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Dear Librarian:

Please place the enclosed document with the rest of the Exxon Crandon Mine Environmental Impact Report (EIR) material. This document represents revised portions of Chapters 4.1.8 and 4.2.8 of the EIR. It includes additional information regarding noise monitoring locations and Exxon's analysis of the potential noise impacts which would result from construction and operation of the firm's proposed Crandon Mine.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

BT/CN/bjb

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4.1.8 Noise

The range of sound pressures that can be heard by humans is very large, varying from sounds that are barely audible to sounds that are so loud as to be painful. The decibel (dB) notation system uses logarithms to compress this wide range of sound pressures to convenient quantities called sound pressure levels (Beranek, 1971).

$$\text{Sound pressure level (dB)} = 20 \log_{10} \frac{P}{P_o}$$

where: P_o = sound pressure required for a threshold sensation of hearing; equal to 20 μPa (micropascals, where 1 micropascal = 10^{-6} newton per square meter) or 0.002 atmosphere; and

P = the measured sound pressure in micropascals or atmospheres.

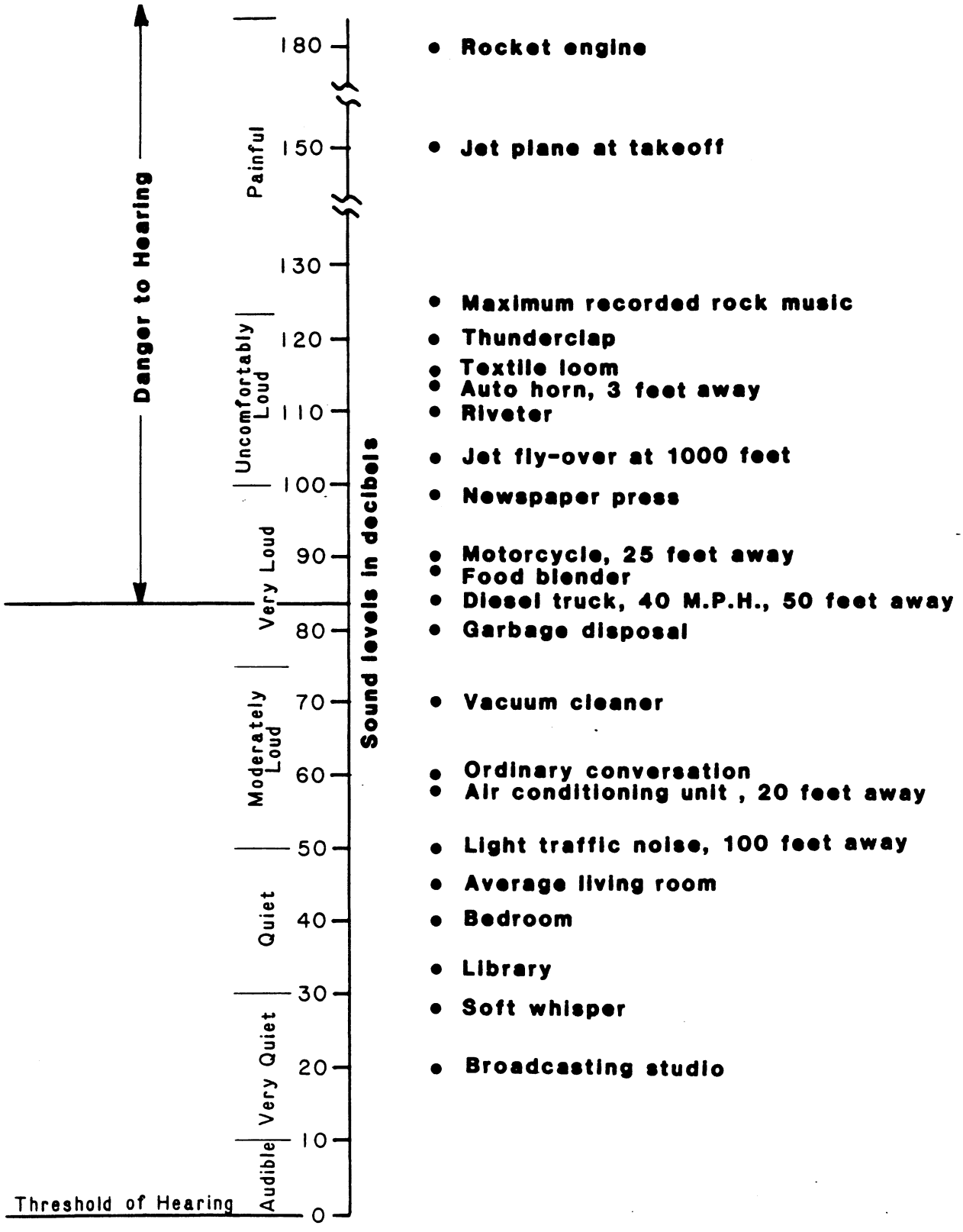
On the decibel scale, 0 dB is assigned to P_o. Approximately 125 dB is the sound level at the threshold of pain (U.S. Department of Labor, 1980).

The human ear does not perceive sounds at low frequencies in the same manner as those at higher frequencies. Sounds of equal intensity at low frequency do not seem as loud as those at higher frequencies. To simulate the human ear evaluations of hearing damage risk or community annoyance impacts (Peterson and Gross, 1967), sound analysis systems incorporate an A-weighting network (American National Standards Institute, 1971a). A-weighted sound levels are expressed in decibels (dB). Typical A-weighted sound levels at a given distance from a sound source and in the environment are shown in Table 4.1-23.

Because sound is not constant with time, statistical analysis is used to describe the temporal distribution of a sound and to compute

TABLE 4.1-23

SOUND LEVELS AND HUMAN RESPONSE



Source: Turk et al. (1974)

single-number descriptions for that sound. The following statistical A-weighted sound levels (National Academy of Science, 1977; Bureau of National Affairs, 1978) are used in this analysis:

L_{90} - The sound level exceeded 90 percent of the time during the measurement period, often called the residual sound level.

L_{50} - The sound level exceeded 50 percent of the time during the measurement period; the median sound level.

L_{10} - The sound level exceeded 10 percent of the time during the measurement period, often called the intrusive sound level.

L_{eq} - The equivalent steady sound level that provides an equal amount of acoustic energy* as the time-varying sound.

L_d - Day sound level, L_{eq} for the daytime period (0700-2200) only.

L_n - Night sound level, L_{eq} for the nighttime period (2200-0700) only.

L_{dn} - Day-night sound level, defined as (U.S. EPA, 1974):

$$L_{dn} = 10 \log_{10} \frac{(15 \times 10^{(L_d/10)}) + (9 \times 10^{(L_n+10)/10})}{24}$$

Note: The EPA adds a 10 dB correction factor to the night sound level as a weighting to compensate for the greater annoyance of nighttime noise (U.S. EPA, 1974).

4.1.8.1 Noise Estimation Model

The noise emissions from sources that will be described subsequently were extrapolated to noise-sensitive areas using a hemispherical

---

*Acoustic energy can be defined as follows: "Acoustic" means of or relating to sound; therefore, the sound energy of the given part of a medium is the total energy in this part of the medium minus the energy which would exist in the same part of the medium with no sound waves present (American National Standards Institute, 1971b).

dispersion model. As the distance from the noise source increases, the sound level* decreases in accordance with an inverse square law. The following equation (Beranek, 1971) represents this effect:

$$L_{AR} = L_{Ar} - 20 \log (R/r)$$

where: L_{AR} = The sound level at the receiver at a distance R from the source;

L_{Ar} = The sound level (probably measured) at a distance r from the source; and

R,r = Respective distances from the source.

The emitted sound is further reduced by absorption by the atmosphere, by trees (with foliage), and by grass and shrubs, and will be referred to as "natural attenuation." Atmosphere, foliage, and grass/shrub attenuation are frequency-dependent and require octave band sound pressure levels of the source noise for computation. Since octave band sound pressure level data are not available, attenuation factors for A-weighted sound levels were determined by assuming that the major sound energy from most noise sources used in the construction and operation of the project facilities will be in the 500 to 1000 Hz range. Since internal combustion engines are used in most of the major noise sources, this assumption is reasonable (see EIR Tables 1.3-2, 1.3-3, and 1.3-4).

The hemispherical dispersion model requires an estimation of the natural attenuation per 100 meters (328 feet) resulting from absorption of

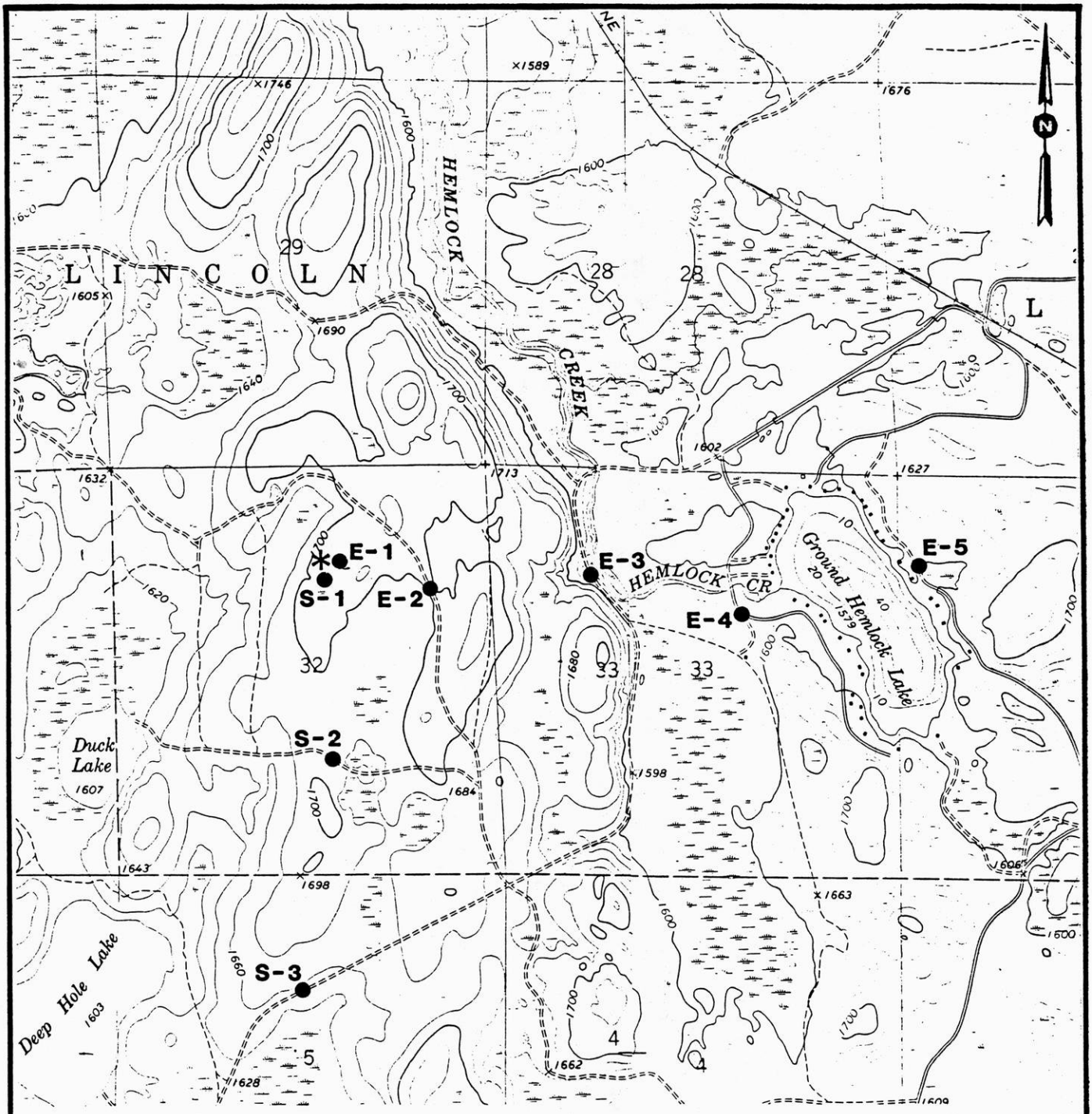
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*All sound levels used in this report are A-weighted unless noted otherwise.

sound by air, trees, grass, and bushes. On July 12, 1983, a field program was conducted to obtain a measured value for natural attenuation. This measured value for natural attenuation was then used in the computer model to compute the sound level contributions from construction activities and the operation of the mine at distant noise-sensitive locations.

To estimate natural attenuation, the following test was conducted. A large diesel engine produces sound with a frequency distribution that has a large amount of acoustic energy in the 500 Hz range. A Caterpillar dozer was used as the noise source, and the muffler was removed from the engine to gain an additional 10 to 15 dB in acoustic output. The site for operation of the dozer's engine was a small cleared area in the proposed mine waste disposal facility (Figure 4.1-1). Use of this area allowed for near-field measurements at 15 m (50 feet) from the dozer, where no trees were located between the microphone and the dozer. Old logging and access roads were available for the measurement of natural sound attenuation by atmosphere and forest vegetation over different distances. Figure 4.1-1 shows the location of the noise source and the locations to the east (labeled E-) and to the south (labeled S-) where sound level measurements were made.

Sound levels were recorded at a distance of 15 m (50 feet) from the noise source at the same time that sound levels were recorded at the distant locations. The data recording systems consisted of:



0 .5 1 MILE

0 .5 1 KILOMETER

KEY:

* NOISE SOURCE (DOZER)

● MEASUREMENT LOCATIONS

EXXON MINERALS COMPANY
CRANDON PROJECT

MEASUREMENT LOCATIONS
USED FOR MODEL CALIBRATION

DAMES & MOORE

FIGURE 4.1-1

Sound Level Meters			
Make	GenRad		GenRad
Model	1933	or	1982
Serial No.	3385		0816
Calibrators			
Make	GenRad		GenRad
Model	1562-A	or	1562-A
Serial No.	11640		21758
Tape Recorders			
Make	Nagra		Nagra
Model	4.2L	or	4.2L
Serial No.	101894		101934

With the muffler removed and due to limitations on engine speed provided by a governor, the noise source could not produce a sound of sufficient intensity for measurement of sound levels at the different distances. Therefore, the dozer had to have an operating load to produce a sound of sufficient intensity for measurement at distant locations. The sound varied with time as the unit was loaded when it moved soil and unloaded as it backed away to prepare to move additional soil. This resulted in an irregular sound rather than a constant intensity as would be most desirable.

The resultant variation in noise intensity with time complicated the attenuation analysis and required that only the A-weighted sound be analyzed rather than spectral analysis. In addition, the time-varying sound was more perceptible even though its measured level was well below the sound level produced by other background sources at the distant measurement locations.

The tape recorded data were analyzed using a computer controlled real-time analyzer. The recorded data were filtered using an A-weighted filter and sampled every 0.5 second. The analysis equipment used were:

Real-Time Analyzer		and	Digital Computer	
Make	GenRad		Make	Digital Equipment Company
Model	1921		Model	PDP 8/e

At each measurement location (E-1 through E-5 and S-1 through S-3), baseline sound levels (no dozer operating) were recorded prior to the measurement period. A summary of the results of the data analysis is presented in Table 4.1-24. Except for Locations E-1, E-2, and S-1, the ambient sound levels before and during dozer operation were the same (Table 4.1-24). Thus, the contribution of the dozer sound to the ambient sound at distant locations could not be determined.

The data from measurements at E-1 and E-2 can be used to estimate natural attenuation. The natural attenuation was determined to be approximately 2 dB/100 m. This was confirmed by the data obtained at S-2. If there were no natural attenuation, the A-weighted sound level at S-2 should be 54 dB. But instead, the A-weighted sound level with the dozer was only 40 dB. Using this difference of 14 dB over the distance of about 760 m (2,492 feet), a value of about 2 dB/100 m is also obtained.

In the assessment of noise impact, the measured value of 2 dB/100 m will be used for summer conditions as the total amount of natural attenuation. Since natural attenuation during winter, when trees lack foliage, is less than during summer, we assumed a total winter natural attenuation value of 0.5 dB/100 m. This represents a conservative value and is equal to atmospheric attenuation (Beranek, 1971).

A comment is warranted regarding a listener's ability to discern the noise of the dozer at distant locations (E-4 or E-5). Even though the level

TABLE 4.1-24

RESULTS OF ATTENUATION CALIBRATION

LOCATION	DISTANCE FROM DOZER (m)	BACKGROUND AMBIENT (dB)	AMBIENT WITH DOZER (dB)	DOZER CONTRIBUTION (dB)	COMPUTED DOZER CONTRIBUTION (dB)
E-1	15	40	88	88	--
E-2	380	37	52	52	60
E-3	1070	41	41	--[a]	51
E-4	1680	40	40	--[a]	47
E-5	2300	42	42	--[a]	44
S-1	15	40	88	80	--
S-2	762	40	40	--[a]	54
S-3	1685	40	40	--[b]	--

[a]Dozer variations discernible but not measurable.

[b]Dozer engine not discernible and not detectable.

of the dozer noise was well below the sounds emitted by closer noise sources such as wind moving the tree leaves, birds, distant traffic, and human activity, the human ear can readily discern changes in pitch of time-varying sounds in the midst of background noise. The reasons for this are many; for example, wind moving tree leaves is a higher frequency sound than the dozer noise. Also, the variation in sound intensity as the dozer was loaded and unloaded aided in discerning its sound from other ambient sounds. If the intensity of the dozer sound was steady, the listener would not be able to discern it as well. Its noise level (dB) may be less but is a distinctly different sound from others.

4.1.8.2 Noise-Sensitive Areas

The noise-sensitive areas in the environmental study area have been described earlier in section 2.8, Noise. Baseline sound level measurements at six locations representative of these noise-sensitive areas were taken in 1977 in summer and winter and at an additional four locations in winter and summer of 1983.

