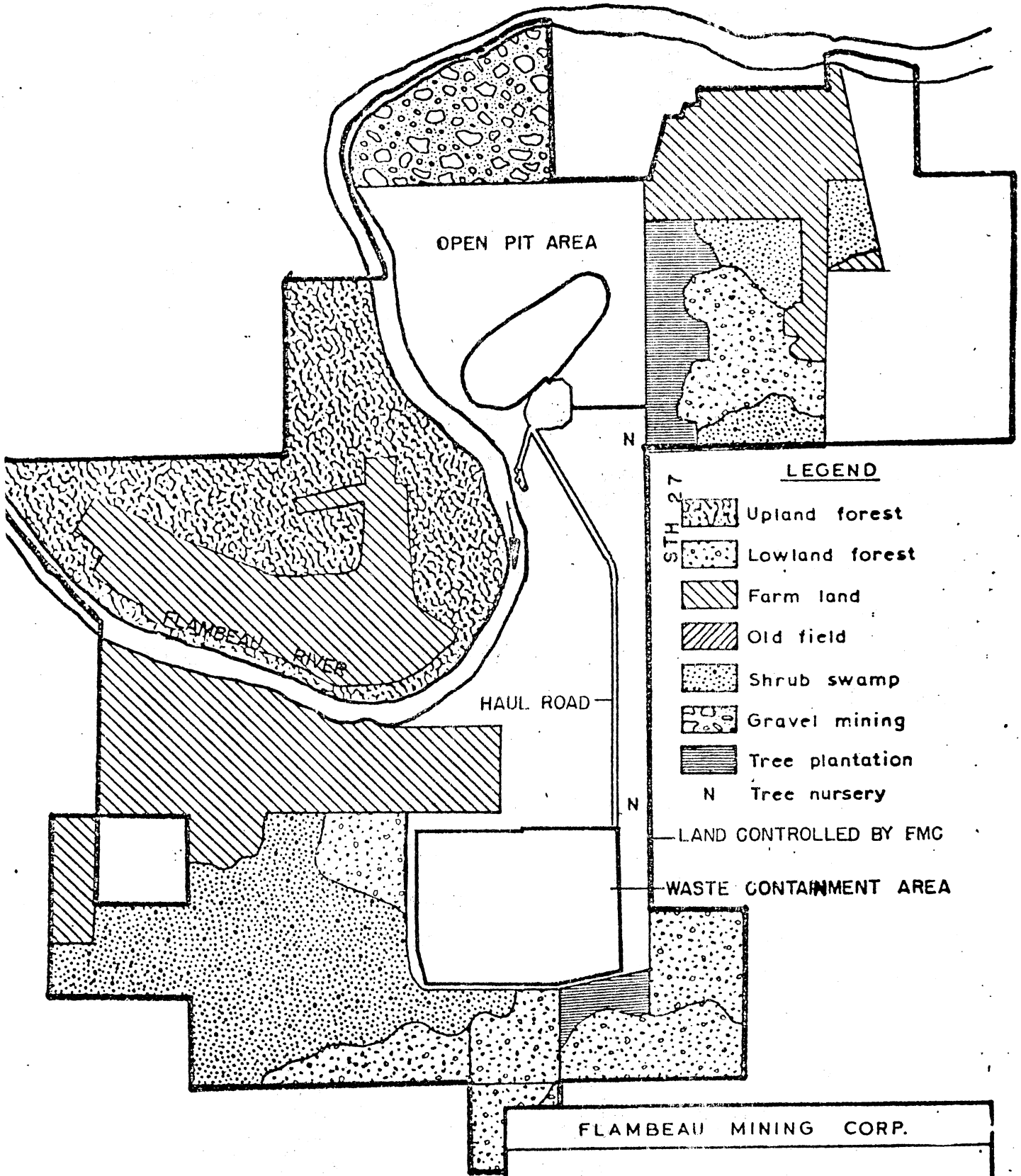
Name	Pit Area	Road Side	Name	Pit Area	Road Side
Grebe, Horned	x		Brown Trasher		x
Grebe, P-b	x		Robin	x	x
Heron, G-b		x	Veery	x	x
Bittern, Am.		x	Bluebird, East.	x	x
Duck, Wood	x	x	Kinglet, G-c	x	
Duck, Am-Gold-eye	x		Waxwing, Cedar		x
Duck, Buf.-head	x		Starling	x	x
Hawk, S-s		x	Vireo, R-e	x	x
Hawk, B-w		x	Vireo, Warbling		x
Hawk, Marsh		x	Warbler, Yellow	x	x
Hawk, Sparrow		x	Warbler, Y-th	x	x
Rail, Sora		x	Warbler, C-nut-sided	x	x
Killdeer	x	x	Oven-bird	x	x
Woodcock		x	Redstart		x
Snipe, Wilson's		x	Sparrow, House		x
Plover, Upland		x	Bobolink	x	x
Tern, Black		x	Meadowlark, East.	x	x
Dove, Rock		x	Meadowlark, West.	x	x
Dove, Mourning	x	x	Blackbird, R-w	x	x
Cuckoo, B-b		x	Oriole, Balt.		x
Nighthawk		x	Blackbird, Rusty	x	x
Swift, Chimney	x	x	Blackbird, Breu.		x
Kingfisher, B.	x	x	Grackle	x	x
Flicker, U-s	x	x	Cowbird	x	x
Woodpecker, R-h	x	x	Tanager, Scar.		x
Sapsucker, Y-b	x	x	Grosbeak, R-b		x
Woodpecker, Hairy	x	x	Bunting, Indigo		x
Woodpecker, Downy	x	x	Grosbeak, Eve.		x
Kingbird, East.	x	x	Finch, Purple		x
Flycatcher, Crest.		x	Goldfinch	x	x
Phoebe, East.		x	Towhee	x	x
Swallow, Tree	x	x	Sparrow, Sav.	x	x
Swallow, Barn		x	Sparrow, Le Conte's		x
Swallow, Cliff		x	Sparrow, Vesp.	x	x
Martin, Purple		x	Junco, S-cl	x	x
Blue Jay	x	x	Sparrow, Tree	x	x
Crow	x	x	Sparrow, Chip.	x	x
Chickadee, Bl-c	x	x	Sparrow, Cl-c		x
Nuthatch, W-b	x	x	Sparrow, W-th	x	
Wren, House		x	Sparrow, Fox	x	x
Wren, S-b Marsh	x	x	Sparrow, Swamp	x	x
Catbird	x	x	Sparrow, Song	x	x

