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Subsidiary of Kennecott Corporation  
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**Kennecott**

October 3, 1994

Mr. Lawrence Lynch  
Wisconsin Department of Natural Resources  
Mine Reclamation Unit  
P.O. Box 7921  
Madison Wisconsin 53707-7921

Dear Mr. Lynch:

For a number of weeks Flambeau Mining Company has been investigating the feasibility of recovering the ore remaining between the final west wall and the vertical projection of the permitted 140 foot set-back from the Flambeau River. We believe the recovery of this ore is entirely feasible using commonly applied mining methods, without any additional environmental impact.

The attached paper describes the applied methodology, with specific commentary directed toward geotechnical and hydrological aspects.

Approximately 81,000 tons of ore would be extracted representing 4.3% of Flambeau's original ore reserve. There is no associated waste rock being mined. Ore extraction would be sequenced with the progressive deepening of the open pit, thus making it an intermittent process extending over the life of the pit. The total project reserve does not increase beyond the permitted value of 1.9 million tons (plus 10%).

If this ore is not recovered then it will be lost forever once the pit is reclaimed.

While the technical and environmental risk is no greater than what is associated with the mining of the open pit, there is added value to the community in the additional Net Proceeds Tax paid proportional to the ore removed. This additional ore is covered under the provisions of the Local Agreement and specifically the guarantee of Net Proceeds Tax.

Although it is our belief that the recovery of this ore falls within Flambeau's existing permits, we would appreciate your advice as to how best to proceed. We have already made

Mr. Larry Lynch

-2-

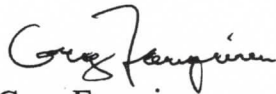
October 3, 1994

presentations to the Local Impact Committee (Sept. 29) and to an informal meeting of Rusk County and Town of Grant Boards (Sept. 21).

If you wish I can arrange to make a presentation to the WDNR and at the same time answer any questions.

Your timely response would be appreciated.

Sincerely,



Greg Fauquier  
General Manager

GF/cg

Attachments

cc: J. Barnes  
L. Cardy-Yates  
A. Christianson  
B. Dukerschein  
P. Kent  
K. Markart  
E. May  
T. Riegel  
Rusk County Zoning  
G. Sevick  
Z. Zavodni

**ENHANCED RESOURCE RECOVERY OF WEST WALL ORE  
FLAMBEAU MINE  
RUSK COUNTY, WISCONSIN**

**PREPARED FOR THE  
WISCONSIN DEPARTMENT OF NATURAL RESOURCES**

**OCTOBER 1994**

# ENHANCED RESOURCE RECOVERY OF WEST WALL, FLAMBEAU MINE, RUSK COUNTY, WISCONSIN

## 1.0 INTRODUCTION

The purpose of the work outlined in the following pages is to recover ore in the west wall of the open pit which would otherwise be lost forever once the open pit has been reclaimed. At today's metal prices the ore is considered to be economically recoverable.

Recovery of the approximate 81,000 tons of ore, would be accomplished by driving short tunnels into the pit wall and immediately backfilling the void with concrete. All the work undertaken is within the presently permitted project area.

The estimate of recovered ore represents approximately 4.3% of the total Flambeau open pit ore reserve of 1.9 million tons.

Technically the project is completely viable. The mining method to be used is known as "under cut and fill", a technique commonly used in mines throughout North America. Following our study of the geotechnical and hydrological characteristics of the west wall, it is our opinion that there are no anomalous features that would preclude the viability of the project. At no time will the tunnels come closer to the river than the vertical projection of the horizontal setback of 140 feet as defined in the Mining Permit.