The locations representing noise-sensitive areas are presented in Table 4.1-25, together with their approximate distances from the principal operations within the Project boundary. Also shown in Table 4.1-25 are the approximate distances of forest and grass/shrub through which the sound must pass. These distances were estimated using data presented in section 2.6, Figure 2.6-7.

TABLE 4.1-25

DISTANCES FROM NOISE SOURCES TO NOISE-SENSITIVE AREAS

LOCATION	DESCRIPTION	MINE/MILL DISTANCE (ft)	WASTE DISPOSAL DISTANCE (ft)	ACCESS ROAD DISTANCE (ft)	RAILROAD SPUR DISTANCE (ft)	HAUL ROAD DISTANCE (ft)	SLURRY PIPELINE DISTANCE (ft)	WATER DISCHARGE STRUCTURE DISTANCE (ft)	EXHAUST FAN WER DISTANCE (ft)	EXHAUST FAN EER DISTANCE (ft)
1	Mole Lake School	16,700[a]	20,000	15,700	22,800	19,800	19,800	3,600	13,600	18,000
		2,950[b]	6,200	3,900	4,900	2,950	3,000	3,600	9,020	11,480
		13,200[c]	11,050	7,900	14,800	14,800	14,800	0	4,580	6,520
2	Community Center	11,100	15,000	10,000	16,600	14,400	14,400	10,000	8,600	12,800
		2,600	650	0	0	2,000	2,000	10,000	0	3,300
		8,500	10,800	10,000	16,600	12,400	12,400	0	8,600	9,020
3	Mihalko Residence	11,600	15,000	3,000	11,800	13,800	13,800	20,700	12,600	14,000
		1,100	0	0	0	0	0	16,700	0	0
		10,500	15,000	3,000	11,800	13,800	13,800	4,000	12,600	14,000
4	Residence 3712	19,200	13,200	18,000	12,900	17,000	17,000	38,500	22,500	19,300
		660	0	0	0	0	0	8,200	3,300	0
		17,700	12,500	18,000	12,100	16,400	16,400	30,300	19,200	19,300
5	Exxon Field Office	2,900	4,800	2,200	9,200	4,900	4,900	19,200	1,750	2,750
		0	660	1,000	2,300	0	0	7,500	0	0
		2,900	1,640	1,200	6,900	4,900	4,900	9,900	1,750	2,750
6	Webb Residence	6,150	5,900	5,500	11,900	6,900	6,900	18,750	4,500	5,000
		2,950	0	2,600	4,900	0	0	7,800	0	3,280
		3,200	2,630	2,900	6,600	1,000	1,000	10,950	4,500	1,720
7	Lake Metonga, South Shore	13,700	15,200	7,100	10,000	14,200	14,200	28,700	16,000	15,500
		3,280	3,900	1,300	4,900	3,300	3,300	13,100	0	3,280
		10,420	11,300	5,800	5,100	10,900	10,900	15,600	16,000	12,220
8	Rolling Stone Lake, North Shore	17,600	15,500	16,900	23,300	18,300	18,300	19,200	15,100	16,300
		1,640	0	660	1,000	0	0	660	0	0
		15,960	13,100	16,240	16,400	14,100	14,100	18,540	14,800	11,380
9	Ground Hemlock Lake, West Shore	13,800	3,900	14,500	10,600	10,500	10,500	33,000	16,400	12,000
		0	0	0	0	0	0	0	2,640	0
		13,800	2,300	13,800	10,600	10,500	10,500	33,000	13,960	12,000
10	St. John's Lake	17,700	7,000	12,000	21,700	15,500	15,500	31,000	19,500	16,000
		0	0	1,000	0	0	0	0	0	0
		16,700	7,000	7,500	21,700	15,500	15,500	31,000	16,000	15,300

[a]Distance from source to receiver.

[b]Grass/shrub distance.

[c]Tree distance.

4.1.8.3 Noise Sources

For the mine/mill site, construction day-night sound level (L_{dn}) contours were provided for each of the 5 years of construction (Pygin, 1982). Since construction will occur only during daytime hours, these contours were used to develop the daytime construction noise contribution for this area. However, construction activities for shaft sinking will occur on a 24-hour basis. For the water discharge structure, specific information on construction equipment was not available. Therefore, data on typical industrial construction equipment and noise levels, available from Dames & Moore files and published reports, were used for this analysis.

Construction activities will occur in several phases, which include: site clearing, grading and excavation; equipment erection; facility fabrication; and finish work and landscaping. It is estimated that the excavation phase will be the noisiest activity for all construction sites.

Because noise levels are not simply additive, to estimate impacts, equivalent sound levels (L_{eq}) are used to weight all component noise emanations from a combination of sources active in a defined area. To calculate the construction period L_{eq} for the mine/mill site year No. 1, average day-night contours were used to obtain two hypothetical major noise source locations. The first is located immediately west of the proposed access road and was calculated to have a sound level of 89 dB at 15 m (50 feet). The second is located adjacent to the proposed timber and steel storage area, with an associated sound level of 85 dB at 15 m (50 feet). Mine waste disposal facility excavation phase equipment (from EIR section 1.3,

Table 1.3-3), associated sound levels, and usage factors (the fraction of time the equipment operates in its noisiest mode) are presented in Table 4.1-26. The total construction noise level contribution from the mine waste disposal facility was calculated using the following equation (Kessler, 1978):

$$L_{eq} = 10 \log \left(10^{L_A/10} \times U.F.\right)$$

where: L_A = Equipment maximum sound level; and

U.F. = Usage Factor (percentage of time equipment operates in its noisiest mode).

The excavation phase L_{eq} at 15 m (50 feet) was calculated to be 92.7 dB. To assess the construction sound level contribution to each noise-sensitive location, the construction activity was assumed to be situated at the mine waste disposal facility boundary nearest the noise-sensitive area. Therefore, the calculated construction sound level contribution will be the "worst-case" situation, as construction activities at each nearest boundary location will only occur for a relatively short period of time.

Typical public works and industrial construction data (U.S. EPA, 1975) were used for the water discharge structure analysis. An L_{eq} of 87 dB at 15 m (50 feet) was used. For the slurry and water discharge pipelines, an L_{eq} of 87.7 dB at 15 m (50 feet) was used (Table 4.1-27). For the railroad spur construction, an L_{eq} of 95 dB at 15 m (50 feet) was used (Table 4.1-27). The construction site sound level for the access road and haul road is 95.9 dB at 15 m (50 feet) (Table 4.1-27).

The access road construction was assumed to be located at the closest point along the access road to each of the noise-sensitive locations.

TABLE 4.1-26

WASTE DISPOSAL AREA EXCAVATION EQUIPMENT

EQUIPMENT		MAXIMUM SOUND LEVEL L_A AT 15 M (50 FEET) (dB)	USAGE FACTOR
Scraper	CAT 631	87	0.13
Bulldozer	CAT D9	88.8	0.15
Bulldozer	CAT D8	89	0.15
Bulldozer	CAT D6	88	0.15
Front-End Loader	CAT 988	86	0.30
Front-End Loader	CAT 966	89	0.30
Motor Grader	CAT 16G	86	0.30
Motor Grader	CAT 14G	80	0.30
Excavator	CAT 235	83	0.70
Backhoe	J.D. 410	82	0.15
Dump Truck	Ford LT-9000	92	0.50
Belly Dump Truck and Trailer	Ford LT-9000	92	0.50

Total equivalent sound level (L_{eq}) contribution at 15 m (50 feet) = 92.7 dB

Source: Kessler, 1978

TABLE 4.1-27

EQUIPMENT

EQUIPMENT TYPE	QUANTITY	SOUND LEVEL dB AT 15 M	USAGE FACTOR
SLURRY AND WATER DISCHARGE PIPELINES AREA			
Bulldozer D7	1	88	0.15
Backhoe CAT 235	1	83	0.15
Front-End Loader 988B	1	86	0.15
Dump Truck 5 CYD	1	92	0.10
Flatbed Truck 8 T	1	83	0.10
Trencher	1	85	0.70
L_{eq} for site = 87.7 dB at 15 m			
RAILROAD SPUR AREA			
Chainsaw	5	91	0.20
Front-End Loader 988B	1	86	0.15
Front-End Loader 992C	1	89	0.15
Bulldozer D9	1	89	0.15
Bulldozer D6	2	88	0.15
Backhoe (Comb.)	2	83	0.10
Motor Grader 16G	1	86	0.10
Dump Truck 5 CYD	8	92	0.10
Compactor	4	80	0.10
L_{eq} for site = 95 dB at 15 m			
ACCESS ROAD AND HAUL ROAD AREA			
Chainsaw	5	91	0.20
Front-End Loader 988B	1	86	0.15
Front-End Loader 977L	1	89	0.15
Motor Grader 16G	2	86	0.10
Gradall G1200	1	86	0.10
Bulldozer D9	1	89	0.15
Bulldozer D6	2	88	0.15
Backhoe (Comb.)	2	83	0.10
Dump Truck 5 CYD	12	92	0.10
Compactor	5	80	0.10
Crane	2	85	0.05
L_{eq} for site = 95.9 dB at 15 m			

Source: Sadik, 1983.

The railroad spur construction activities were assumed to be located at the northeastern end of the railroad spur. The construction activities for the haul road and slurry pipeline were assumed to be located halfway between the mine/mill and mine waste disposal facilities. Construction of the water discharge pipeline will occur south of Mole Lake, which is about 670 m (2,200 feet) from the noise-sensitive area indicated by measurement Location 1. Construction activities for the water discharge structure were assumed to occur at the discharge location on Swamp Creek (section 3.4, Figure 3.4-10).

4.1.8.4 Construction Noise Impact

The contribution of each noise source to each noise-sensitive area is presented in Table 4.1-28. The data for the construction of the water discharge pipeline were omitted from this table. The maximum sound level contribution at Location 1 from the water discharge pipeline during summer construction will be 49 dB. Construction of this pipeline will have no effect on the sound at noise-sensitive areas represented by the other sound measurement locations.

The summer ambient sound levels will be increased for a short duration during the closest of the water discharge pipeline construction activities. Maximum sound levels should occur very briefly, because the rate of construction of the pipeline is expected to be 152 m (500 feet) per day.

TABLE 4.1-28

CONSTRUCTION ACTIVITY NOISE LEVEL (dB) CONTRIBUTION*

LOCATION	MINE/ MILL	WASTE DISPOSAL	ACCESS ROAD	RAIL SPUR	HAUL ROAD	SLURRY PIPELINE	WATER DISCHARGE STRUCTURE	TOTAL
				WINTER				
1	18.2	22.5	33.8	13.0	21.3	13.1	49.7	49.8
2	28.9	26.5	34.5	19.1	27.7	19.5	41.0	42.4
3	25.5	20.1	55.6	29.4	25.9	17.7	28.4	55.6
4	10.2	25.1	17.2	27.0	20.1	11.9	0.0	30.0
5	49.2	50.4	61.1	39.0	48.5	40.3	20.1	62.0
6	42.2	47.1	50.5	37.3	51.5	43.3	18.7	55.4
7	24.2	25.7	43.9	41.2	30.1	21.9	7.9	46.0
8	13.6	22.7	20.4	16.5	23.0	14.8	6.9	27.8
9	19.1	51.2	25.5	32.2	33.3	25.1	0.0	51.3
10	12.4	39.3	36.6	9.1	22.5	14.3	0.0	41.2
				SUMMER				
1	0.0	0.0	0.0	0.0	0.0	0.0	49.7	49.7
2	0.0	0.0	0.0	0.0	0.0	0.0	41.0	41.0
3	0.0	0.0	41.9	0.0	0.0	0.0	10.1	41.9
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	36.0	42.9	55.6	7.5	26.2	18.0	0.0	55.9
6	27.6	35.1	37.2	7.1	47.0	38.8	0.0	48.2
7	0.0	0.0	17.3	17.9	0.0	0.0	0.0	20.6
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	40.7	0.0	0.0	0.0	0.0	0.0	40.7
10	0.0	7.8	2.1	0.0	0.0	0.0	0.0	8.8

*All values are A-weighted sound levels in dB.

Due to the water discharge pipeline construction, daytime ambient sound levels will be increased, for a short period, from L_d = 46.6 dB to L_d = 49.9 dB, a change of 3.3 dB, which is not considered major. No change in nighttime ambient sounds will occur.

Table 4.1-29 uses data from Table 4.1-28. The total sound level contribution from construction (worst-case) is shown in Table 4.1-29, together with the baseline and construction ambient sound levels and the change from the baseline. In summer, the only major change in ambient sound levels L_d, L_n, and L_{dn} will occur at Location 6 due to haul road construction. In winter, change in daytime ambient sound level, L_d, and day-night sound level, L_{dn}, will occur at all locations; however, minimum construction is planned in winter.

Mine/mill construction will consist of a phase in which construction will occur for a 24-hour period. This activity will occur in winter, which will increase nighttime sound levels significantly at Location 6 and moderately at Locations 2, 3, and 5. The results of a conservative (worst-case) computation are shown in Table 4.1-29. The International Organization for Standards (1971) has adopted guidelines for assessing community response to noise, and their Recommendation No. 1996, "Noise Assessment with Respect to Community Noise," contains a procedure for assessing community response to noise based upon the change the community will experience by a change in ambient sound. This table is abstracted below:

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

TABLE 4.1-29

CONSTRUCTION EFFECT ON AMBIENT SOUND LEVELS[a]

LOCATION	BASELINE			CONSTRUCTION NOISE	CONSTRUCTION			CHANGE		
	L_d	L_n	L_{dn}	L_A	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
				WINTER						
1	42.8	29.8	41.9	49.7 (18.2)[b]	50.5	30.1	48.8	7.8	0.3	6.9
2	37.9	28.5	38.1	42.4 (28.9)[b]	43.7	31.7	43.1	5.8	3.2	5.0
3	39.3	23.9	37.9	55.6 (25.5)[b]	55.7	27.8	53.7	16.4	3.9	15.8
4	43.7	35.1	44.2	30.0 (10.2)[b]	43.9	35.1	44.4	0.2	0.0	0.2
5	42.4	50.5	56.4	62.0 (49.2)[b]	62.0	52.9	62.4	19.6	2.4	6.0
6	51.6	19.0	49.5	55.4 (42.2)[b]	56.9	42.2	55.7	5.3	23.2	6.2
7	44.8	41.8	48.8	46.0 (24.2)[b]	48.5	41.9	50.1	3.7	0.1	1.3
8	34.2	30.8	37.9	27.8 (13.6)[b]	35.1	30.9	38.2	0.9	0.1	0.3
9	33.4	30.0	37.1	51.3 (19.1)[b]	51.4	30.3	49.6	18.0	0.3	12.5
10	33.4	31.0	37.8	41.2 (12.4)[b]	41.9	31.1	41.6	8.5	0.1	3.8
				SUMMER						
1	46.6	42.7	49.9	49.7	51.4	42.7	51.9	4.8	0.0	2.0
2	42.1	39.7	46.5	41.0	44.6	39.7	47.2	2.5	0.0	0.7
3	47.1	44.1	51.0	41.9	48.2	44.1	51.4	1.1	0.0	0.4
4	63.8	47.0	62.3	0.0	63.8	47.0	62.3	0.0	0.0	0.0
5	58.6	26.5	56.6	55.9	60.5	26.5	58.4	1.9	0.0	1.8
6	38.0	38.6	44.9	48.2	48.6	38.6	48.6	10.6	0.0	4.2
7	47.5	41.3	49.3	20.6	47.5	41.3	49.3	0.0	0.0	0.0
8	40.7	39.6	46.2	0.0	40.7	39.6	46.2	0.0	0.0	0.0
9	42.7	27.4	41.4	40.7	44.8	27.4	43.2	2.1	0.0	1.8
10	38.6	28.1	38.4	8.8	38.6	28.1	38.4	0.0	0.0	0.0

[a]All sound levels are A-weighted in dB.

[b]Nighttime mine/mill contribution during shaft sinking (see Table 4.1-28).

Since only residents living near the baseline measurement Location 6 will observe a large change in nighttime sound levels and others will experience a change of less than 5 dB, little impact is expected except by the residents near Location 6. Nighttime outdoor sound levels at Location 6 will be quite low (less than 45 dB), and no interference is anticipated.

The State of Wisconsin does not have industrial noise control regulations or standards. The U.S. Environmental Protection Agency (U.S. EPA) has identified a day-night sound level (L_{dn}) of 55 dB as a requisite for the protection of public health and welfare with a conservative margin of safety (U.S. EPA, 1974). Since sound levels in most communities generally exceed this level, the agency has identified an L_{dn} of 65 dB as its short-term goal and an L_{dn} of 55 dB as its long-term goal. During winter construction, ambient sound levels will meet the U.S. EPA short-term goal at all locations and the long-term goal at all locations except Locations 5 and 6. During summertime, ambient sound levels at all locations except 4 and 5 meet U.S. EPA long-term goals. Presently, the ambient sound levels at these locations exceed this U.S. EPA goal, but they do not exceed the short-term goal.

References

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4.2.8 Operations

The methodology used to estimate off-site noise during operations is identical to that for construction noise in subsection 4.1.8. For a general discussion of noise levels, see subsection 4.1.8.

4.2.8.1 Noise-Sensitive Areas

The noise-sensitive areas and distances to the operation noise sources are presented in subsection 4.1.8.

4.2.8.2 Noise Sources

The major sources of noise during Project operation will be associated with the following facilities:

1. Mine/Mill

   Mine/mill area noise sources and associated sound levels* were developed and are presented on the Surface Plant Operations noise contours map (Ralph M. Parsons Company, 1982). The major noise sources at the mine/mill site are presented in Table 4.2-16. The equivalent sound level (L_{eq}) for the mine/mill site is 88.3 dB at 15 m (50 feet).

   The mine/mill site operations noise was assumed, for assessment purposes, to be located at the northwestern end of the railroad tracks at the load-out.

   In addition to the above noise sources, two vent fans -- West Exhaust Raise and East Exhaust Raise -- are considered. The sound level for each unit is 82.5 dB at 15 m (50 feet).