EXHIBIT 37

FISH OF THE FLAMBEAU RIVER BETWEEN LADYSMITH AND THE THORNAPPLE DAM

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

EXHIBIT 38



FLAMBEAU MINING CORP.

PROPOSED LAND USE
Proposed Project Site
Grant Township, Rusk County, Wisconsin

SCALE: 1" = 2000' DATE Nov. 1975
DRAWN BY: GLB MAP NO.

EXHIBIT 39

ESTIMATED AVERAGE YEARLY SALARIES AND INCOME TAX FOR CONSTRUCTION PERIOD

Class of Worker	Average Number Employed	Average Yearly Income	Yearly State Personal Income Tax	Total Yearly State Personal Income Tax
Construction and operating	120	$15,800	$898	$107,760
Service employees during construction period	34	7,500 (est.)	255	8,670
Total yearly				$116,430
Construction period 2-year total				$232,860

ESTIMATED AVERAGE YEARLY SALARIES AND INCOME TAX FOR OPERATING PERIOD

Class of Worker	Number Employed	Average Yearly Income	Yearly State Personal Income Tax	Total Yearly State Personal Income Tax
Construction crew including supervision and administration	78	$13,077	$654	$51,012
Service employees during operating period	22	7,500 (est.)	255	5,610
Operating period yearly total				$56,622

1974 FMC REAL ESTATE TAXES

		Land	Improvements	Total
Full value as determined by Department of Revenue		$1,248,675	$ 51,600	$1,300,275
Local assessment rate (83%)		1,036,400	428,250	1,464,650
Mill rate .036679 - Total Tax				53,722
Distributed as follows:				
State	.000241		$ 353	
Reassessment	.0014045		2,057	
County	.006791		9,946	
School - Ladysmith	.028918		42,355	
Vocational school	.0015995		2,343	
Grant Township	.001		1,565	
Gross tax	.039954		$58,519	
Less state tax credit	.003275		4,797	
Net real estate tax	.036679		$53,722	