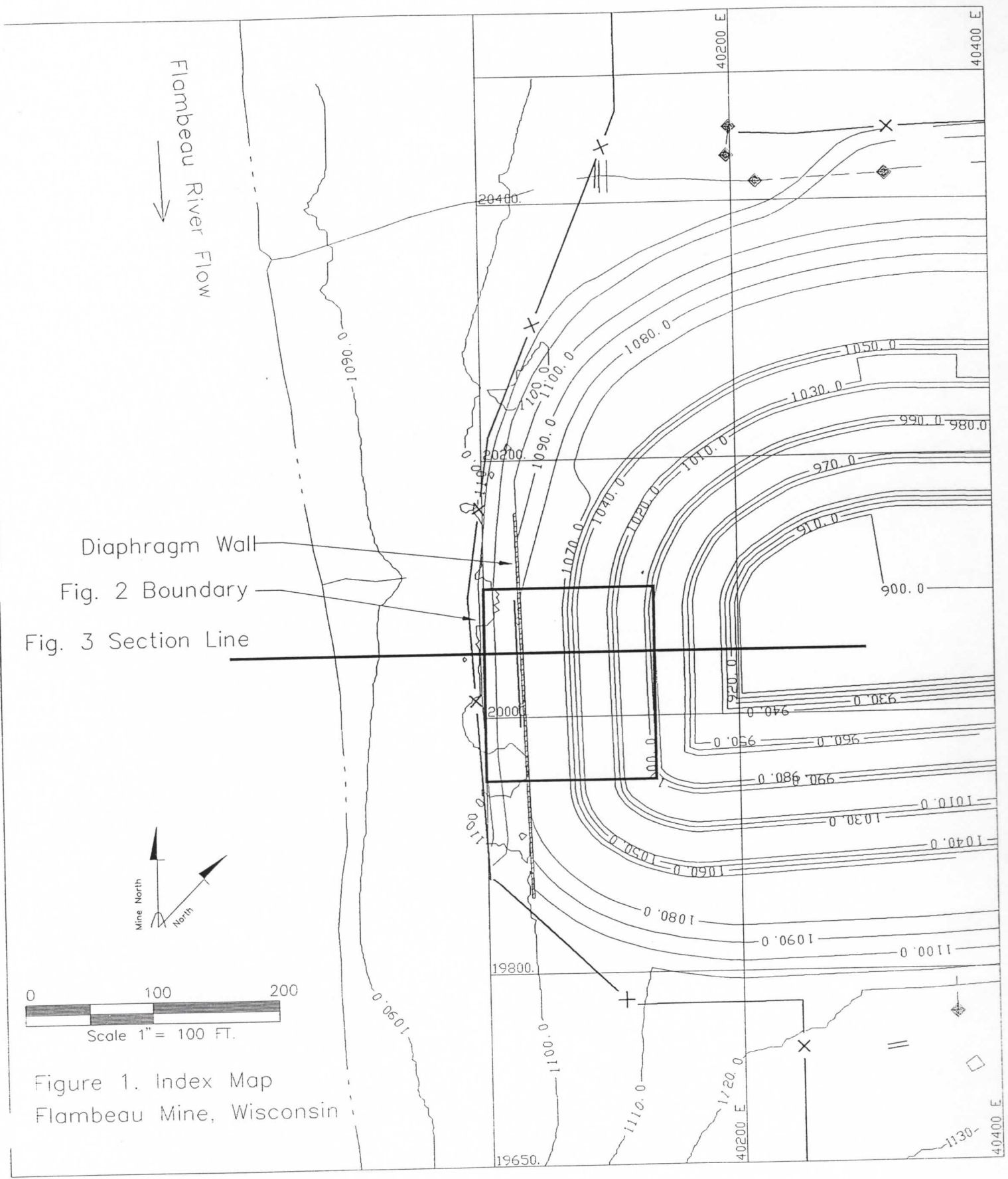
It is our opinion that the project has no greater environmental impact than that which is associated with the mining of the open pit.

As a result of the increased production there is an obvious fiscal benefit to the community in the additional guarantee of Net Proceeds Tax paid by Flambeau. Recall that this guarantee is proportional to the tonnage produced at a rate equivalent to \$2.57 per ton of ore (indexed from 1982 at the CPI). Assuming 81,000 tons was finally recovered, this would equate to \$209,000 in additional payments to the community.

## 2.0 GENERAL GEOLOGY

The ore reserves occur in two sulfide, supergene enriched orebodies designated the A and B lenses (Figure 1 and 2). Both lenses are currently exposed on the west wall of the open pit and extend for an indeterminable distance into the wall. This shallow mineralization does not extend, however, west of the Flambeau River. The northern lens, A, averages about 40 feet in width whereas the B lens is more irregular ranging from 5 feet to 15 feet in horizontal width. Both lenses strike N45°E and dip about 75° to the northwest. Intimately associated with the sulfides especially along the contacts is a hard blocky chert up to 15 feet in width. Much of the chert will be mined since it contains sufficient copper and gold values.