2. Mine Waste Disposal Facility

   The mine waste disposal facility operating noise was assumed to be produced by two trucks at the boundary nearest each noise-sensitive location. The L_{eq} from these two trucks is 91 dB at 15 m (50 feet) (Kessler, 1978).

*All sound levels used in this report are A-weighted unless noted otherwise.

TABLE 4.2-16

MINE/MILL SITE OPERATIONS NOISE SOURCES

EQUIPMENT	SOUND LEVEL (dB) AT 15 M (50 FEET)
Train/Concentrator	88
Transformer	72
Crusher	65
Batch Plant	67
Air Heater A	68
Air Heater B	68
Compressor	63
East Exhaust Raise Vent (2 units)	82.5
West Exhaust Raise Vent (2 units)	82.5

Total Mine/Mill L_{eq} = 88.3 dB at 15 m (50 feet)

3. Access Road

The noise levels associated with the access road were calculated from the number and types of vehicles that will be traveling along the road (estimates from subsection 1.4.7) during the morning, afternoon, and nighttime periods. The L_{eq} from the access road was calculated to be 52.4 dB at 15 m (50 feet) (Federal Highway Administration, 1978). The noise source location for the access road was chosen at the point along the road that is nearest to each noise-sensitive location.

4. Railroad Spur

The railroad spur operation noise level was obtained from the mine/mill noise contours. The locomotive and freight cars have a noise level of 88 dB at 15 m (50 feet). The noise source was located at the northeastern end of the spur.

5. Haul Road

The haul road was assumed to have three heavy trucks traveling at the midpoint of the road. The L_{eq} of 92.8 dB at 15 m (50 feet) results from combining the three truck noise emissions (Kessler, 1978).

6. Pipelines (Slurry and Water Discharge) and Discharge Structure

The slurry pipeline, water discharge pipeline, and water discharge structure were assumed to have no operating noise associated with them because they are located underground or in an enclosure.

The operations noise emissions used in this assessment are "worst-case" levels. At the mine/mill site, it was assumed that all listed noise sources would be in continuous operation, although some may operate intermittently. At the mine waste disposal facility, the trucks were assumed to be at the nearest boundary, when in actuality they will only operate there for a small fraction of the time. Railroad spur operations were assumed to be continuous for 24 hours per day. For actual plant operations, there will only be, on the average, 25 railcars per day, which will take less than 1 hour to travel the length of the spur.

Table 4.2-17 contains a summary of the sound level contributions of each noise source. Since no noise is anticipated for the underground slurry pipeline and water discharge pipeline and for the water discharge structure, they are not included in this table. This table also contains the summer and winter baseline and operation ambient sound levels and the projected changes from baseline sound levels.

There is no change in ambient day-night sound levels in the summer at Locations 1, 2, 3, 4, 7, 8, and 10 due to Project operation. At Location 5, a change of about 1 dB is anticipated, predominantly due to waste disposal activities. This change will not be perceptible. At Location 6, there is a change of about 7 dB, principally due to the haul road. At Location 9, an increase of 5.4 dB is anticipated. The mine waste disposal facility is the predominant source. The estimated noise level contributions are conservative and will probably be lower during most of the actual operations.

The change in summer nighttime ambient sound levels, L_n, at Locations 5 and 9 appear to be large. This was attributed to the low ambient nighttime sound levels. However, nighttime ambient sound levels will be below 45 dB and will not affect the residents' sleep.

The winter operations ambient sound levels change more than the summer sound levels due to the lower foliage attenuation factor. There will be an increase of 1 dB or less in L_{dn} at Locations 1, 4, 7, and 8. There will probably be an increase of 1.9 and 3.3 dB at Locations 3 and 2, respectively. These changes will not be discernible. A larger increase of 5.8 dB at Location 5, 7.2 dB at Location 10, 8.6 dB at Location 6, and 18.9 dB at Location 9 may occur. These increases are predominantly due to the

TABLE 4.2-17

OPERATION NOISE CONTRIBUTION TO AMBIENT SOUND LEVELS (dB)

	BASELINE			OPERATION NOISE CONTRIBUTION*								OPERATION			CHANGE		
LOCATION	L_d	L_n	L_{dn}	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_T	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
WINTER OPERATIONS																	
1	42.8	29.8	41.9	17.5	20.8	0.0	6.0	18.2	26.7	21.3	29.3	43.0	32.6	42.9	0.2	2.8	1.0
2	37.9	28.5	38.1	28.2	24.8	0.0	12.1	24.6	24.6	20.5	32.2	38.9	33.8	41.4	1.0	5.3	3.3
3	39.3	23.9	38.0	24.8	18.4	12.1	22.4	22.8	15.1	12.1	29.0	39.7	30.2	39.9	0.4	6.3	1.9
4	43.7	35.1	44.3	9.5	23.4	0.0	20.0	17.0	0.0	1.2	25.8	43.8	35.6	44.6	0.1	0.5	0.3
5	42.4	50.5	56.4	48.5	48.7	17.6	32.0	45.4	48.8	43.3	54.4	54.7	55.9	62.2	12.3	5.4	5.8
6	51.6	19.0	49.6	41.5	45.4	7.0	30.3	48.4	36.4	39.7	51.2	54.4	51.2	58.2	2.8	32.2	8.6
7	44.8	41.8	48.8	23.5	24.0	0.4	34.2	27.0	7.9	13.9	35.6	45.3	42.7	49.6	0.5	0.9	0.8
8	34.2	30.8	37.9	12.9	21.0	0.0	9.5	19.9	10.2	14.7	24.7	34.7	31.7	38.7	0.5	0.9	0.8
9	33.4	30.0	37.1	18.4	49.5	0.0	25.2	30.2	10.8	16.5	49.6	49.7	49.6	56.0	16.3	19.6	18.9
10	33.4	31.0	37.8	11.7	37.6	0.0	2.1	19.4	6.1	8.7	37.7	39.1	38.5	45.0	5.7	7.5	7.2
SUMMER OPERATIONS																	
1	46.6	42.7	49.9	0.0	0.0	0.0	0.0	0.0	5.8	0.0	5.8	46.6	42.7	49.9	0.0	0.0	0.0
2	42.1	39.7	46.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.1	39.7	46.5	0.0	0.0	0.0
3	47.1	44.1	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.1	44.1	51.1	0.0	0.0	0.0
4	63.8	47.0	62.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.8	47.0	62.3	0.0	0.0	0.0
5	58.6	26.5	56.6	35.3	41.2	12.1	0.5	23.1	40.8	30.7	44.8	58.8	44.8	57.7	0.2	18.3	1.1
6	38.0	38.6	44.9	26.9	33.4	0.0	0.1	43.9	15.9	31.9	44.6	45.5	45.6	52.0	7.5	7.0	7.1
7	47.5	41.3	49.3	0.0	0.0	0.0	10.9	0.0	0.0	0.0	10.9	47.5	41.3	49.3	0.0	0.0	0.0
8	40.7	39.6	46.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.7	39.6	46.2	0.0	0.0	0.0
9	42.7	27.4	41.4	0.0	39.0	0.0	0.0	0.0	0.0	0.0	39.0	44.2	39.3	46.8	1.5	11.9	5.4
10	38.6	28.1	38.4	0.0	6.1	0.0	0.0	0.0	0.0	0.0	6.1	38.6	28.1	38.4	0.0	0.0	0.0

*Operation noise sources: L_1 = mine/mill, L_2 = waste disposal, L_3 = access road, L_4 = railroad spur, L_5 = haul road, L_6 = west exhaust raise, L_7 = east exhaust raise.

contribution from the mine waste disposal facility. At Location 6, the haul road also contributes to environmental sound levels.

Nighttime sound levels, L_n, change at Locations 6 and 9 due to the present low ambient sound levels. Since a worst-case situation is considered, actual operations ambient sound levels are expected to be lower. Most of the time, waste disposal will be below grade behind a berm and will take place further from Location 9 than considered in this computation.

The State of Wisconsin does not have industrial noise control regulations or standards. The U.S. Environmental Protection Agency (U.S. EPA) has identified a day-night sound level (L_{dn}) of 55 dB as a requisite for the protection of public health and welfare with a conservative margin of safety (U.S. EPA, 1974). Since sound levels in most communities generally exceed this level, the agency has identified an L_{dn} of 65 dB as its short-term goal and an L_{dn} of 55 dB as its long-term goal. During winter operations, ambient sound levels will meet the U.S. EPA short-term goal at all locations and the long-term goal at all locations except Locations 5, 6, and 9. During summertime, ambient sound levels at all locations except 4 and 5 meet U.S. EPA's long-term goals. Presently, the ambient sound levels at these locations exceed this U.S. EPA goal, but they do not exceed the short-term goal.

References

Kessler, F., 1978, Construction site noise control cost benefit estimation technical background: CERL Technical Report N-37.

Federal Highway Administration, 1978, FHWA highway traffic noise prediction model: FHWA-RD-77-108.

Ralph M. Parsons Company, 1982, Letter report regarding anticipated noise emissions during construction and operation (September 3).

U.S. Environmental Protection Agency, 1974, Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety: U.S. EPA 550/9-74-004.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

March 1, 1984

File Ref: 1630
Exxon

Dear Librarian:

Please place the enclosed documents with the Exxon Environmental Impact Report (EIR) material:

1. Crandon Project Mine/Mill Facility Site Master Plan by the Sanborn Group, Inc., December, 1983.

2. Exxon response (January 25, 1984) to DNR comments (July 11, 1983) on the firm's air permit application.

3. Addendum to Chapter 2.8 ("Noise" portion) of the EIR.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:mm

Attachments

July 11, 1983 DNR Comments (initial responses were sent to the DNR's January 26, 1983 comment letter)

Comment No. 1

During the May 17, 1983 meeting between D. Ziege, T. Steidl and myself from the WDNR and J. DeMarte, D. Herbst and other staff from Exxon it was made clear that if the air pollution control permit for the Crandon Project requires the use of the emission control equipment (e.g. venturi scrubbers, fabric filter baghouses, etc.) specified in the permit application, stationary source particulate emissions will be less than 250 tons per year (TPY) and the Crandon Project will be exempt from the federal Prevention of Significant Deterioration of Air (PSD) program. Additionally, if adequate control of the dust emission during MWDF construction is included in the permit, total particulate emissions from stationary and fugitive dust sources combined should be less than 250 TPY and the Crandon Project will be a minor air pollution source as defined by Wisconsin Statutes.

Response:

Comment acknowledged. Exxon expects to maintain the conditions provided in its air pollution control permit application and to abide by the conditions of the air permit. As a result, the Crandon Project will be exempt from the federal PSD program and a minor air pollution source as defined by Wisconsin Statutes.

Comment No. 2

Accurate emission estimates require that the type of operation and the maximum throughput of material be known. Figure 4-2 in the air permit application provides daily throughput for each surface operation. If these throughput rates are the capacity of the equipment to be installed, then they can be used for emission estimates. Otherwise, the maximum daily throughput for each operation should be provided. The average annual treatment rate of 9100 metric tons per day is useful for estimating the annual emission expected. However, the air quality modeling predicts maximum 24 hour particulate impacts for each source which require maximum daily emissions, and hence, maximum daily throughput.

Response:

The daily process maximums presented in Figure 4-2 of the air permit application will be revised as shown (see attached Figure 4-2) to indicate the current estimate of peak daily operation throughputs. As previously noted on Figure 4-2, individual maximums can not occur simultaneously because of downstream or upstream limiting processes.

Comment No. 3

The effectiveness of any control equipment will be dependent on the particle size distribution in the gas stream exhausting through it, as indicated in your reference in U.S. EPA publication AP-42. Please provide a particle size distribution analysis estimated for each gas stream exhausting through control equipment and specific design parameters of each piece of equipment

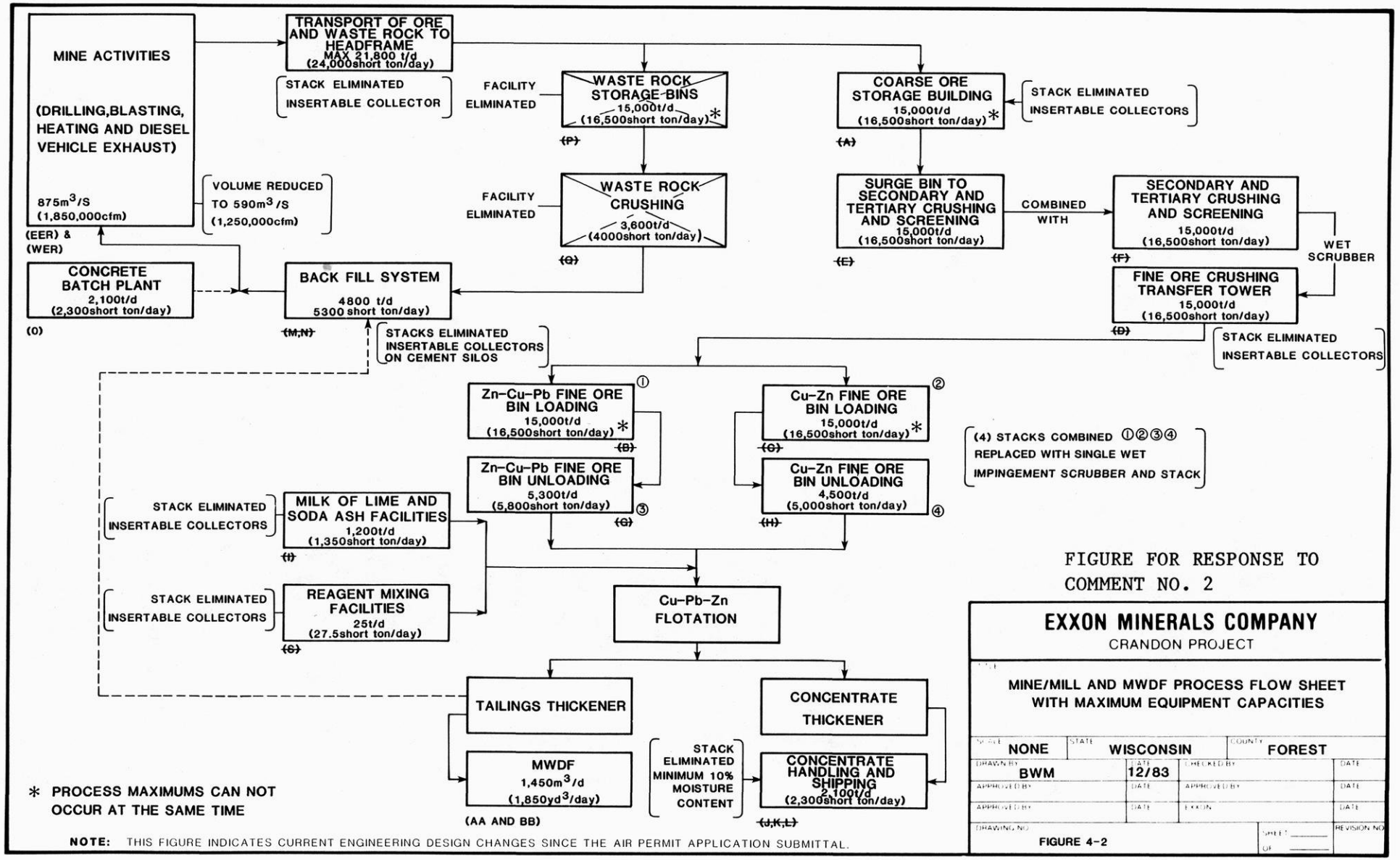


FIGURE FOR RESPONSE TO COMMENT NO. 2

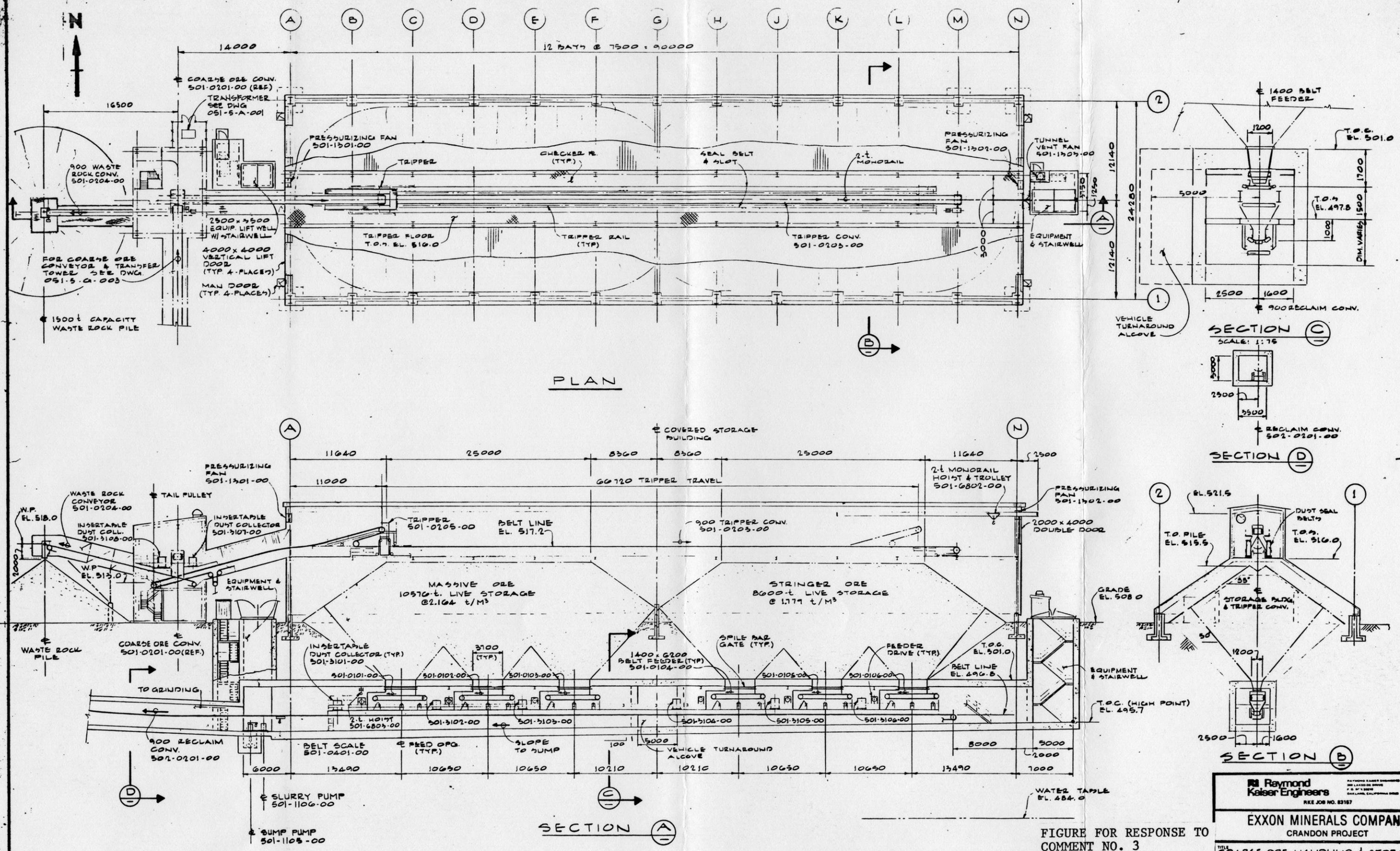
EXXON MINERALS COMPANY
CRANDON PROJECT

MINE/MILL AND MWDF PROCESS FLOW SHEET WITH MAXIMUM EQUIPMENT CAPACITIES

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
BWM	12/83		
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE

DRAWING NO. FIGURE 4-2 SHEET ___ OF ___ REVISION NO.