EXHIBIT 40

ESTIMATED FMC REAL ESTATE TAXES DURING OPERATIONS

	Land	Improvements	Total
Estimated full value	$2,250,000	$1,050,000	$3,300,000
Estimated local assessment rate (83%)	1,867,500	871,500	2,739,000
Mill rate .036679 - Total tax			100,464

Distributed as follows:

State	.000241	$ 660
Reassessment	.0014045	18,294
School - Ladysmith	.028918	79,206
Vocational school	.0015995	4,381
Grant Township	.001	2,739
Gross tax	.039954	$109,434
Less state tax credit	.003275	8,970
Net real estate tax	.036679	$100,464

EXHIBIT 41

EXHIBIT 42

ESTIMATED EMPLOYMENT INCREASE IN RUSK COUNTY AS A RESULT OF THE FLAMBEAU PROJECT

A	B	C	D	E	F	G	H
Elapsed Time After Start of Construction	Total Construction Crew Employees	Total Operating Crew Employees	Total Employees on Project Derived from Residents of County	Total Added Service Employees as Result of Project	Total Added Service Employees from Residents of County	Total New Employees From Out of County	Cumulative Population Increase of County as Result of Project
1 month	8	5	2	4	3	12	28
2	29	5	5	10	8	31	59
3	34	5	6	11	8	36	68
4	60	5	10	18	14	59	105
5	80	5	13	24	18	78	137
6	90	5	14	27	20	88	154
7	100	5	16	29	22	96	166
8	100	5	16	29	22	96	166
9	125	5	20	36	27	119	204
10	155	5	24	45	34	147	250
11	170	5	27	49	37	160	272
12	185	5	29	53	40	174	295
13	210	5	32	60	45	198	335
14	220	5	34	63	47	207	351
15	193	10	35	57	43	182	309
16	163	15	33	50	38	157	272
17	140	20	33	45	34	138	245
18	77	78	59	43	32	107	245
19	40	78	53	33	25	73	188
20	30	78	51	30	23	64	172
21	15	78	49	26	20	50	150
22	5	78	48	23	17	41	136
23	5	78	48	23	17	41	136
24 months	5	78	48	23	17	41	136
Average	93	27	29	34	25	100	176
3 years - 12 years	0	78	47	22	17	36	127

EST. RANGE FOR ZERO DRAWDOWN
MAX. LIMIT ZERO DRAWDOWN
MIN. LIMIT ZERO DRAWDOWN
ULTIMATE PIT LIMIT
DRAINAGE DITCH
PLANT SITE
FLAMBEAU RIVER
RIVER
LEGEND
DOMESTIC WELL (W-)
PUMPING TEST WELL
MONITOR WELL
SOIL & PERMEABILITY TEST HOLE
GROUND WATER GRADIENT CONTOUR
ESTIMATED SOIL STRATA CONTACTS
PIPE LINE

EXHIBIT 43

EXHIBIT 44

PERMEABILITIES AND EXPECTED TRAVEL TIME OF TAILINGS WATER THROUGH SELECTED BASE SOILS UNDER THE WASTE CONTAINMENT AREA

Boring Number	Sample Tested	Depth & Thickness of Sample Tested	Soil Type(1)	Averaged cm/sec.	Permeabilities feet/day(2)	Porosity(3)	Thickness of Soil Layer to Dissipate Head(4)	Time in days required for water(5) to pass through soil stratum(a) at various heads in days. 1'	6'	10'	25'	50'
ST-21-27	4	6' to 7'	SM	6.5×10^{-7}	1.842×10^{-3}	0.23	0 to 7'	6100	1017	610	244	122
ST-21-33	2	2' to 3.5'	ML	1.1×10^{-6}	3.11×10^{-3}	0.33	0 to 3.8'	1550	258	155	62	31
ST-21-38	1	0 to 2'	OL	( )								
	2	2' to 4'	SM-ML	( )								
	3	4' to 6'	SM	(1.7×10^{-6})	4.81×10^{-3}	0.28	0 to 8'	3750	625	375	150	75
	4	6' to 8'	SM	( )								
ST-21-53	2	2' to 4'	ML	6.6×10^{-8}	1.87×10^{-4}	0.28	0 to 4'	2400	400	240	96	48
ST-21-40(7)	1	0 to 2'	ML	( )								
	2	2' to 4'	ML	(9.1×10^{-7})	2.57×10^{-3}	0.26	0 to 11.5'	13,350	2,225	1,335	534	267
	5	10' to 11.5'	SM	( )								