Flambeau River Flow

Diaphragm Wall

Fig. 2 Boundary

Fig. 3 Section Line

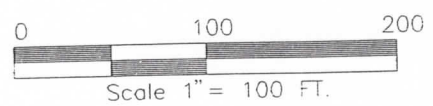
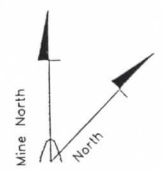


Figure 1. Index Map  
Flambeau Mine, Wisconsin

A well foliated quartz-sericite schist separates and encloses the lenses with a separation distance of about 55 feet. The sulfide and chert ores are generally hard, blocky and competent whereas the schist is foliated, slabby and less hard.

Groundwater follows the foliation planes and horizontal and northwest-striking, steeply dipping joint sets. Water inflow measurements on the 1040 level are about 45 gpm and 65 gpm on the 1030 level. The Flambeau River elevation is about 1085 feet with some of the higher water seeps in the west wall located at the 1059 foot elevation. Some of the water inflow is coming into the pit through the blocky and clay/sericite free orebodies. Replacing the sulfide ores with concrete will make the final open pit more impermeable during backfilling and eventual reclamation. Much of the groundwater flow on the 1040 level has been intentionally created by drilling vertical and horizontal holes into the west wall to lower the water table. These holes are producing about 30 gpm.

### 3.0 EXTRACTION OF WEST WALL MINERALIZATION

#### General

Mining of the west wall reserve will be synchronized with the deepening of the open pit. With each 10 foot bench, approximately five parallel tunnels will be driven into the A lens of the west wall and subsequently backfilled before progressing to the next open pit bench (Figure 2). The number of tunnels on each bench will be determined by the width of the ore lens on that bench, but generally five tunnels will cover the average A lens width of 50 feet. In the case of the B lens, being 5 to 15 feet wide, it is likely only one tunnel will be required.

In the A lens typically, the two outside tunnels are mined first together with the middle tunnel. On completion of mining, these three tunnels are backfilled with concrete. Once the concrete is set, the two remaining tunnels (now positioned as pillars between the backfilled tunnels) are mined and then backfilled. This then completes the process and mining progresses to the next bench.

In this way the tunnels on each successive bench will be mined beneath a "filled" tunnel above, thus the name for the mining method "under cut and fill"; the concrete backfill in the tunnel above becomes the roof for the tunnel below.

#### Mining

The normal cycle of mining and backfilling, as described above, commences from the 1030 level in both lenses. However, due to the pit geometry on the 1030 level and the considered need to leave a rock support for the overlying gossan, the extraction of ore in the A lens will not go beyond the toe of the 1040 bench; that is to say there will be no tunnels mined on the 1030 level in the A lens. As the rock overlying the B lens is considered to be sufficiently competent, the ore can be extracted to within the "140 foot" limitation, thereby requiring short stub tunnels.