NOTE
ALL DIMENSIONS IN MILLIMETERS
ALL ELEVATIONS IN METERS

FIGURE FOR RESPONSE TO COMMENT NO. 3

REVISED	DATE	BY	DESCRIPTION
1	11-16-83		GENERAL REVISION

EXXON PROPRIETARY

Raymond Kaiser Engineers
RKE JOB NO. 83157

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: COARSE ORE HANDLING & STORAGE STORAGE BUILDING G.A. PLAN & SECTIONS

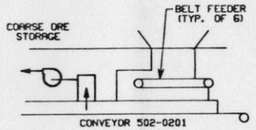
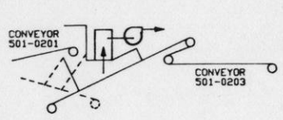
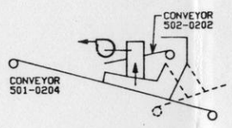
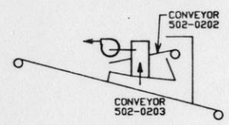
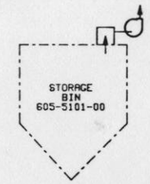
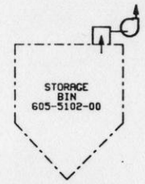
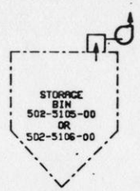
SCALE: 1:200 U.N. | STATE | COUNTY

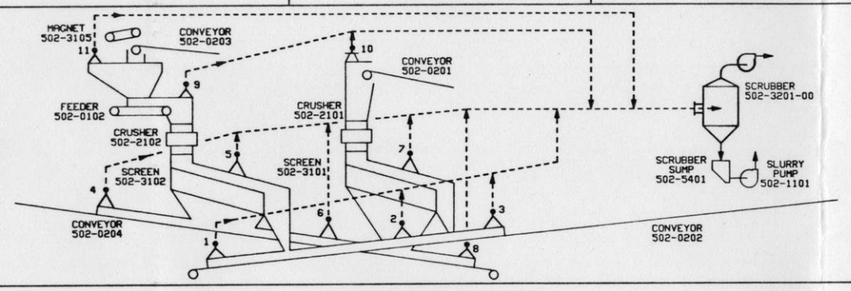
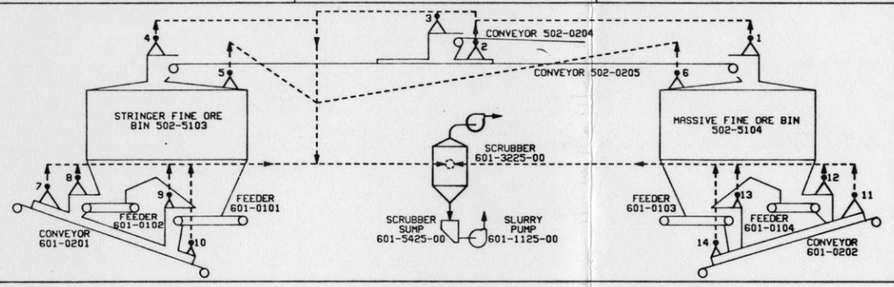
DRAWN BY: B. TERRY | DATE: 6-8-83 | CHECKED BY: W. Young

APPROVED: | DATE: 6-14-83 | PROJ. ENGR.:

APPROVED: | DATE: 7-11-83 | EXXON

DRAWING NO. 051-5-G-002 | SHEET

SYSTEM DIAGRAM							
LOCATION/SYSTEM	RECLAIM TUNNEL	TRANSFER TOWER - TRIPPER CONVEYOR	TRANSFER TOWER - WASTE ROCK CONVEYOR	TRANSFER TOWER - FINE CRUSHING	STORAGE BIN - CONCENTRATOR	STORAGE BIN - CONCENTRATOR	STORAGE SILO - CONCENTRATOR
DUST COLLECTOR EQUIP. NO.	(6 REQ'D) 501-3101-00 THRU 501-3106-00	501-3107-00	501-3108-00	502-3103-00	605-3101-00	605-3102-00	(2 REQ'D) 502-3115-00 & 502-3116-00
FAN EQUIPMENT NO.	-	-	-	-	-	-	-
MATERIAL	STRINGER ORE/MASSIVE ORE	STRINGER ORE/MASSIVE ORE	WASTE ROCK	STRINGER ORE/MASSIVE ORE	BURNT LIME	SODA ASH	CEMENT
SYSTEM VOLUME M^3/SEC	1.0	1.65	1.65	1.65	0.71	0.71	1.42
FAN STATIC PRESS. Kg/cm^2	0.018	0.018	0.018	0.018	0.018	0.018	0.018
FAN HORSEPOWER	5	5	7.5	7.5	5	5	5
REFERENCE DRAWING	051-5-G-002	051-5-G-002	051-5-G-002	051-5-G-005	051-6-G-008	051-6-G-008	051-6-G-007

SYSTEM DIAGRAM			
LOCATION/SYSTEM	FINE ORE CRUSHING AND SCREENING	FINE ORE STORAGE AND MILL FEED	
DUST COLLECTOR EQUIP. NO.	502-3201-00	502-3202-00	
FAN EQUIPMENT NO.	-	-	
MATERIAL	STRINGER ORE/MASSIVE ORE	STRINGER ORE/MASSIVE ORE	
PICK-UP POINT 1 M^3/SEC	0.35	0.70	
PICK-UP POINT 2 M^3/SEC	1.18	1.40	
PICK-UP POINT 3 M^3/SEC	1.18	0.70	
PICK-UP POINT 4 M^3/SEC	1.18	0.70	
PICK-UP POINT 5 M^3/SEC	3.76	0.70	
PICK-UP POINT 6 M^3/SEC	1.18	0.70	
PICK-UP POINT 7 M^3/SEC	3.76	1.18	
PICK-UP POINT 8 M^3/SEC	0.35	0.82	
PICK-UP POINT 9 M^3/SEC	1.06	0.82	
PICK-UP POINT 10 M^3/SEC	0.60	0.35	
PICK-UP POINT 11 M^3/SEC	1.22	1.18	
PICK-UP POINT 12 M^3/SEC	-	0.82	
PICK-UP POINT 13 M^3/SEC	-	0.82	
PICK-UP POINT 14 M^3/SEC	-	0.35	
SYSTEM VOLUME M^3/SEC	15.80	11.30	
FAN STATIC PRESS. Kg/cm^2	0.043	0.043	
REFERENCE DRAWING	051-5-G-005	051-5-G-004	

NOTES
1. ALL FANS TO BE SELECTED FOR VOLUME = 1.15 X SYSTEM VOLUME.

FIGURE FOR RESPONSE TO COMMENT NO. 3

24-AUG-83
KE15270

REVISED	DATE	BY	DESCRIPTION
1	11-23-83	RS	GENERAL REVISION

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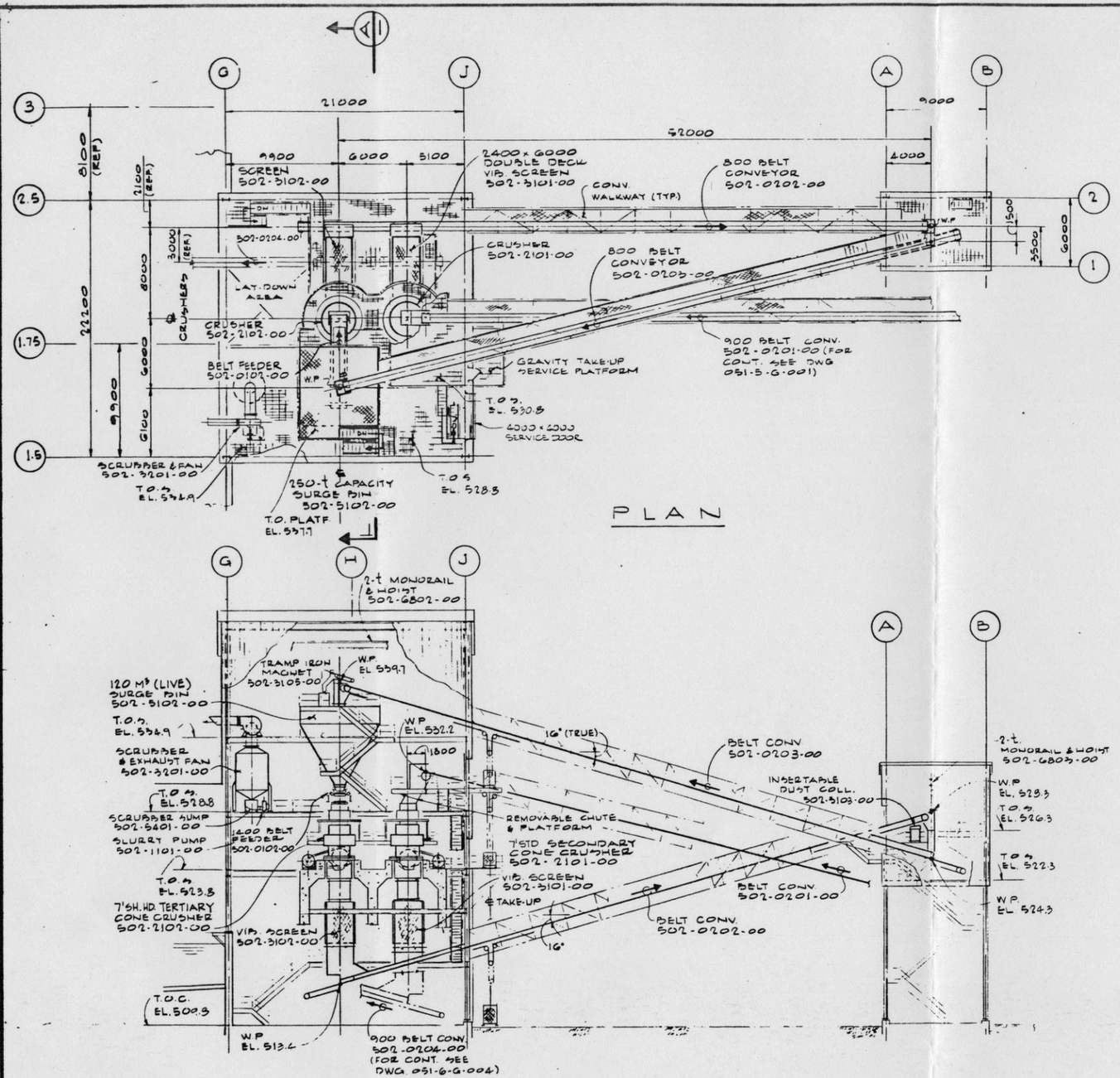
Raymond Kaiser Engineers
RAYMOND KAISER ENGINEERS INC.
300 LAKESIDE DRIVE
P. O. BOX 23910
OAKLAND, CALIFORNIA 94623
RKE JOB NO. 83157

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
DUST COLLECTOR SCHEDULE

SCALE	NONE	STATE		COUNTY	
DRAWN BY	RDS	DATE	CHECKED BY		DATE 8-26-83
APPROVED BY		DATE 8-26-83	APPROVED BY		DATE 11/28/83
APPROVED BY		DATE 8-26-83	EXXON		DATE
DRAWING NO	051-1-M-001		SHEET 1 OF 1		REVISIONS 1

ALIGN AND SCALE



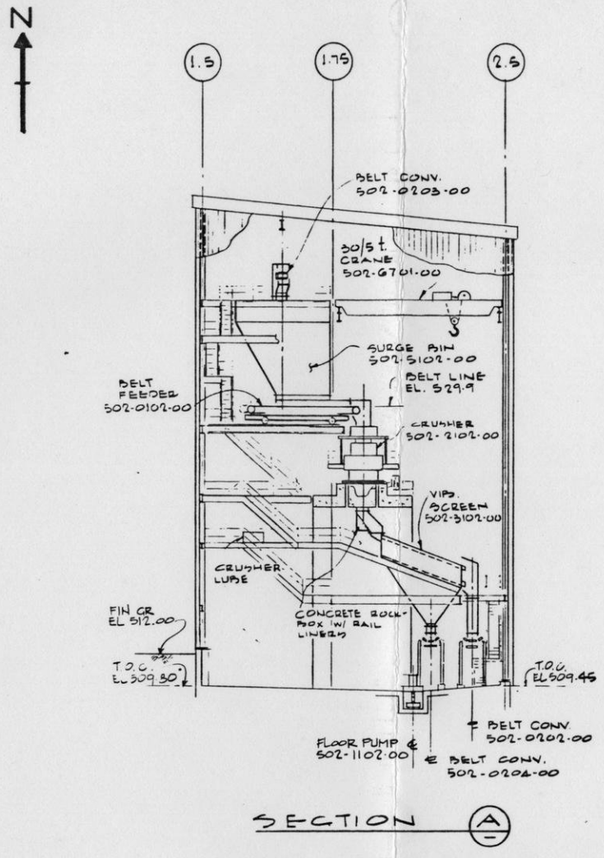


FIGURE FOR RESPONSE TO COMMENT NO. 3

NOTE:
ALL DIMENSIONS IN MILLIMETERS
ALL ELEVATIONS IN METERS

REVISED	DATE	BY	NEW MATERIAL
2	11 16 83		GENERAL REVISION
1	8 22 83		REVISED PLT & WORK PT REV., ACCESS DELETED & RELOCATED SERVICE DOOR

EXXON PROPRIETARY

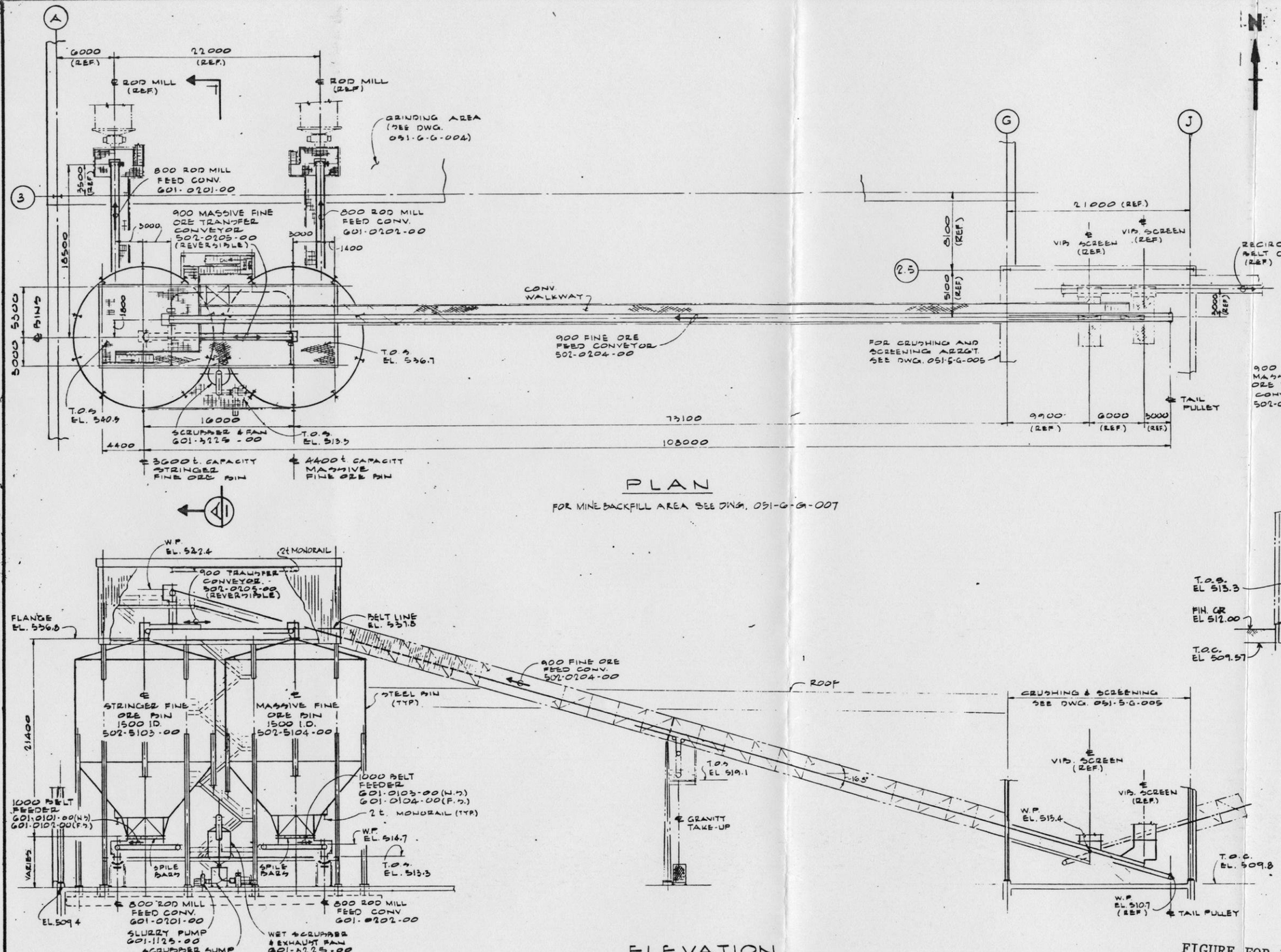
Raymond Kaiser Engineers
RKE JOB NO. 83157