Notes:

1. As per Unified Soil Classification System
2. Where number of strata were tested, the arithmetic average was calculated. Please see STS Report 4970, dated 12-12-72, Part I, Figure 8.
3. Total porosity
4. Calculations of travel time based on assumption that all of head is dissipated through this thickness. Thus, the calculations may be conservative.
5. Calculations of travel time based on following forumulas:
   a. $v_{seepage} = v_s \frac{\text{discharge velocity}}{\text{porosity}} = v \frac{\text{discharge}}{n} = \frac{v_d}{n}$
   b. $v_d = ki$
   c. $v_s = \frac{ki}{n}$
   d. $t = \text{time} = \text{thickness} / v_s$
   (Reference: Seepage, Drainage & Flow Nets, Cedergren, Harry R. (John Wiley & Sons, 1967)
6. The analysis assumes that there will be no self-sealing in the waste containment area from slimes. (However, experience with existing tailings ponds suggest that slimes accumulation will act to seal the pond bottom so that leakage will be minimized.
7. This soil would not be flooded until more than 6 feet of tailings and water have accumulated in the waste containment area.

Source: Soil Testing Services of Wisconsin
January 15, 1976

ESTIMATED ACREAGE OF CHANGED VEGETATION COMMUNITIES DUE TO CONSTRUCTION OF MINE

Mine Facility Description	A. Mixed Deciduous-Coniferous Lowland	B. Shrub Swamp Type 6 Wetland	C. Mixed Deciduous-Coniferous Upland	D. Sedge Meadow Type 2 Wetland	E. Old Field	F. Bog	G. River Basin	H. Wooded Swamp	I. Producing Agricultural Field	Acreage
Total acres with changed use	9	7	70	12.3	12.9	0	0	0	200.8	312
Open pit			41						14	55
Concentrator plant and operation buildings									3	3
Magazines and access road			4						1	5
Waste containment area		5		11					140	156
Soil (till) stockpile		2	1	1					32	36
Railroad siding and loading facilities	9			.3	.4				1.8	11.5
Haul road			7						9	16
Public observation point, parking lot and trail					1.5					1.5
Gravel pit (contingent on second phase shaft mine)			17		11					28