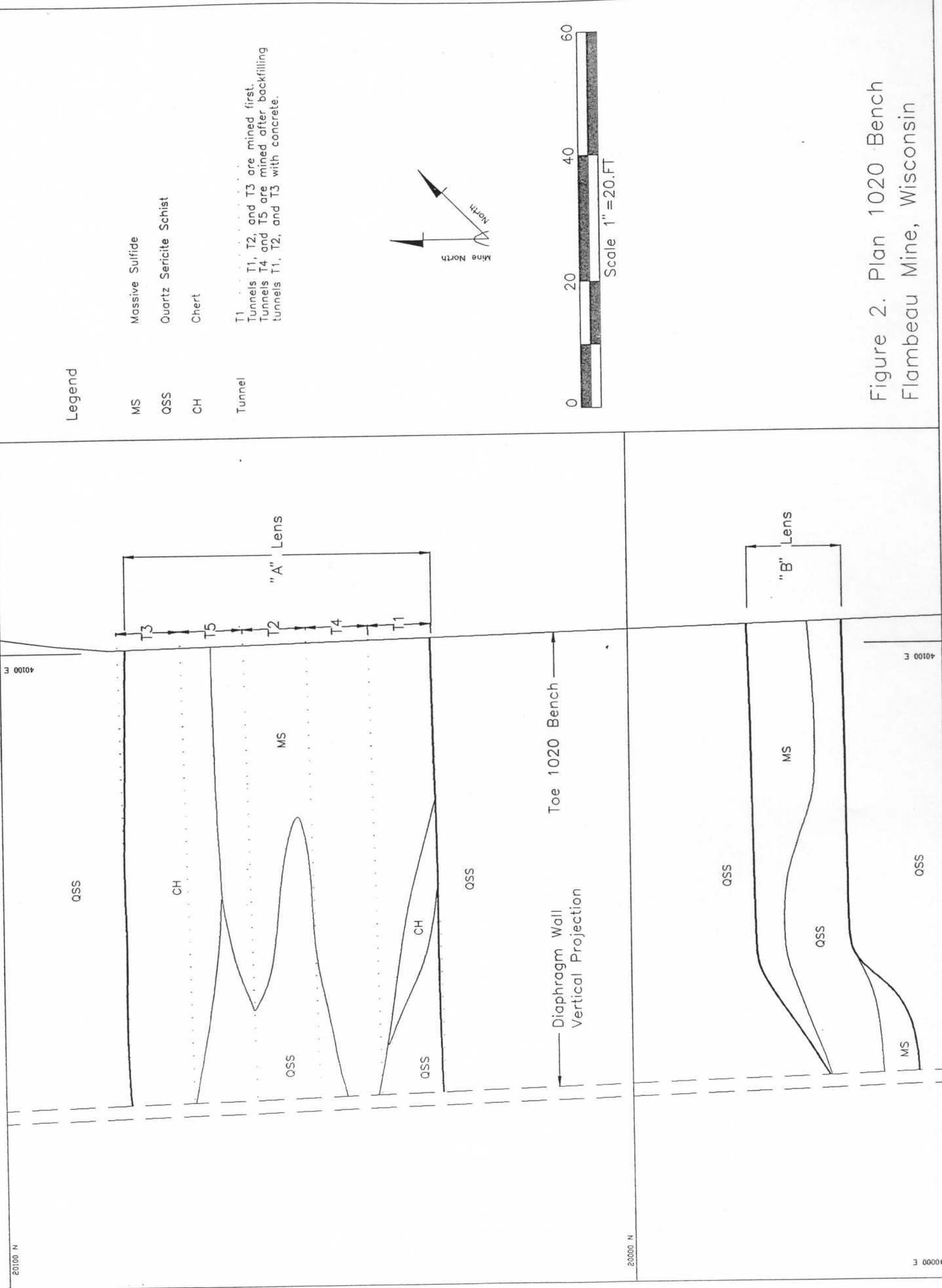


Figure 2. Plan 1020 Bench  
 Flambeau Mine, Wisconsin



Drilling will be done with jacklegs and/or a jumbo drill and a 10 to 12 foot round blasted. Muck grab samples will also be taken. A scooptram or modified small frontend loader will muck out the round to the open pit. The mining subcontractor shall maintain sufficient upgradient necessary to maintain good water drainage. Rock bolting will be conducted when and where necessary and will be based upon visual wall inspection and detailed geological mapping. Back bolting will not generally be required due to backfilling with concrete except where:

- a) the upper 1020 bench in the A lens and 1030 bench B lens penetrates into the west wall a distance of 44 feet per heading; and
- b) the west end of some headings that locate ore further west than the overlying bench.

Rock bolting with or without mesh could be required along the hangingwall and footwall of the two orebodies depending on the rock strength.

Lateral extent and control of headings is important since mining is only permitted up to within 140 horizontal feet of the Flambeau River. Thus, tunnelling cannot proceed west of a vertical plane extending below the east edge of the diaphragm wall (Figure 3). Survey controls shall be provided on a regular basis for maintaining the work activities within the permit boundaries and for monthly progress and payment schedule reporting.

Mining is planned to occur between November 1994 and November 1997 with ore extraction intermittent since these activities will depend on the vertical progression of the open pit (Table 1). It is proposed to extract the west wall ore now in order to take advantage of existing freight and processing contracts rather than wait until the open pit mining terminates and favorable contracts expire. Mining will probably require two shifts for heading advancement to synchronize with the open pit schedule, however, blasting will be conducted during daylight hours only. The labor force will consist of approximately 5 to 7 persons, all of whom would likely be "non-local" by definition<sup>1</sup> as specified in the Local Agreement. The project will remain in compliance of the "75% local content" clause in the Local Agreement (Section 12).

Water control will be important with seep locations and amounts noted during routine geological mapping. Additionally, geotechnical features will be noted and any irregularities analyzed. A horizontal pilot hole will be drilled at least two full rounds ahead. Drilling penetration rates and any water inflows will be noted. Drainage control and grouting may have to be considered in areas of higher than expected water inflows.