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: FINE ORE CRUSHING & STORAGE CRUSHING & SCREENING G.A. PLAN & SECTIONS

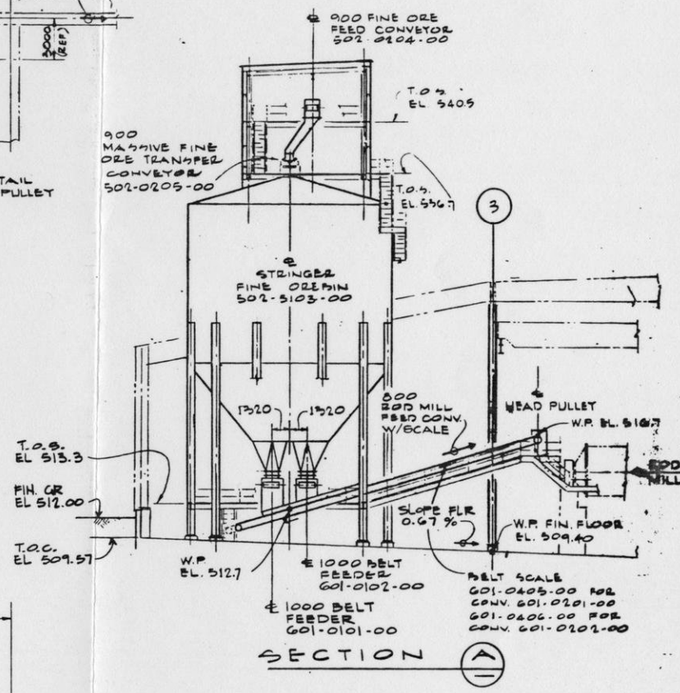
SCALE 1:200 | STATE | COUNTY

DRAWN BY: B STEVENS 2-15-83
CHECKED BY: M Young 4-15-83
APPROVED BY: J.R.O. 4-29-83
APPROVED BY: R. Baker 9-11-83
DRAWING NO: 051-5-A-005
SHEET 2 OF 2



PLAN

FOR MINE BACKFILL AREA SEE DWG. 051-G-G-007



SECTION A

ELEVATION

NOTE:
ALL DIMENSIONS IN MILLIMETERS
ALL ELEVATIONS IN METERS

FIGURE FOR RESPONSE TO COMMENT NO. 3

REVISED	DATE	BY	DESCRIPTION
2	11-16-83		GENERAL REVISION
1	8-22-83		REVISED PLT PLAN, CONV. WORK PT. PLAN & SLOPE, ADDED EQP. DRAWING

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EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: FINE ORE CRUSHING & STORAGE
FINE ORE STORAGE
G.A. PLAN & SECTIONS

SCALE: 1:200 | STATE | COUNTY

DRAWN BY: P. STEVENS | DATE: 4-13-83 | CHECKED BY: J. ON
APPROVED BY: | DATE: 4-29-83 | APPROVED BY:
APPROVED BY: S. Bruno | DATE: 4-11-83 | EXXON | SIZE: D

DRAWING NO: 051-5-G-004 | SHEET: 1 | REV: 2

(e.g. water flow rates for impingement scrubbers and venturi scrubbers, pressure drop for venturi scrubbers, air to cloth ratio and fabric material for fabric filter and baghouse collectors).

Response:

The processes which are exhausted through scrubbers or baghouses prior to air venting from external stacks to the atmosphere are listed below with specifics about estimated particle size distributions, water flow rates, air to cloth ratios, and fabric materials. The control equipment is for the current engineering design and these changes will be included in the air permit application.

Coarse ore storage building - Within this operational facility will be eight individual insertable particle collectors as air pollution control equipment for the various activities. This type of collector discharges the collected particles back to the process belts, and will have no external environment exhaust stack. Locations of individual units are presented in Drawing No. 051-5-G-002 (see attached) and specifics of operation are presented in Drawing No. 051-1-M-001 (see attached). Each insertable collector contains 323 sq ft of 16-oz Dacron filter material and has an air to cloth ratio of 6.6 (CFM) per 1.0 (ft^2). The equipment is similar to a DCE-Vokes Model DLMV 30/1 - F10 (i.e. all facility insertable collectors will be of this type). Particulate removal efficiencies by particle size are as follows:

	< 5 um	5 to 10 um	10 to 20 um	20 to 44 um	>44 um
% passed	0.25	0	0	0	0
% collected	99.75	100	100	100	100

Secondary and tertiary crushing and screening - Air from these processes will be vented through one wet scrubber labelled No. 502-3201-00 in Drawing No. 051-5-G-005 (see attached). Pickup points and air volumes are presented in the drawing titled "Dust Collector Schedule" (No. 051-1-M-001). The water rate necessary to operate (i.e. recirculation) a Ducon Model 126-UW-4 wet scrubber is 134 gpm. Particulate removal efficiencies by particle size for this scrubber are as follows:

	< 5 um	5 to 10 um	10 to 20 um	20 to 44 um	>44 um
% passed	0.2	0.08	0.05	0	0
% collected	99.8	99.92	99.95	100	100

Cu-Pb-Zn and Cu-Zn fine ore bins loading and unloading - Air from these processes will also be vented through one wet scrubber labelled No. 601-3225-00 in Drawing No. 051-5-G-004 (see attached). Pickup points and air volumes are presented in the drawing titled "Dust Collector Schedule" (Drawing No. 051-1-M-001). The water rate

necessary to operate (i.e. recirculation) a Ducon Model 108-US-4 wet scrubber is 96 gpm. Particulate removal efficiencies by particle size for this scurbber are as follows:

	< 5 um	5 to 10 um	10 to 20 um	20 to 44 um	>44 um
% passed	1.2	0.3	0.2	0	0
% collected	98.8	99.7	99.8	100	100

Comment No. 4

A map was provided by J. DeMarte of your staff on June 21st.

Response:

Comment acknowledged.

Comment No. 5

See Item 8.

Response:

Comment acknowledged.

Comment No. 6

Adequate response.

Response:

Comment acknowledged.

Comment No. 7

Adequate response.

Response:

Comment acknowledged.

Comment No. 8

Particulate emissions due to underground activities such as blasting, or handling and crushing operations will exhaust to the surface via the east and west exhaust raises. It is essential to quantify the dust emissions expected from the raises in order to accurately estimate the impact of the Crandon Project. The assumption that the mine drifts and air exhaust shafts will act similarly to a spray tower is not acceptable. The fine water spray of a spray tower is absent from the mine drifts and exhaust shafts.

As discussed with Joe DeMarte on June 21st, I think it would be more appropriate to compare the mine drifts and exhaust shafts as elongated settling chambers. If the particle distribution is known for the dust generated by underground activities, the settling velocity can be determined

for various size categories. If a given dust particle is present in the mine long enough to settle onto the walls of the drifts and shafts, it will not be emitted. The underground humidity and wetted rock surfaces should insure that settled dust will not likely be reentrained into the air exhausting to the surface. This approach should be used to estimate the collection efficiency of the mine drifts and air exhaust shafts.

Response:

See response to Comment No. C1.

Comment No. 9

Adequate response.

Response:

Comment acknowledged.

Comment No. 10

Adequate response.

Response:

Comment acknowledged.

Comment No. 11

Please provide data on the maximum liquid sulfur dioxide (SO_2) usage and the subsequent SO_2 emissions expected from the soda ash scrubber in units of pounds per hour.

Response:

Further engineering design for the concentrator has eliminated the soda ash scrubber. Approximately 4 to 5 tank trucks per month containing liquid sulfur dioxide will be delivered to the bulk storage tanks. The liquid sulfur dioxide will be transferred directly from the tanker to the bulk storage tanks using a compressor. Liquid sulfur dioxide will be metered directly into the process streams. As a result there will be no sulfur dioxide emissions to the atmosphere from storage and distribution of sulfur dioxide in this segment of the operations.

Comment No. 12

Adequate response.

Response:

Comment acknowledged.

Comment No. 13

The emission source tables in the air permit application (Tables 2.1-2.7) should accurately summarize the emission sources for the Crandon Project and should not be altered to reflect any air quality modeling efforts. Please revise Table 2.6 and 2.7 if any sources were incorrectly added or omitted.

Response:

Comment acknowledged and the amended air polluton control permit application will contain revised Tables 2.6 and 2.7.

Comment No. 14

Adequate maps were received from Joe DeMarte on June 21st.

Response:

Comment acknowledged.

Comment No. 15

Adequate response.

Response:

Comment acknowledged.

Comment No. 16

Adequate response.

Response:

Comment acknowledged.

Comment No. 17

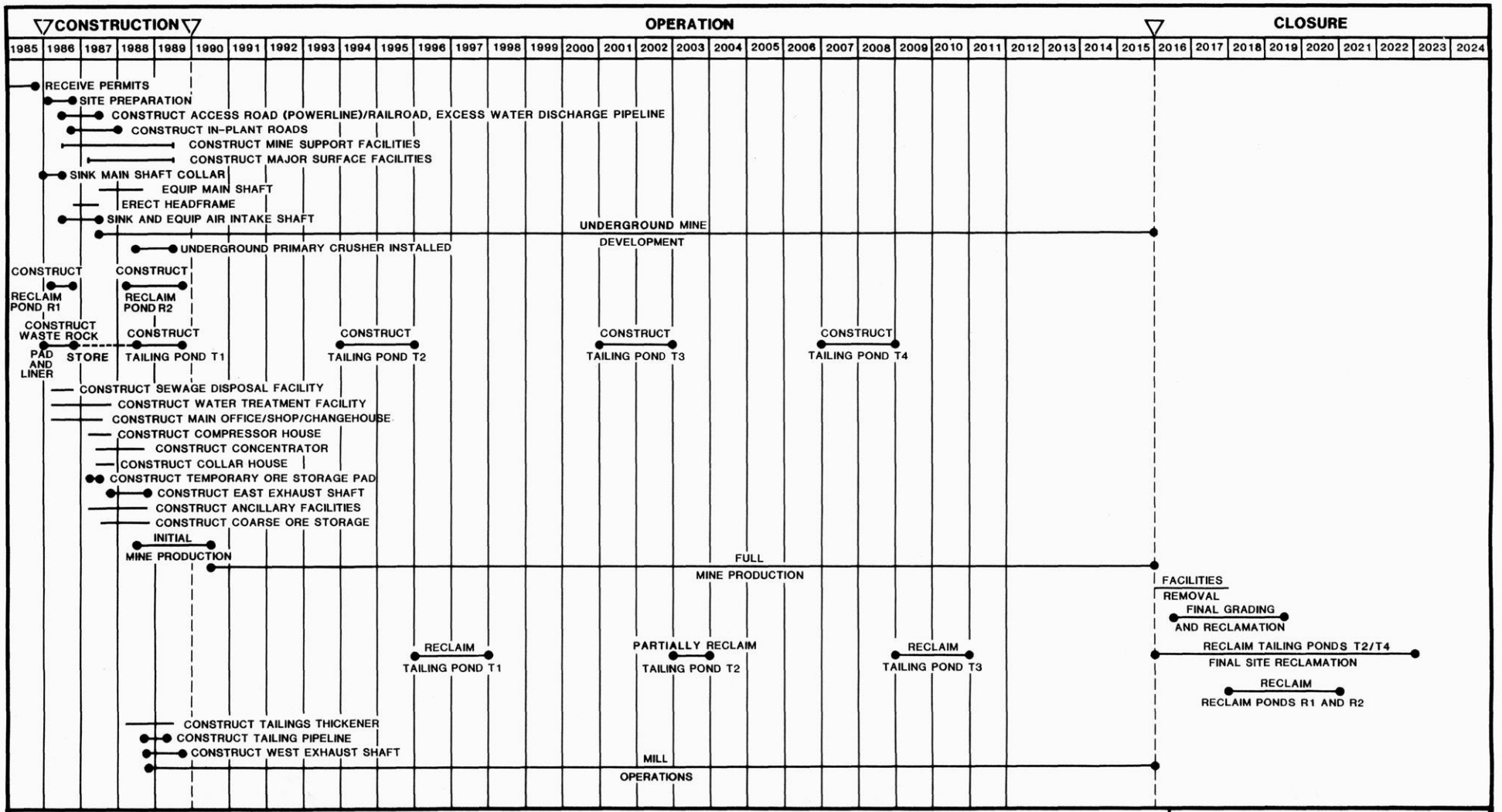
Even if reclamation phase emissions will be less than those during construction activities, these emissions should be calculated and summarized. This will further justify the logic used to choose appropriate years and sources for air quality modeling used to estimate worst case impact.

During my meeting with Joe DeMarte, it was indicated that a figure summarizing the Crandon Project activities and their emissions during the lifetime of the mine would be useful for the air quality analysis. This figure could be similar to Figure 1-1 in the air permit application but would include the yearly emissions expected for each activity. The total emissions for each year could then be summarized. This would clearly indicate the years when emissions are highest, air quality impact could be expected to be the greatest and for which air quality modeling would be appropriate.

EXXON MINERALS COMPANY

CRANDON PROJECT

SCHEDULE



LEGEND

- TOTAL CATEGORY ACTIVITIES TIME FRAME
- FACILITY FABRICATION AND INTERNAL CONSTRUCTION-NO EMISSIONS ESTIMATED
- CONSTRUCTION, OPERATION AND/OR CLOSURE PHASE ACTIVITIES-AIR EMISSIONS ESTIMATED (SEE TABLES 1.1 AND 1.2 OF THESE RESPONSES)

FIGURE FOR RESPONSE TO COMMENT NO. 17

EXXON MINERALS COMPANY	
CRANDON PROJECT	
LOCATION	WISCONSIN
TITLE	SCHEDULE OF CONSTRUCTION, OPERATION, AND CLOSURE PHASES
SCALE	NONE
DRAWN BY	DMC, IM
DATE	12/88
CHECKED BY	
APPR./REV. BY	RPH
ORIGINATOR	RPH
DRAWING NUMBER	FIGURE 1-1
REVISION NUMBER	

Response:

The following calculations estimate the reclamation phase TSP air emissions as provided in Tables 1.1 and 1.2 and Figure 1.1 of these responses (see attached). Example calculations for these activities are provided below.

The general emission factor for TSP of 1.2 st/acre/month provided in U.S. EPA AP-42, Section 11.2.4 represents an emission rate for heavy construction activities (i.e. blasting, soil excavation, cut-and-fill operations, and particular facility construction) in an area with soil silt content of approximately 30% and in a semi-arid climate with precipitation and soil moisture conditions of PE 50 (PE = Thornwaite's precipitation-evaporation index). A silt content of approximately 15% (i.e. based on site area soil classification) was previously used for the till at the Crandon mine/mill site and the soil moisture content is considerably higher (i.e. PE 120 based on site area precipitation and evaporation rates) than soils in semi-arid areas. These two factors, silt content and soil moisture, heavily influence the fugitive particulate (TSP) emission rate. Although a specific relationship has not been verified, the use of an emission rate of 1.2 st/acre/month to calculate emissions from construction activities at the site area will result in a conservatively high estimate. However, this factor was used in all of the revised calculations without any correction factors to estimate TSP emissions from construction and operation phase activities.

Examples:

Reclaim Tailing Pond T1 - Earthmoving, regrading, and replanting activities will occur to develop final grades, surface water drainage patterns and final use compatibility with the Reclamation Plan.

Emission Factors and Source: AP-42, Section 11.2.4
TSP-EF = 1.2 short tons/acre/month

Process Rate: 24 months for 82 acres or approximately 3.4 acres/month

Duration: 24 months (1996-97)

Control Method and Efficiency: Watering of disturbed area if necessary.

Example Calculation:
Process Rate x Emission Factor x Duration = Emission Rate
3.4 acres/month x 1.2 st/acre/month x 12 months/yr = 49.0 st/yr

Reclaim Tailing Pond T2 (partial)

Process Rate: 12 months for 54 acres or approximately 4.5 acres/month

Duration: 12 months (2003)

Example Calculation:
4.5 acres/month x 1.2 st/acre/month x 12 months/yr = 64.8 st/yr

Table 1.1

Schedule associated with Project activities during construction and operation phases and the estimated TSP air emissions from proposed sources.