EXHIBIT 45

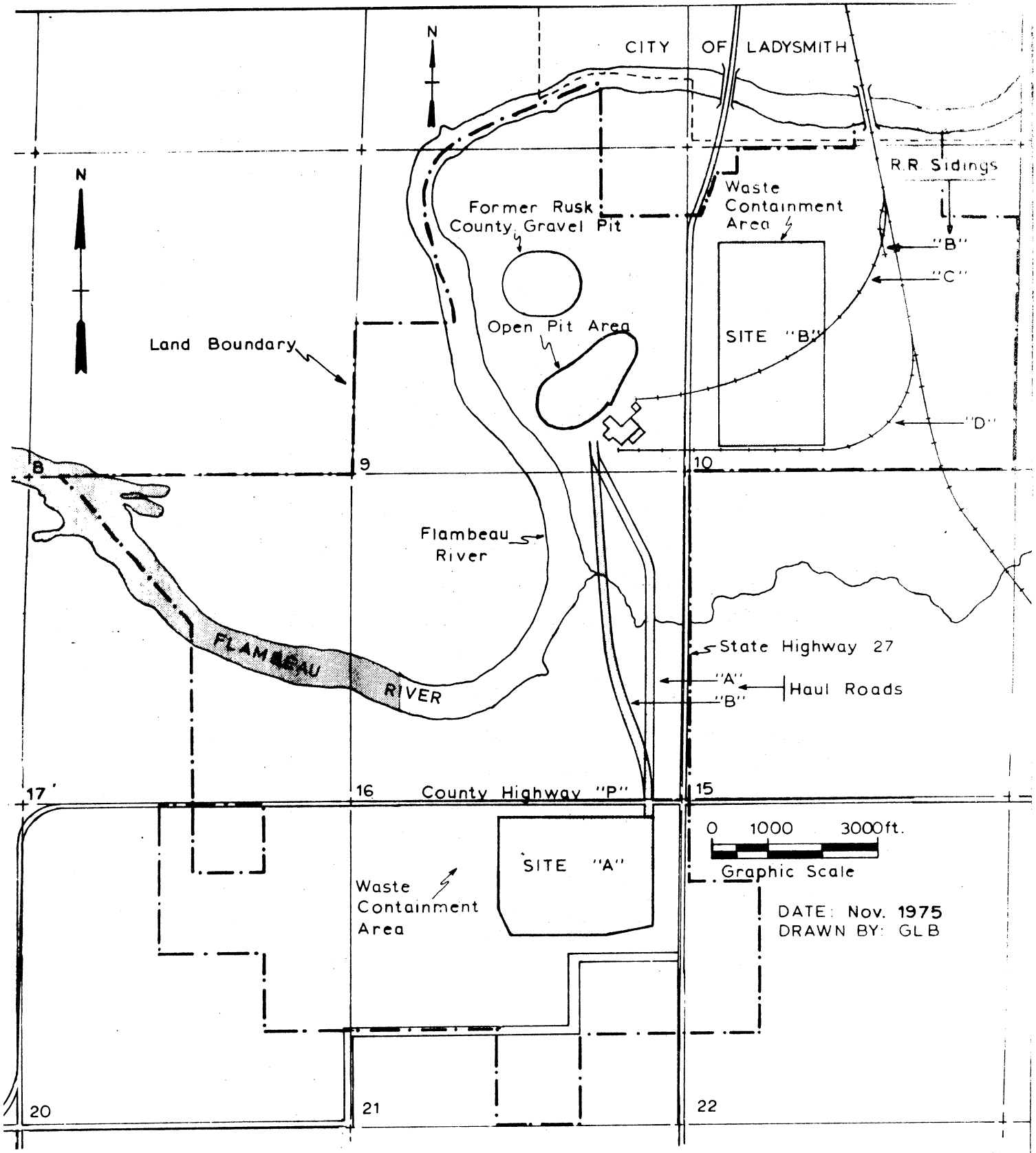
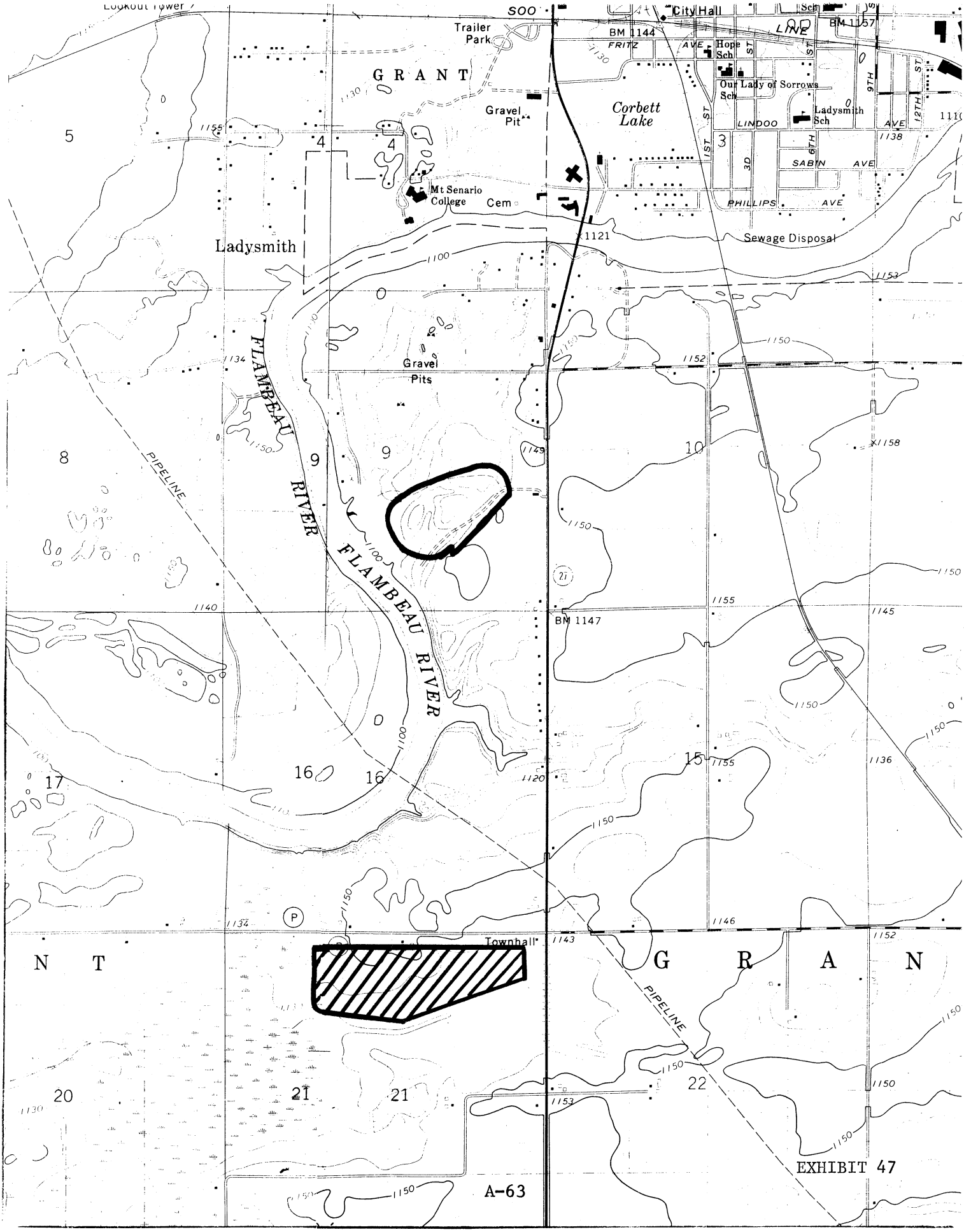