It is important to note that should circumstances warrant, mining could be suspended, indefinitely if necessary, at any point in the cycle.

Ventilation will be via suspended inflatable conduit with a forced air fan at the portal installed

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<sup>1</sup> Local Agreement between Kennecott and the local governments, August 1988



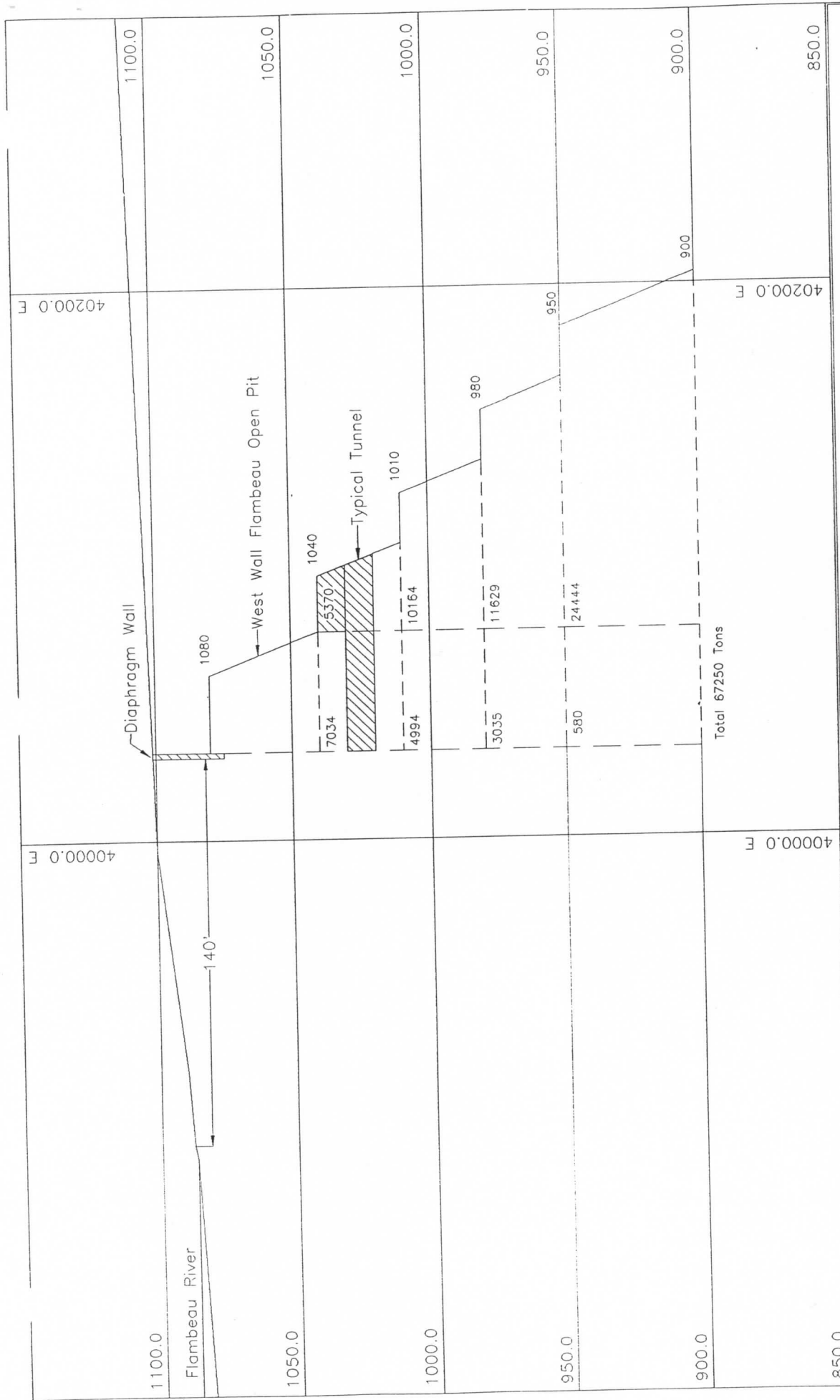
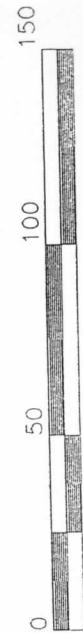


Figure 3. "A" Lens Proven Reserves, 20,050 N  
 Flambeau Mine, Wisconsin



Scale 1" = 50.FT

with a silencer. Electrical heating units will be necessary to warm the air intake during mid-winter.