Project Activities ( )**	CONSTRUCTION				OPERATION																
	1986	1987	1988	1989	1990	1991-92	1993	1994	1995	1996	1997	1998-2000	2001	2002	2003	2004	2005-06	2007	2008	2009	2010	2011-15
Site Preparation (trees & brush)																						
1. Mine Shafts (A1)	17.6																					
2. Mill/Mill Site (A3, B1)	77.3																					
3. MWDF Area		112.8					112.8					112.8[a]					112.8[b]					
4. Access Road/Powerline (A3, D5, D7)	2.7	3.2	3.24	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Railroad Spur (A3, D4)	4.2	0.14	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Haul Road (B1)	4.0																					
7. Water Discharge Pipeline (B5)	10.2																					
8. In-Plant Roads (B2, D5)	4.8	48.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9. Mobile Sources (Table 2.3)	8.0	*	*	*																		
10. Concrete Batch Plant (Table 2.3)	2.7	*	*	*																		
Construct Mine Support Facilities																						
1. Sink Main Shaft	10.6	4.1																				
2. Sink and equip air intake shaft	3.0	2.5																				
3. Construct east exhaust shaft			0.8																			
4. Construct west exhaust shaft				0.8																		
5. Power Generation (A2, C3)	4.2	0.2	*	*																		
Construct Major Surface Facilities																						
1. Construct Reclaim Pond R1	59.3																					
2. Construct Reclaim Pond R2		18.0	18.0																			
3. Construct Temporary Ore Storage Pad	Included in Mine Shafts																					

Table 1.1 (continued)

Schedule associated with Project activities during construction and operation phases and the estimated TSP air emissions from proposed sources.

Project Activities ( )**	CONSTRUCTION				OPERATION																
	1986	1987	1988	1989	1990	1991-92	1993	1994	1995	1996	1997	1998-2000	2001	2002	2003	2004	2005-06	2007	2008	2009	2010	2011-15
Construct MWDF Facilities																						
1. Construct Tailing Pipeline			6.0	6.0																		
2. Install Liner (E4)	1.0		1.0	1.0				1.0	1.0				1.0	1.0				1.0	1.0			
3. Waste Rock Handling (A4)				40.3																		
4. Construct Tailing Pond T1 (E1)			96.3	96.3																		
5. Construct Tailing Pond T2 (E1)								96.3	96.3													
6. Reclaim Tailing Pond T1 (17)										49.0	49.0											
7. Construct Tailing Pond T3 (E1)													96.3	96.3								
8. Reclaim Tailing Pond T2 (partial) (17)															64.8							
9. Construct Tailing Pond T4 (E1)																		96.3	96.3			
10. Reclaim Tailing Pond T3 (17)																				60.5	60.5	
Underground Mine Development																						
1. Develop Drifts and Stopes		0.2	1.4	3.9	3.3																	
Mine Production																						
1. Initial (A4)					12.7																	
2. Full (C1)																						
a. Blasting						13.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
b. Rock handling						7.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
c. Mobile equipment						5.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d. Mine air heating						0.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Table 1.1 (continued)

Schedule associated with Project activities during construction and operation phases and the estimated TSP air emissions from proposed sources.

Project Activities ( )**	CONSTRUCTION				OPERATION																
	1986	1987	1988	1989	1990	1991-92	1993	1994	1995	1996	1997	1998-2000	2001	2002	2003	2004	2005-06	2007	2008	2009	2010	2011-15
Mill/Concentrator Operations																						
1. Coarse Ore Transport (A4)					12.7	*																
2. Crushing and Screening					8.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3. Fine Ore Loading (Table 2.4)					0.7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4. Fine Ore Unloading (Table 2.4)					1.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Concrete Batch Plant (D3)					0.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Facility Heating					0.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7. Emergency Diesel Generators (C3)					0.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
TOTAL	209.6	200.7	186.7	211.5	92.4	104.0	204.1	188.6	188.6	140.3	140.3	204.1	188.6	188.6	156.1	91.3	204.1	188.6	188.6	151.8	151.8	91.3

* Means previous annual estimate is used for this year.

** Number within parentheses identifies this letter's response or air permit application source for the information.

[a]In the year 2000 only.

[b]In the year 2006 only.

Table 1.2

Schedule associated with Project activities during closure (reclamation phase) and the estimated TSP air emissions from proposed sources.

Project Activities ( )*	CLOSURE						
	2016	2017	2018	2019	2020	2021	2022
Reclamation Phase							
1. Remove Surface Facilities							
2. Reclaim Tailing Pond T4 (17.)					40.3	40.3	40.3
3. Reclaim Reclaim Ponds R1 and R2 (17.)			30.2	30.2	30.2		
4. Reclaim Tailing Pond T2 (remainder) (17.)	43.2	43.2					
5. Final Site Reclamation (17.)	20.9	41.8	41.8	20.9			
a. Reclaim Railroad Spur (17.)					24.5	24.5	
b. Reclaim Access Road (17.)						21.6	21.6
TOTAL	64.1	85.0	72.0	51.1	95.0	86.4	61.9

* Number within parentheses identifies this letter's response or air permit application source for the information.

Reclaim Tailing Pond T3

Process Rate: 24 months for 100 acres or approximately 4.2 acres/month

Duration: 24 months (2009-10)

Example Calculation:
4.2 acres/month x 1.2 st/acre/month x 12 months/yr = 60.5 st/yr

Reclaim Tailing Pond T2 (remainder)

Process Rate: 18 months for 54 acres or approximately 3.0 acres/month

Duration: 18 months (2016-17)

Example Calculation:
3.0 acres/month x 1.2 st/acre/month x 12 months/yr = 43.2 st/yr

Reclaim Mine/Mill Site

Process Rate: 36 months for 104 acres or approximately 2.9 acres/month

Duration: 36 months (2016-19)

Example Calculation:
2.9 acres/month x 1.2 st/acre/month x 12 months/yr = 41.8 st/yr

Reclaim Tailing Pond T4

Process Rate: 36 months for 99 acres or approximately 2.8 acres/month

Duration: 36 months (2020-22)

Example Calculation:
2.8 acres/month x 1.2 st/acre/month x 12 months/yr = 40.3 st/yr

Reclaim Ponds R1 and R2

Process Rate: 36 months for 75 acres or approximately 2.1 acres/month

Duration: 36 months (2018-20)

Example Calculation:
2.1 acres/month x 1.2 st/acre/month x 12 months/yr = 30.2 st/yr

Reclaim Railroad Spur

Process Rate: 24 months for 40 acres or approximately 1.7 acres/month

Duration: 24 months (2020-21)

Example Calculation:
1.7 acres/month x 1.2 st/acre/month x 12 months/yr = 24.5 st/yr

Reclaim Access Road

Process Rate: 24 months for 35 acres or approximately 1.5 acres/month

Duration: 24 months (2021-22)

Example Calculation:
1.5 acres/month x 1.2 st/acre/month x 12 months/yr = 21.6 st/yr

July 11, 1983 DNR comments - continued (initial responses were sent to DNR's February 24, 1983 comment letter)

Comment No. 5

The emission rates used in the air quality modeling should be the maximum allowable rate for each source. These maximum allowable emissions are those which would be allowed under Chapter NR 154, Wisconsin Administrative Code, for each source, or any more restrictive emission rate (and control measure) which would become a condition of the air permit once issued.

As discussed during the meeting on May 17th, these more restrictive emission rates would be used to make the major-minor source determination for the Crandon Project.

Response:

Comment acknowledged.

Comment No. 8

Your response to these comments would be appreciated. I am preparing additional questions concerning the sources and air pollution emissions expected from the Crandon Project. After these have been answered, I feel we can meet to discuss new air quality modeling of the project.

Response:

Comment acknowledged.

September 12, 1983 DNR Comments

A. Mine Construction

Comment No. A1

Prior to development of mine shafts and stopes beneath the surface, it is anticipated that excavation work will be required on the surface. Please estimate the fugitive dust generated during the initial stages of construction of the mine due to this excavation work to determine if it will be a significant source of emissions.

Response:

The surface construction activities necessary to prepare for sinking of the Main mine and Intake air shafts, East and West exhaust shafts (i.e. raises), and the road to the potable water supply well were included in the original estimates provided under the heading of mine/mill surface facilities construction. The estimated TSP air emissions for the construction of these individual areas are provided below for your information.

Emission Factor and Source: AP-42, Section 11.2.4.
TSP-EF - 1.2 st/acre/month

Access road to potable water supply well with pad - outside fence

Process Rate:

Road - $\frac{235 \text{ m} \times 6 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.35 acres

Pad - $\frac{\pi(25 \text{ m}/2)^2}{4047 \text{ m}^2/\text{acre}}$ = 0.12 acres

0.47 acres

Access road to east exhaust shaft with pad - outside fence

Process Rate:

Road - $\frac{135 \text{ m} \times 6 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.20 acres

Pad - $\frac{20 \text{ m} \times 20 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.10 acres

0.30 acres

Access road to west exhaust shaft with pad - outside fence

Process Rate:

Road - $\frac{45 \text{ m} \times 6 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.07 acres

Pad - $\frac{20 \text{ m} \times 20 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.10 acres

0.17 acres

Access road to explosives magazine and pad - outside fence

Process Rate:

Road - $\frac{88 \text{ m} \times 6 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.13 acres

- $\frac{527 \text{ m} \times 8 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 1.04 acres

Pad - $\frac{55 \text{ m} \times 120 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 1.63 acres

2.80 acres

Access road to preproduction ore storage and pad - outside fence

Process Rate:

Road - $\frac{240 \text{ m} \times 24 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 1.42 acres

Pad - $\frac{188 \text{ m} \times 188 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 8.70 acres

- $\frac{125 \text{ m} \times 25 \text{ m}}{4047 \text{ m}^2/\text{acre}}$ = 0.80 acres

10.92 acres

Total All = 14.7 acres

Duration: Assume all activities occur in the same month.
Control Method and Efficiency: Watering of disturbed area if necessary.
Example Calculation:
TSP - 1.2 st/acre/month x 14.7 acres = 17.6 st

Comment No. A2.

If temporary diesel generators are to be used prior to installation of electrical power lines, supply the expected fuel usage rates and predict the maximum hourly, daily and yearly air pollutant emissions for these generators (page 1.3-4 of the EIR).

Response:

The use of temporary diesel generators may be necessary for the first 6 months of the construction phase if transmission line electrical power is not available at the site. One 2500-kw unit will be required during these months to supply electrical power for mine shaft and mine/mill surface facilities construction (i.e. another 2500-kw unit will be installed for emergency purposes only for construction and operation). Fuel consumption for a 2500-kw unit is estimated to average 161 gallons per hour, 3,864

gallons per day, and 108,192 gallons per month. The resultant emissions from this unit were estimated as follows:

Diesel Generator:

Emission Factors and Source: AP-42, Appendix - C, Internal Combustion - electric generation - diesel

TSP - 13.0 lbs/10^3 gal
SO_x - 140.0 lbs/10^3 gal
NO_x - 370.0 lbs/10^3 gal
CO - 225.0 lbs/10^3 gal
HC - 37.0 lbs/10^3 gal

Process Rate: 161 gal/hr, 3,864 gal/day, and 108,192 gal/month

Duration: First 6 months of construction phase.

Control Method and Efficiency: None

Example Calculation:
TSP - 108,192 gal/month x 13.0 lbs/10^3 gal x 6 months x st/2000 lbs = 4.2 st/yr

	st/yr
TSP:	4.2
SO_x:	45.4
NO_x:	120.0
CO :	73.0
HC :	12.0

Comment No. A3.

Tree stumps and brush will be either burned or mulched for use in land restoration (page 1.3-2 of the EIR). Estimate the quantities of stumps and brush which will be burned during this phase of construction, provide the method which will be employed to insure clean, pollution-free burning and estimate the resultant emissions.

Response:

The following calculations estimate the air emissions if burning instead of mulching occurs for the tree stumps and brush accumulated from the mine/mill site, access road and railroad spur construction. Burning will be on the surface in an open area.

Emission Factors and Source: AP-42, Table 2.4-2, Forest residues - unspecified

Particulate (TSP)	NO_x	CO	HC
lb/st	lb/st	lb/st	lb/st
17	4	140	24.7

Process Rate: Total burn.
Duration: 12 months
Control Method and Efficiency: None
Example Calculations:

Mine/Mill Site - 1732 st of Forest residues for 104 acres

TSP: st of brush/yr x TSP lbs/st x st/2000 lbs =
1732 st/yr x 17 lb/st x st/2000 lbs =
TSP = 14.7 st/yr

NO_x: 1732 x 4 ÷ 2000 = 3.5 st/yr
CO : 1732 x 140 ÷ 2000 = 121.2 st/yr
HC : 1732 x 24.7 ÷ 2000 = 21.4 st/yr

Access Road - 316 st of Forest residues for 37 acres

TSP: 316 x 17 ÷ 2000 = 2.7 st/yr
NO_x: 316 x 4 ÷ 2000 = 0.6 st/yr
CO : 316 x 140 ÷ 2000 = 22.1 st/yr
HC : 316 x 24.7 ÷ 2000 = 3.9 st/yr

Railroad Spur - 497 st of Forest residues for 45 acres

TSP: 497 x 17 ÷ 2000 = 4.2 st/yr
NO_x: 497 x 4 ÷ 2000 = 1.0 st/yr
CO : 497 x 140 ÷ 2000 = 34.8 st/yr
HC : 497 x 24.7 ÷ 2000 = 6.1 st/yr

Comment No. A4

Approximately 551,000 short tons of preconstruction ore along with waste rock will be transported to the waste rock disposal area by truck prior to construction of the ore processing facilities (page 1.2-27 of the EIR). Estimate the fugitive dust generated by the transport, dumping and storage of this material during the mine construction phase to determine if it will be a significant source of emissions.

Response:

During the construction phase, waste rock and preproduction ore will be utilized or stored on the following schedule.

Year	Waste Rock Hauled (k-st)	Waste Rock In Storage (k-st)	Ore Handled (k-st)	Ore In Storage (k-st)
1986	11	11	-	-
1987	66	77	11	9*
1988	763	840	523	532
1989	1146	1986	366	898
1990	-	-	898	-

* 2 k-st (k = thousand) processed in pilot plant.

Estimates of fugitive dust (TSP) generated from various activities associated with waste rock and preproduction ore handling and storage are presented below.

Transportation emissions:

Emission Factor and Source: AP-42, Section 11.2.1.3

$TSP\text{-}EF = k\ 5.9\ (s/12)(S/30)^{2*}(W/3)^{0.7}(w/4)^{0.5}(d/365) = lb/veh\text{-}mile$

k = particle size multiplier (AP-42)
s = silt content (%)
S = vehicle speed (mph)
W = vehicle weight (st)
w = number of vehicle tires
d = number of dry days per year

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* Note: For speeds less than 30 mph the square of the ratio of $(S/30)^2$ [i.e. $(5/30)^2$] is used as recommended by the Wyoming Department of Environmental Quality (Fugitive dust emission factors. WDEQ, Division of Air Quality. January 24, Memorandum from Charles A. Collins, 1979).

Waste rock transport

k = 0.8	Maximum transport year = 1989
s = 6%	Tons hauled in year 1989 = 1,146,000 st
S = 15 mph	At 35 st/haul = 32,743 hauls
W = 51 st average (33 st truck empty)	Average haul distance = 4.4 miles/round trip
	Total mile haulage in 1989 = 144,069 veh-miles
w = 6 tires	
d = 230 dry days	

$EF = (0.8)\ 5.9\ (6/12)(15/30)^2(51/3)^{0.7}(6/4)^{0.5}(230/365) = lb/veh\text{-}mile$
$= 3.3\ lb/veh\text{-}mile$

Emissions (uncontrolled) = 3.3 lb/veh-mile x 144,069 veh-miles/yr x st/2000 lbs
= 237.7 st/yr

Emissions (controlled) = 237.7 st/yr x 0.15** = 35.7 st/yr

**85% control with chemical stabilization

Ore transport

k = 0.8
s = 6%
S = 15 mph
W = 51 st average (33 st truck empty)
w = 6 tires
d = 230 dry days

Maximum transport year = 1990
Tons hauled in year 1990 = 898,000 st
At 35 st/haul = 25,657 hauls
Average haul distance = 1.0 mile/round trip
Total mile haulage in 1990 = 25,657 hauls x 1.0 veh-mile/haul = 25,657 veh-miles

$$TSP\text{-}EF = (0.8)\ 5.9(6/12)(15/30)^2(51/3)^{0.7}(6/4)^{0.5}(230/365)$$
$$= 3.3 \text{ lb/veh-mile}$$

Emissions (uncontrolled) = 25,668 miles x 3.3 lb/veh-mile x st/2000 lbs
= 42.4 st

Emissions (controlled) = 42.4 st x 0.15* = 6.4 st

* 85% control with chemical stabilization

Loading and Dumping Emissions:

Emission Factors and Source: AP-42, Section 11.2.3, Aggregate Storage

$$TSP\text{-}EF\ (lb/st) = \frac{(f)(0.33)}{(PE/100)^2}$$

f = Decimal fraction of total emissions from individual activity
PE = Thornwaite's precipitation-evaporation index

Waste rock loading and dumping

1,146,000 st loaded and dumped in 1989
f = 0.12 for loading, and 0.15 for dumping
PE = 120 for site area

$$TSP\text{-}EF = \frac{(0.12)(0.33)}{(120/100)^2} = 0.0275 \text{ lb/st for loading}$$

$$= \frac{(0.15)(0.33)}{(120/100)^2} = 0.0344 \text{ lb/st for dumping}$$

Emissions (uncontrolled) = 0.0619 lb/st x 1,146,000 st/yr x st/2000 lbs
= 35.5 st/yr

Emissions (controlled) = 35.5 x 0.10** = 3.6 st/yr

** 90% control with water and chemical stabilization of storage pile.

Ore loading and dumping

898,000 tons loaded and dumped in 1990

EF's same as for waste rock

Emissions (uncontrolled) = 0.0619 lb/st x 898,000 st/yr x st/2000 lbs
= 27.8 st/yr

Emissions (controlled) = 27.8 st/yr x 0.10* = 2.8 st/yr

* 90% control with water and chemical stabilization of storage pile.

Wind-blown emissions:

Emission Factors and Source: See air permit application, Appendix B, p. B-29, PEDCO - Environmental Specialists, Inc., 1976. Evaluation of Fugitive Dust Emissions from Mining Task 1 Report. Identification of Fugitive Dust Sources Associated with Mining. Cincinnati, Ohio.