EXHIBIT 46

ALTERNATIVE

WASTE CONTAINMENT AREAS
RAILROAD SIDINGS
AND
HAUL ROADS


Lookout Tower
SOO
City Hall
Sch
BM 1144
BM 1157
LINE
Trailer Park
GRANT
FRITZ
AVE
Hope Sch
ST
Our Lady of Sorrows Sch
9TH
12TH
Gravel Pit
Corbett Lake
Ladysmith Sch
LINDOO
AVE
1138
1ST
6TH
3D
SABIN
AVE
PHILLIPS
AVE
Mt Senario College
Cem
Ladysmith
1121
Sewage Disposal
1100
1153
1150
1152
Gravel Pits
FLAMBEAU RIVER
1134
PIPELINE
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1158
1140
BM 1147
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1136
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1143
Townhall
GRANT
PIPELINE
1130
1153
EXHIBIT 47
A-63

THE STATE HISTORICAL SOCIETY OF WISCONSIN

816 STATE STREET / MADISON, WISCONSIN 53706 / JAMES MORTON SMITH, DIRECTOR

State Historic Preservation Office

July 20, 1976

Mr. William L. Goetz
Chief, Construction-Operations Division
St. Paul District, Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

SHSW 0408-76
Re: NCSED-ER

Dear Mr. Goetz:

We have reviewed the archeological survey report of the proposed Flambeau Mining Corporation project prepared by Mr. Joseph Tiffany.

We concur with the findings of Mr. Tiffany, and we recommend that the alternate route of the railroad spur not be selected for construction.

We see no reason why the Corps of Engineers should not issue the proposed permit (NCSCO-S 76-53-317-000-01) to the Flambeau Mining Corporation. There are no sites of historical or architectural significance in the project area that are listed on, or eligible for, the National Register of Historic Places. With the one exception, stated above, this same is true for archeological sites.

Please inform us when a final decision is reached on the location of the railroad spur.

Sincerely,

James Morton Smith
State Historic Preservation Officer

JMS:rdc

EXHIBIT 48

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Anthony S. Earl
Secretary

BOX 450
MADISON, WISCONSIN 53701

July 16, 1976

IN REPLY REFER TO: 2700

Mr. Robert F. Post
Chief, Environmental Res. Branch
St. Paul Dist., Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, MN 55101

Dear Mr. Post:

Reference is made to your July 9, 1976 letter to Mr. Carroll D. Besadny regarding the EIS which the Corps of Engineers is preparing on Flambeau Mining Corporation's proposed copper mine near Ladysmith, Wisconsin.

You requested the Department's views on the acceptability of an alternative alignment of the proposed waste containment area, as shown on the map attached to that letter.

Flambeau Mining Corporation has never submitted a proposal for such a configuration to us. They indicate that they do not presently have the construction plans, seepage rate calculations, and other data which would be required for us to make a meaningful determination of the acceptability of such an alternative configuration.