Special provisions will be made to supply water and concrete to the mining subcontractor during periods of extreme cold weather. This will require heating devices and possible portal curtains.

Concrete shall be supplied by a local subcontractor in accordance with standard specifications published in 1987 by the American Concrete Institute for cold weather concreting. Routine testing will be performed using ASTM procedures as well as throughout the project life. Concrete will need to meet a minimum 1,000 psi during a 14 to 20 day cure time. Fly-ash content, curing time, and heat buildup will also be carefully monitored. An inclined concrete delivery pipe system could be installed in each overlying backfill pour for increasing backfilling efficiency and reducing void space at the back. Another possibility is the use of shotcreting equipment to assist in correct and efficient placement of concrete.

#### Geotechnical Considerations

Two areas of evaluation are host rock wall stability, and excessive water inflow.

In general, the massive sulfide lenses are hosted by competent blocky chert units. As mining progresses with depth the chert content decreases with an increase in well foliated, slabby quartz-sericite schist. The quartz-sericite schist becomes the dominant host rock below the 980 catchment bench. The effects of supergene rock alteration should be decreasing in intensity below the 980 level with the rock strength increasing. Detailed geological mapping and necessary rock bolting and possible wire meshing will assist in controlling any potential rock sloughing.

Water flow observations will be conducted on a regular basis to monitor inflow paths and amounts. Drill round pilot holes will be monitored to gain an understanding of expected water inflows. Excessive flows could signify premature termination of the heading or utilization of grouting equipment. Adequate water drainage methods will need to be employed before backfilling to ensure the concrete backfill meets specified strength criteria.

A "french" drain constructed of broken ore from the last round or two at the end of the tunnel will be considered with possible laying of black plastic on top of the broken muck. Wire mesh could be laid on top of the broken material and possibly a 2 to 3 foot layer of higher compressive strength concrete laid on top of the mesh. These procedures would improve drainage, facilitate pouring of concrete and provide a clean high strength back.

#### 4.0 INFRASTRUCTURE

The infrastructure requirements for this work can be easily accommodated by existing mine facilities.

Operations water to cool the drills will come from a specifically built shallow sump located on the open pit floor in an area noted to make water. Having the water sump lower than the mined tunnels will facilitate dewatering equipment and lines during down times. Electricity for the operations to provide light, power the ventilation fans and possibly the drills will be supplied from a substation located on the southwest corner of the pit perimeter. An adequately covered power cable will be laid on the surface and over the pit walls to reach the 900 level.

Stick powder or packaged emulsion explosives will probably be used due to the expected wet conditions. A 10,000 pound magazine will be placed within the existing magazine earthworks, which will meet the needs of both the open pit and west wall contractors.

A single bay maintenance shop will be provided in the east end of the H&H building that is located within the east boundary of the permitted mine area. This area will be partitioned off and heated by propane gas. Spent hydrocarbons, filters and cleansing fluids will be stored in dedicated containers and disposed of by the subcontractors that service the existing open pit maintenance shop facilities.

A field office, change room-dry, and bathroom facilities will be established in the existing H&H building adjacent to the maintenance bay. A lamp room will also be in the field office together with a personalized tag board for workers to use when they commute to the west wall and return at the end of the shift.

The above west wall facilities will not be used continuously over the three year period but only on an as-needed basis as determined by the mining schedule in Table 1. All these facilities will be part of the final mine site reclamation as approved in the Mining Permit.



TABLE 1

ESTIMATED SCHEDULE  
 ENHANCED RESOURCE RECOVERY PROJECT  
 FLAMBEAU MINE, RUSK COUNTY, WISCONSIN

YEAR	MONTH	BENCH	TOTAL FOOTAGE OF HEADINGS PER BENCH		
			A LENS	B LENS	A & B
1994	September	1030	0	45	45
	October	1020	355	70	425
	November	1010	375	60	435
	Subtotal 1994:		730	175	905
1995	January	1000	465	80	545
	Subtotal 1995:		465	80	545
1996	April	990	460	100	560
	October-November	980	380	85	465
	December	970	440	105	545
	Subtotal 1996:		1,280	290	1,570
1997	March	960	355	130	485
	May	950	325	40	365
	June	940	440		440
	July	930	455		455
	August	920	430		430
	October	910	455		455
	November	900	195		195
	Subtotal 1997:		2,655	170	2,825
	TOTALS:		5,130	715	5,845