TSP-EF = a I K C L V**

a = Portion of total wind erosion losses measured as suspended particles (a = 0.025 for waste rock and preproduction ore)

I = Soil erodibility, tons/acre/year = 38 for waste rock and preproduction ore

K = Accounts for resistance to wind erosion provided by ridges and furrows or large soil clumps in the field. Ranges from 0.5 for a field with optimum ratio of ridge height to ridge spacing, to 1.0 (no reduction) for field with smooth surface. surface.

Assume 0.75 for storage areas and MWDF.

C = Climatic factor = 0.05 in site area
L = Unsheltered field width = 0.7
V = Vegetation cover factor. Assume unvegetated. V = 1.0

** Universal soil loss equation (see also response E3 for definition of variables.)

Waste rock wind-blown emissions

Assume 40 acres disturbed in 1989

TSP-EF = a I K C L V
a = 0.025
I = 38
K = 0.75
C = 0.05
L = 0.7
V = 1

TSP-EF = (0.025)(38)(0.75)(0.05)(0.7)(1) = 0.02494 st/acre/yr

Emissions (uncontrolled) = 40 acres x 0.02494 st/acre/yr = 1.0 st/yr

Ore wind-blown emissions

Total disturbed area in 1989 = 8 acres
TSP-EF = a I K C L V
a = 0.025
I = 38
K = 0.75
C = 0.05
L = 0.7
V = 1.0
EF = 0.02494 st/acre/yr

Emissions (uncontrolled) = 0.02494 st/acre/yr x 8 acres = 0.2 st/yr

Totals for construction phase hauling and storage of waste rock and preproduction ore are:

Source	Emissions (st/yr)	Maximum Year
Waste rock transport	35.7	1989
Waste rock loading and dumping	3.6	1989
Waste rock wind-blown emissions	1.0	1989
Ore transport	6.4	1990
Ore loading and dumping	2.8	1990
Ore wind-blown emissions	0.2	1990

Preproduction Ore Crushing and Handling:

Emission Factors and Source: AP-42, Table 8.23-1
TSP-EF = 0.5 lb/st - Primary Crushing
= 0.12 lb/st - Materials Handling

Process Rate: 440 st/hr, 5,510 st/day, 898,000 st/yr
Duration: 18 months (maximum in year 1990)

Control Method and Efficiency: Baghouse collector, 99% efficiency

Example Calculation:
TSP - 898,000 st/yr x 0.5 lb/st x (1-.99) x st/2000 lbs = 2.2 st/yr
898,000 x 0.12 x 2 x (1-.99) x st/2000 lbs = 1.1 st/yr
Total = 3.3 st/yr

B. Mine/Mill Surface Facilities Construction

Comment No. B1

Fugitive emissions from earthmoving and excavation activities were estimated using an emission factor (EF) of 0.0555 tons/acre/month corrected for silt content and precipitation data. Section 11.2.4 of U.S. EPA publication AP-42, however, states that: "Test data are not sufficient to derive the specific dependence of dust emissions on correction parameters." The original EF of 1.2 tons/acre/month provided in AP-42 should be used for these calculations unless adjustment of this value can be sufficiently justified. Additionally, the 6% soil silt content used to adjust the emission factor appears too low. Soils of Wisconsin published by the University of Wisconsin Press indicates silt contents of the native soils in the proposed mine site area range from 50% to 70%.

The fugitive dust emission calculations for the mine/mill site construction activities (page B-6 of the air permit application appendix) indicates construction will occur only 9 months per year, 5 during winter and 4 during summer. If this is in error and construction occurs at the summer level for 7 months during the year, the estimated fugitive dust emissions for the mine/mill site construction activities should be revised.

Response:

Major mine/mill surface facilities development will be completed within the first 12 months of the construction phase (see also response 17).

Emission Factors and Source: Two emission factors are used to represent fugitive dust (TSP) emissions from site area construction activities. On-site construction activities will be represented by the general factor described in response 17, (i.e. 1.2 st/acre/month). This general factor was not adjusted based on the site area estimated silt content of 15% from soil classification tests. However, some of the surface till will be hauled to the MWDF. Hauling emissions will be based on the following factor from AP-42.

$$\text{TSP-EF (lbs/veh-mile)} = k5.9\ (s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}\ (d/365)$$

The silt content (i.e. 6%) used in this calculation was as recommended by the DNR in comment E(D)1. Further, the calculations estimating the emissions are for the total year and not just the summer months.

(See responses 17, A4 and E1 for further definition of variables)

Example Calculations:

On-site construction

Site preparation completed in 12 months
Mine/mill site = 104 acres
Area disturbed/month = 104 ÷ 12 = 8.7 acres

Emissions (uncontrolled) = 1.2 st/acre/month x 8.7 acres x 12 months/yr
= 125.3 st/yr

Emissions (controlled) = 125.3 x 0.5* = 62.6 st/yr

* Control factor for watering from AP-42, Section 11.2.4.

Hauling of excavated till from mine/mill site to MWDF

Total soil material hauled:

96,396 yd^3 x 2,970 lb/yd^3 x st/2,000 lbs = 143,148 st
Assume 35 st/haul truck
Total number of trips = 4,090
Round trip miles from mine/mill site to MWDF = 4 miles
Total miles = 4,090 trips x 4 miles/trip = 16,360 miles
TSP-EF = $(0.8)5.9(s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}(d/365)$ = lb/veh-mile
= $(0.8)5.9(6/12)(15/30)^2(51/3)^{0.7}(6/4)^{0.5}(230/365)$
= 3.3 lb/veh-mile

Emissions (uncontrolled) = 3.3 lb/veh-mile x 16,360 miles x st/2,000 lb
= 27.0 st/yr

Emissions (controlled) = 27.0 st x 0.15** = 4.0 st/yr

** 85% control with chemical stabilization

Total TSP emissions from mine/mill site development including earthmoving excavation activities = 66.6 st/yr.

Comment No. B2

Estimate the fugitive dust emissions produced from use of the existing gravel roads before the construction of the access road is completed.

Response

Emissions of fugitive dust (TSP) from using existing gravel roads will be primarily from delivery of bentonite from the Woodlawn siding 6 miles east of the MWDF before the railroad spur is completed during 1987. Emission estimates are based on the following assumptions:

1) The access road and railroad will be constructed during the first 12 months of Project development;

2) Most traffic prior to construction of the new access road will use Sand Lake road to a 1/2 mile gravel access road to the mine/mill site;

3) Distance from the Woodlawn siding to MWDF is approximately 6 miles;

4) Construction personnel traffic during the first 12 months is estimated to be: 413 vehicles/day (i.e. 1.6 persons/vehicle and 1 mile round trip per vehicle).

5) Bentonite hauled during the first year would be 2,000 tons in 25 ton tractor trailers at 15 miles/hr along the 6 mile distance from the Woodlawn siding to the MWDF; and

6) An additional 12 service trucks, and 3 equipment delivery trucks would come on-site per day (i.e. 1 mile round trip).

Fugitive dust (TSP) emissions on gravel roads are based on the following factor:

$$TSP\text{-}EF = (0.8)5.9(s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}(d/365)$$

(See response to comment No. A4 for definition of variables)

Personnel traffic:

Assume average vehicle weighs 1.75 tons with 4 wheels.

$$TSP\text{-}EF = (0.8)5.9(12/12)(15/30)^2(1.75/3)^{0.7}(4/4)^{0.5}(230/365) = 1b/veh\text{-}mile$$
$$= 0.5\ 1b/veh\text{-}mile$$

Total miles traveled = 413 veh-miles/day x 5 days/week x 50 weeks/yr = 103,250 veh-miles/yr

Emissions (uncontrolled)= 103,250 veh-miles/yr x 0.5 lbs/veh-mile x st/2000 lbs
= 25.8 st/yr

Emissions (controlled) = 25.8 st/yr x 0.15* = 3.9 st/yr

* 85% control with chemical stabilization

Equipment truck traffic:

Assume average weight of heavy equipment trucks = 10 st, and service trucks = 5 st.

Heavy equipment truck traffic

3 truck miles/day x 5 days/week x 50 weeks/yr = 750 veh-miles/yr

$$TSP\text{-}EF = (0.8)5.9(12/12)(15/30)^2(10/3)^{0.7}(18/4)^{0.5}(230/365) = 1b/veh\text{-}mile$$
$$= 3.7\ 1b/veh\text{-}mile$$

Emissions (uncontrolled) = 3.7 1b/veh-mile x 750 veh-mile/yr st/2000 lbs
= 1.4 st/yr

Emissions (controlled) = 1.4 x 0.15* = 0.2 st/yr

Service truck traffic

12 truck miles/day x 5 days/week x 50 weeks/yr = 3,000 veh-mile/yr

$$TSP\text{-}EF = (0.8)5.9(1)(0.25)(5/3)^{0.7}(10/4)^{0.5}(0.6) = lb/veh\text{-}mile$$
$$= 1.7\ lb/veh\text{-}mile$$

Emissions (uncontrolled) = 1.7 lb/veh-mile x 3,000 veh-mile/yr x st/2000 lbs = 2.6 st/yr

Emissions (controlled) = 2.6 st/yr x 0.15* = 0.4 st/yr

Bentonite haulage

2,000 tons in 1986 ÷ 25 ton hauls in truck = 80 trips
80 trips x 12 miles per trip = 960 veh-miles
Average vehicle weight = (20 tons empty + 45 tons loaded) ÷ 2 = 33 tons

$$TSP\text{-}EF = (0.8)(5.9)(1)(0.5)^2(33/3)^{0.7}(6/4)^{0.5}(0.6) = lb/veh\text{-}mile$$
$$= 4.6\ lbs/veh\text{-}mile$$

Emissions (uncontrolled) = 4.6 lbs/veh-mile x 960 veh-miles/yr x st/2000 lbs = 2.2 st/yr

Emissions (controlled) = 2.2 st/yr x 0.15* = 0.3 st/yr

* 85% control with chemical stabilization

Total TSP emissions from use of gravel roads are 4.8 st/yr.

Comment No. B3

As with mine construction, if temporary diesel generators are to be used prior to installation of electrical power lines, supply the expected fuel usage rates and predict the maximum hourly, daily and yearly air pollulant emissions for these generators (page 1.3-4 of the EIR).

Response:

The estimated air emissions from the temporary diesel generators necessary during the mine/mill surface facilities construction phase is included in response A2.

Comment No. B4

As with mine construction, estimate the quantities of tree stumps and brush which will be burned during this phase of construction, provide the method which will be employed to insure clean, pollution-free burning and estimate the resultant emissions.

Response:

See response to Comment No. A3.

Comment No. B5

Estimate the fugitive dust generated during construction of the water discharge pipeline to determine if it will be a significant source of emissions.

Response:

Construction of the wastewater discharge pipeline will not be an important source of TSP emissions based on the following calculations.

Assume:

Total construction area	= 15 acres
Pipeline distance	= 6.1 miles
Total disturbed width	= 20 ft
Sand and gravel backfill	= 3,500 yd^3
Average haul distance	= 3 miles
Pipeline construction period	= 6 months

Emissions are primarily generated from general excavation, and stripping and hauling of sand and gravel.

General Construction:

TSP-EF = 1.2 st/acre/month
Area disturbed/month = 15 acres/6 months = 2.5 acres/month

Emissions (uncontrolled) = 1.2 st/acre/month x 2.5 acres/month x 6 months
= 18 st

Emissions (controlled) = 18 st x 0.5* = 9 st

Hauling:

3,500 yd^3 sand and gravel ÷ 5 yd^3/haul = 700 hauls
700 hauls at 6 miles round trip/haul = 4,200 veh-miles

TSP-EF = $(0.8)5.9(15/12)(10/30)^2(10/3)^{0.7}(6/4)^{0.5}(230/365)$ = lb/veh-mile
= 1.2 lb/veh-mile

Emissions (uncontrolled) = 1.2 x 4,200 veh-miles x st/2000 lb = 2.5 st/yr

Emissions (controlled) = 2.4 st/yr x 0.5* = 1.2 st/yr

* 50% control with watering.

Total construction phase TSP emissions for the wastewater discharge pipeline are conservatively estimated to be 10.2 st/yr.

Comment No. B6

Provide the capacity and number of diesel and gasoline storage tanks to be used during the construction phase of the Crandon Project.

Response:

The mine/mill surface facilities development will require the following fuel storage tanks during the construction phase. For initial site construction, one 20,000-gallon temporary tank will be used for diesel fuel storage. Also, one 1,000-gallon temporary tank will be used for gasoline storage. Both of these tanks will be replaced 24 months after start of construction with the following:

Diesel fuel storage tanks

1. Two 15,000-gallon main tanks - above ground;
   4 m in diameter x 5 m height
   with fixed roofs.

2. Two 3,000-gallon transfer tanks - above ground;
   2.5 m in diameter x 3 m height
   with fixed roofs.

Fueling station, diesel and gasoline tanks

1. One 4,000-gallon underground tank (diesel)
2. One 1,000-gallon underground tank (gasoline)

The maximum use of diesel fuel and gasoline during the construction phase is estimated to occur in months 9 through 13. During this period peak fuel consumption rates for diesel fuel and gasoline are estimated to be 6,000 gallons per day and 125 gallons per day, respectively.

C. Mine Operations

Comment No. C1

When calculating the dust emissions from mine operations, each ore transfer operation should be addressed as a source of emissions. The discussion of ore transport and primary crushing (page 1.4-4 of the EIR) indicates approximately twelve (12) transfers for which the appropriate emission factor should be applied. Emissions from blasting should be estimated separately. It is assumed that dust emissions from the east and west exhaust raises will be recalculated treating the mine as a settling chamber as discussed in Item 8, page 2 of my July 11, 1983 letter to yourself.

Response:

The mine emission values initially submitted were calculated without the aid of the recently published AP-42, Sections 8.23 and 8.24, emission factors. Therefore, a rework of the estimates with the new emission factors and the use of gravity settling has led to the following peak rates for TSP emissions from the entire underground mine. Procedures used in derivation of these values are attached for your information. As per the DNR comment, the mine was treated as a settling chamber using the specific air velocity rates in the mine to determine the residence settling times for each activity.

Previous reference to a control efficiency similar to that found in spray towers was more directly related to conditions typically experienced in mine exhaust shafts. For example, in the mine exhaust shafts moisture saturated air ascends the exhaust shafts and loses its ability to retain moisture. The air physics experienced in mine exhaust shafts are similar to those for an ideal gas, as presented by the equation PV = nRT; where P = pressure, V = volume, n = weight of air in pounds (lbs), R = universal gas constant (i.e. 53.3) and T = temperature. In this equation the decrease in pressure and the increase in volume, causes a decrease in temperature (i.e. 2°F per 1000 ft rise); therefore, supersaturation occurs and water droplets form. These droplets begin to fall as they combine with other droplets. Some of the condensed moisture contacts the shaft walls as it falls and some are deposited at the shaft bottom or re-evaporated and distributed with the air as it rises in the exhaust shaft.

In the mine exhaust shafts only the smallest droplets remain in the air stream and eventually are discharged from the shaft. Once outside the shafts, the contained moisture will condense further (i.e. cold conditions) and deposit rapidly or evaporate (i.e. warm conditions). These conditions will definitely affect the retention and settling of particles. The majority of the particles in the mine exhaust air stream will deposit within the shaft or settle in close proximity to the point of discharge. This process serves to assist the settling rates used in the attached calculation. However, credit for this "spray tower" effect was not used, and in addition, the conservative emission rates derived from blasting factors for surface coal mining (i.e. none are available for hard rock mining which would be lower) were utilized to calculate the estimated TSP emissions.

Underground Blasting Emissions: Blasting of rock using 90% ANFO and 10% water gel in production stope blasting and drift development.

Emission Factor and Source: AP-42, Table 8.24-2, Blasting-surface coal mining

$$\text{TSP-EF} = \leq 30 \text{ um}$$

$$\text{TSP-EF} = \frac{344(A)^{0.8}}{(D)^{1.8}\ (M)^{1.9}}$$

where;
A = Area blasted - m^2
D = Hole depth - m
M = Material moisture content - %

Process Rate:

Production Stopes

A = 45 m x 20 m = 900 m^2
D = 1/2 Depth of stope drillhole - 60 m
M = Material moisture content - 4 % minimum

$$\text{TSP-EF} = \frac{344(900)^{0.8}}{(60)^{1.8}(4)^{1.9}} = 3.6 \text{ kg/blast}$$

Stope blast material weight (W) = Volume (V) x Density
V = 900 m^2 x 60 m = 54,000 m^3/stope blast
Density = 3.026 t/m^3

W = 54,000 m^3/stope blast x 3.026 t/m^3 = 163,404 t/stope blast
3,276,000 t/yr ÷ 163,404 t/stope blast x 3.6 kg/blast x t/1000 kg = 0.07 t/yr

Development Headings

A = 3.5 m x 5 m = 17.5 m^2
D = Depth of heading drill hole - 3.66 m
M = Material moisture content - 4%

$$\text{TSP-EF} = \frac{344(17.5)^{0.8}}{(366)^{1.8}(4)^{1.9}} = 23.6 \text{ kg/blast}$$

W = V x Density
V = 17.5 m^2 x 3.2 m = 56 m^3
Density = 3.026 t/m^3

W = 56 m^3/heading blast x 3.026 t/m^3 = 169.5 t/heading blast
353,000 t/yr ÷ 169.5 t/heading blast x 23.6 kg/heading blast x t/1000 kg = 49.1 t/yr

Total TSP (underground blasting) = 49.2 t/yr before gravity settling.

Underground Blasting Emissions with Gravity Settling:

Production Stopes and Development Headings - using average distances and velocities to the mine exhaust shafts (Use 350 m level stope 3-18 as a typical scheme).