In the company's EIR submitted to the Department in June of 1974, they had included a portion west of the northwest portion of the alignment shown in the Department's EIS, published in February, 1976. Information submitted with the EIR indicated that this western extension would contain soils of significantly higher permeability than in the balance of the area, with resulting greater hazard of seepage of leachate to the ground water. This more permeable western extension, which was subsequently removed from the proposal by the mining company, would again be included in the alternative alignment shown on the map attached to your letter. Obviously, this would make the alternative alignment much less desirable, without extensive modifications such as cutoff trenches and incorporation of a clay liner in the WCA.

Based upon information you provided to us, it appears that the surface area of the structure would be considerably less than for the alignment shown in the EIS. Thus, in order to accommodate the same amount of waste material, the alternative structure would have to be considerably higher than than proposed in the EIS.

When and if the necessary information for any alternative proposal is submitted to us, we will proceed with a detailed review to determine its acceptability.

Sincerely,
Bureau of Water Regulation & Zoning

Floyd F. Stautz, P.E.
Director

GHR:kb

cc: Ed Maye
R. Henneger
D. Gebken
D. Nichols
P. Didier
Northwest District

EXHIBIT 49

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
LWR-PER

JUL

Colonel Forrest T. Gay, III
District Engineer
U.S. Army Corps of Engineers
St. Paul
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Gay:

This refers to Public Notice NCSCO-S (76-53-317-000-01), dated April 16, 1976, concerning an application from Flambeau Mining Corporation, Ladysmith, Wisconsin to deposit approximately 4,100,000 cubic yards of mine tailings from an open pit copper mine which is to be located immediately south of Ladysmith, Wisconsin. The disposal site would cover an area of 156 acres, of which 19 acres is wetland with drainage to the Flambeau River. The project is located in Section 21, T. 34 N., R. 6 W., Rusk County, Wisconsin.

These comments have been prepared under the authority of and in accordance with provisions of the U.S. Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969. The application and the Wisconsin EIS have been reviewed and discussed with the Wisconsin Department of Natural Resources personnel and several mitigating measures have been approved between the Wisconsin Department of Natural Resources and the Flambeau Mining Corporation.

It appears that the best available site for the waste containment structure is the proposed site. No other site is suitable which contains the low permeability of the subsurface soils that would prevent toxic mine tailings from leaching into the surrounding wetlands and the Flambeau River.

The proposed disposal site contains 19 acres of a Type VI shrub swamp (U.S. FWS, Circular 39), of value to several wildlife species. Construction of the waste containment dike will result in the loss of this shrub swamp.

Although a planned network of nature trails and the establishment of an environmental visitors' center on the applicant's property would not replace the shrub swamp per se, these facilities should be built to provide additional outdoor areas, environmental education, and outdoor recreation for the public, at no fee.

EXHIBIT 50

The U.S. Fish and Wildlife Service recommends that any permit issued contain the following stipulations:

1. Free public access be provided to areas which pose no safety hazards to human health.

2. Nature trails be developed to encourage environmental education and provide outdoor areas and opportunities for public recreation.

3. An environmental education visitors' center be developed to foster appreciation of the environment.

Sincerely yours,

Acting Regional Director

cc: Secretary, Wisconsin Department of Natural Resources, Madison
Bill Richie, NW District WDNR, Spooner
U.S. EPA, Federal Activities Branch, Chicago
Director, BOR, Ann Arbor

EXHIBIT 50

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

IN REPLY REFER TO:
AFA-SE

Mr. Robert F. Post
Chief, Environmental Resources Branch
Engineering Division
St. Paul District
Corps of Engineers
Department of the Army
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Attn: Mr. Gary Palesh

Dear Mr. Post:

In response to your letter of July 15 (NCSED-ER), Mr. Engel of my staff called Mr. Palesh and discussed endangered species found within the Flambeau Mining Project area. The only species currently listed by the Fish and Wildlife Service and found within the area is the Arctic peregrine falcon. It is possible this species passes through the area during spring and fall migrations.

The Federal Register for June 16, 1976 on Plants proposes a number of plant species for the endangered species list, some of which may be found within the area of concern. Consideration for these species and the possibility of listing them as endangered should be included in all planning efforts.

We hope this information is of assistance to you in development of the environmental impact statement and look forward to the opportunity of reviewing the document.

Sincerely yours,

Assistant Regional Director
Federal Assistance

EXHIBIT 51