Mine ventilation air stream branch velocities:

Horizontal Velocity ft/minute	Distance ft	Time minutes
137	345	2.5
86	267	3.1
621	628	1.0
417	510	1.2
732	979	1.3

Total = 9.1 minutes (546 seconds) - (i.e. horizontal airways only) for travel time from blast area to exhaust shaft

Emission Factor and Source: AP-42, Appendix A-1, Stone quarrying and processing - crushing

Particle size distribution				
< 5 um	5 to 10 um	10 to 20 um	20 to 30 um	>30 um
25%	25%	25%	25%	0

Settling velocity: Particle density: 3.026 t/m^3

Settling height, average: 2.0 m

Weight Percent	Particle Size (um)	Vertical Settling Velocity (m/sec)		Time (sec)		Settled Distance
25%	<5.	0.0036	x	546	=	1.96 m passed
25%	7.5 (5-10)	0.00637	x	546	=	3.48 m settled
25%	15 (10-20)	0.0254	x	546	=	13.87 m settled
25%	25 (20-30)	0.058	x	546	=	31.67 m settled

Determination of % Control (i.e. percent settled): Using a settling height of 2 m, all particles in the <5 um range are assumed to remain in the air stream. Therefore, 75% overall control (i.e. percent settled) is estimated for gravity settling of blasting TSP emissions.

Total TSP (underground blasting) with gravity settling estimated in the air stream from mine exhaust shafts.

49.3 t/yr x 0.25 (i.e. 1 - decimal fraction settled) = 12.3 t(13.6 st)/yr

Handling Emissions at Stope Drawpoints and Development Headings:

Rock handling performed by LHD equipment. A maximum of 12 in operation at any given time.

Emission Factor and Source: AP-42, Table 8.23-1, p. 8.23-4.

The use of this AP-42 section is not directly applicable because of the large size of the mined rock. However, the ore and waste rock is expected to have a moisture content of no less than 4% by weight and is considerably larger than that encountered after coarse rock crushing. Therefore, the values presented in EPA Table 8.23-1 are a conservative estimate of TSP emissions.

TSP-EF = 0.005 kg/t - Handling of high moisture rock

Process Rate: 900 t/hr, 16,000 t/day, 3,629,000 t/yr for ore and waste rock at maximum production rate.

Duration: As noted in process rate.
Control Method and Efficiency: Wetting dry piles.

Example Calculation:
TSP - 3,629,000 t/yr X 0.005 kg/t ÷ 1000 kg/t = 18.1 t/yr

Total TSP (drawpoints and development headings) = 18.1 t/yr before gravity settling.

Handling Emissions at Stope Drawpoints and Development Headings with Gravity Settling:

Emission Factor and Source: AP-42, Appendix A, Table A-1, p.A-3, Stone quarrying and processing - crushing

Particle size distribution				
<5 um	5 to 10 um	10 to 20 um	20 to 44 um	>44 um
5%	5%	5%	10%	75%

Settling parameters and mine ventilation air stream branch velocities are the same as for the underground blasting emissions.

Weight Percent	Particle size (um)	Vertical Settling Velocity (m/sec)		Time (sec)		Settled Distance
5%	<5.	0.0036	x	546	=	1.96 m passed
5%	7.5 (5-10)	0.00637	x	546	=	3.48 m settled
5%	15. (10-20)	0.0254	x	546	=	13.87 m settled
10%	25. (20-44)	0.058	x	546	=	31.67 m settled
75%	>44.	0.181	x	546	=	98.83 m settled

Determination of % Control (i.e. percent settled):
Using a settling height of 2 m, all particles >5 um are assumed to settle. Therefore, 95% overall control (i.e. percent settled) is estimated for gravity settling of stope and development headings rock handling.

Total TSP (drawpoints and development headings) with gravity settling estimated in the air stream from the mine exhaust shafts.

18.1 t/yr x 0.05 (i.e. 1 - decimal fraction settled) = 0.9 t(1.0 st)/yr

Emissions from Handling at Orepasses and Waste Rock Passes:

Emission Factor and Source: AP-42, Table 8.23-1.
TSP-EF = 0.005 kg/t - Handling of high moisture rock

Process Rate: 900 t/hr, 16,000 t/day, 3,629,000 t/yr
Duration: As noted in process rate.
Control Method and Efficiency: Wetting if necessary.

Example Calculation:
TSP - 3,629,000 t/yr x 0.005 kg/t ÷ 1000 kg/t = 18.1 t/yr

Total TSP (orepasses and waste rock passes) = 18.1 t/yr before gravity settling.

Emissions from Handling at Orepasses and Waste Rock Passes with Gravity Settling:

Mine ventilation air stream branch velocities:

Horizontal Velocity ft/minute	Distance ft	Time minutes
621	628	1.0
417	510	1.2
732	979	1.3
		Total = 3.5 minutes (210 seconds) - (i.e. horizontal airways only) for air travel time from load area to exhaust shaft

Emission Factor and Source: AP-42, Appendix A, Table A-1, p. A-3, Stone quarrying and processing-crushing

Particle size distribution				
< 5 um	5 to 10 um	10 to 20 um	20 to 44 um	> 44 um
5 %	5 %	5 %	10 %	75 %

Settling parameters are the same as for the underground blasting emissions.

Weight Percent	Particle size (um)	Vertical Settling Velocity (m/sec)		Time (sec)		Settled Distance
5	< 5	0.0036	x	210	=	0.76 m passed
5	7.5 (5 to 10)	0.00637	x	210	=	1.34 m passed
5	15.0 (10 to 20)	0.0254	x	210	=	5.33 m settled
10	25.0 (20 to 44)	0.058	x	210	=	12.18 m settled
75	>44	0.181	x	210	=	38.01 m settled

Determination of % control (i.e. percent settled): Using a settling height of 2 m, all particles > 10 um are assumed to settle. Therefore, 90% overall control (i.e. percent settled) is estimated for gravity settling for rock handling at orepasses and waste rock passes.

Total TSP (orepasses and waste rock passes) with gravity settling estimated in the air stream from mine exhaust shafts.

18.1 t/yr x 0.10 (i.e. 1 - decimal fraction settled) = 1.8 t(2.0 st)/yr

Emissions from Handling - Chute to Rail Car:

Emission Factor and Source: AP-42, Table 8.23-1
TSP-EF = 0.005 kg/t - Handling of high moisture ore
Process Rate: 700 t/hr, 14,000 t/day 3,276,000 t/yr
Duration: As noted in process rate.
Control Method and Efficiency: Wetting if necessary.

Example Calculation:
TSP - 3,276,000 t/yr x 0.005 kg/t ÷ 1000 kg/t = 16.4 t/yr

Total TSP (chute to railcar) = 16.4 t/yr before gravity settling.

Emissions from Handling - Chute to Railcars with Gravity Settling:

Particle size ranges are the same as for handling at orepasses and waste rock passes.

Mine ventilation air stream branch velocities:

Horizontal Velocity ft/minute	Distance ft	Time minutes
285	50	.18
285	100	.35
1156	1235	1.07
1077	498	.46
1268	479	.38
1268	403	.32
2536	160	.06

Total = 2.82 minutes (169 seconds) - (i.e. horizontal airways only) for travel time from load area to exhaust shaft.

Settling parameters are the same as for the underground blasting emissions.

Weight Percent	Particle Size (um)	Vertical Settling Velocity (m/sec)		Time (sec)		Settled Distance
5	5	.0036	x	169	=	0.61 m passed
5	7.5 (5 to 10)	.00637	x	169	=	1.08 m passed
5	15 (10 to 20)	.0254	x	169	=	4.29 m settled
10	25 (20 to 44)	.058	x	169	=	9.80 m settled
75	> 44	.181	x	169	=	30.59 m settled

Determination of % control (i.e. percent settled): Same as for handling at orepasses and waste rock passes.

Total TSP (chute to railcar) with gravity settling estimated in the air stream from mine exhaust shafts.

16.4 t/yr x 0.10 (i.e. 1 - decimal fraction settled) = 1.6 t(1.8 st)/yr

Handling from Railcars into Crusher Feed Bins:

Emission Factor and Source: AP-42, Table 8.23-1
TSP-EF = 0.005 kg/t - Handling of high moisture ore

Process Rate: 700 t/hr, 14,000 t/hr, 3,276,000 t/yr
Duration: As noted in process rate.
Control Method and Efficiency: Wetting if necessary.

Example Calculation:
TSP - 3,276,000 t/yr X 0.005 kg/t ÷ 1000 kg/t = 16.4 t/yr

Total TSP (railcar to crusher feed bins) = 16.4 t/yr before gravity settling.

Handling from Railcars into Crusher Feed Bins with Gravity Settling:

Particle size ranges are the same as for handling at orepasses and waste rock passes.

Mine ventilation air stream branch velocities:

Horizontal Velocity ft/minutes	Distance ft	Time minutes
200	100	.50
379	136	.36
427	165	.39
513	632	1.23
513	632	1.23
606	543	.90
768	714	.93
1609	890	.55
1612	360	.22
1610	242	.15

Total = 6.46 minutes (387 seconds) - (i.e. horizontal airways only) for travel time from loadout area to exhaust shaft.

Settling parameters are the same as for the underground blasting emissions.

Weight Percent	Particle Size (um)	Vertical Settling Velocity (m/sec)		Time (sec)		Settled Distance
5	5	.0036	x	387	=	1.39 m passed
5	7.5 (5 to 10)	.00637	x	387	=	2.47 m settled
5	15 (10 to 20)	.0254	x	387	=	9.83 m settled
10	25 (20 to 44)	.058	x	387	=	22.45 m settled
75	> 44	.181	x	387	=	70.05 m settled

Determination of % control (i.e. percent settled): Same as for handling at stope drawpoints and development headings.

Total TSP (railcar to crusher feed bins) with gravity settling estimated in the air stream from mine exhaust shafts.

16.4 t/yr x 0.05 (i.e. 1 - decimal fraction settled) = 0.8 t(0.9 st)/yr

Crusher Feeder Bins to Primary Crusher:

Emission Factor and Source: AP-42, Table 8.23-1
TSP = 0.005 kg/t - Handling of high moisture rock
Process Rate: 1200 t/hr, 16,000 t/day, 3,629,000 t/yr
Duration: As noted in process rate.
Control Method and Efficiency: Wetting if necessary.

Example Calculation:
TSP - 3,629,000 t/yr x 0.005 kg/t ÷ 1000 kg/t = 18.1 t/yr

Total TSP (feed bins to crusher) = 18.1 t/yr before gravity settling.

Crusher Feed Bins to Primary Crusher with Gravity Settling:

Particle size ranges, mine ventilation air stream branch velocities, settling parameters, and determination of % settled are the same as for handling from railcars into crusher feed bins.

Total TSP (feed bins to crusher) with gravity settling estimated in the air stream from mine exhaust shafts.

18.1 t/yr x 0.05 (1 - decimal fraction settled) = 0.9 t(1.0 st)/yr

Coarse Crushing to -150 mm (-6 inches):

Emission Factor and Source: AP-42, Table 8.23-1
TSP = 0.01 kg/t - Primary crushing of high moisture rock
Process Rate: 1200 t/hr, 16,000 t/day, 3,629,000 t/yr
Duration: As noted in process rate.

Control Method and Efficiency: Insertable Dust Collector, similar to DCE Vokes Model No. DLMV 45/15 F1 - 99% Efficiency.

Example Calculation:
TSP - 3,629,000 t/yr x 0.01 kg/t ÷ 1000 kg/t x (1-.99) = 0.4 t(0.4 st)/yr

Crusher Discharge to Picking Belt:

Emission Factor and Source: AP-42, Table 8.23-1
TSP - 0.005 kg/t - Transfer of high moisture rock
Process Rate: 1200 t/hr, 14,700 t/day, 3,629,000 t/yr
Duration: As noted in process rate.

Control Method And Efficiency: Insertable Dust Collector, similar to DCE Vokes Model No. DLMV 45/15 F1 - 99% Efficiency.

Example Calculation:
TSP - 3,629,000 t/yr x 0.005 kg/t ÷ 1000 kg/t x (1-.99) = 0.2 t(0.2 st)/yr

Transfer from Picking Belt to Loading Belt:

Emission Factor and Source: AP-42, Table 8.23-1
TSP - 0.005 kg/t - Transfer of high moisture rock
Process Rate: 1200 t/hr, 14,400 t/day, 3,629,000 t/yr
Duration: As noted in process rate.

Control Method and Efficiency: Insertable Dust Collector, similar to DCE Vokes Model No. DLMV 45/15 F1 - 99% Efficiency.

Example Calculation:
TSP - 3,629,000 t/yr x 0.005 kg/t ÷ 1000 kg/t x (1-.99) = 0.2 t(0.2 st)/yr

Transfer From Loading Belt to Hoisting Pocket:

Emission Factor and Source: AP-42, Table 8.23-1
TSP - 0.005 kg/t - Transfer of high moisture rock
Process Rate: 1200 t/hr, 14,400 t/day, 3,629,000 t/yr
Duration: As noted in process rate.

Control Method and Efficiency: Insertable Dust Collector, similar to DCE Vokes Model No. DLMV 45/15 F1 - 99% Efficiency.

Example Calculation:
TSP - 3,629,000 x 0.005 kg/t ÷ 1000 kg/t x (1 - .99) = 0.2 t(0.2 st)/yr

Transfer from Hoisting Pocket into Skip:

Emission Factor and Source: AP-42, Table 8.23-1
TSP = 0.005 kg/t - Transfer of high moisture rock
Process Rate: 1100 t/hr, 14,400 t/day, 3,629,000 t/yr
Duration: As noted in process rate.

Control Method and Efficiency: Insertable Dust Collector, similar to DCE Vokes Model No. DLMV 45/15 F1. - 99% Efficiency.

Example Calculation:
TSP - 3,629,000 t/yr x 0.005 kg/t ÷ 1000 kg/t x (1-.99) =
0.2 t(0.2 st)/yr

Mobile Equipment:

Use of diesel equipment to move personnel, materials, and rock. Diesel fuel will contain 0.4 weight percent sulfur maximum.

Emission Factor and Source: "Emission control of a Deutz F6L-714 diesel engine, derated for underground use, by application of water/oil fuel emissions" by A. Lawson, E. W. Simmons, and M. Piett. March 30, 1979.

TSP -	11.0 lb/10^3 gal	(1.61 g/kg)	- Lawson, et al. 1979. p. 62
SO_x -	31.0 lb/10^3 gal	(4.54 g/kg)	- off road construction equipment from EPA NEDS.
NO_x -	108.5 lb/10^3 gal	(15.9 g/kg)	- Lawson, et al. 1979. p. 81
CO -	2.01 lb/10^3 gal	(0.295 g/kg)	- Lawson, et al. 1979. p. 69
HC -	1.97 lb/10^3 gal	(0.289 g/kg)	- Lawson, et al. 1979. p. 66

Process Rate: 879 1/hr, 15,841 1/day, 3,654,000 1/yr
Duration: As noted by process rate.

Control Method and Efficiency: Use of clean burning air cooled Deutz engines with a catalytic scrubber.

Example Calculation:

$$\text{TSP} - \frac{3{,}654{,}000 \text{ 1/yr} \times 0.845 \text{ kg/1} \times .00161 \text{ kg(TSP)/kg}}{1000 \text{ kg/t}} = 5 \text{ t(5.5 st)/yr}$$

Mine Air Heating:

Use of natural gas (heat content 1000 BTU/SCF) for direct-fired mine air heating.

Emission Factor and Source: EPA NEDS - Source classification codes, Appendix C, p. C-5, 12/75.

TSP -	10.0 lb/10^6 SCF	(4.54 kg/10^6 SCF)
SO_x -	0.6 lb/10^6 SCF	(0.27 kg/10^6 SCF)
NO_x -	120.0 lb/10^6 SCF	(54.48 kg/10^6 SCF)
CO -	20.0 lb/10^6 SCF	(9.08 kg/10^6 SCF)
HC -	8.0 lb/10^6 SCF	(3.63 kg/10^6 SCF)

Process Rate: - 91,800 SCF/hr, 2.203×10^6 SCF/day, 110.6×10^6 SCF/yr
Duration: When weather conditions require.
Control Method and Efficiency: Use of natural gas.

Example Calculation:
TSP - 110.6×10^6 SCF/yr x 4.54 kg/10^6 SCF ÷ 1000 kg/t = 0.5 t(0.6 st)/yr

TOTAL Estimated Underground Emissions

	TSP (st/yr)
Blasting	13.6
Rock Handling	
Drawpoints and development headings	1.0
Orepasses and waste rock passes	2.0
Chute to railcar	1.8
Railcar to crusher feed bins	0.9
Feed bins to primary crusher	1.0
Coarse crushing	0.4
Crusher discharge to picking belt	0.2
Picking belt to loading belt	0.2
Loading belt to hoisting pocket	0.2
Hoisting pocket into skip	0.2
Mobile Equipment	5.5
Mine Air Heating	0.6
Total	27.6

Comment No. C2

Four storage tanks for diesel fuel will be located within the mine for use by mine mobile equipment (page 1.2-10 of the EIR). Please provide the size, throughput and emissions of these tanks.

Response:

The present mine engineering specifies two underground diesel fuel storage tanks, one on the 350 m level and another on the 695 m level. Each tank has a storage capacity of 14,000 l (3,700 gal). Total mine fuel consumption peak volumes are estimated to be 813 l (215 gal) per hour, 15,850 l (4,188 gal) per day, and 3,655,000 l (965,655 gal) per year.

Diesel Fuel Underground Storage Tanks:

Filling, breathing loss, and dispensing loss of two - 3,700 gallon storage tanks with diesel fuel.

Emission Factors and Source: AP-42, Table 4.44

HC - gasoline - Submerged filling - 7.3 lb/10^3 gal
- Breathing loss - 1.0 lb/10^3 gal
- Displacement losses (vehicle filling) - 9.0 lb/10^3 gal

$$\text{Diesel Fuel Correction} - \frac{(0.0064\ vp)(130\ mw)\ (Diesel)}{(5.2\ vp)(66\ mw)\ (Gasoline)} = 0.0024\ \text{Multiplier}$$

vp = vapor pressure
mw = molecular weight

Process Rate: 3700 gal/hr, 7400 gal/day, 965,655 gal/yr
Control Method and Efficiency: Submerged filling.

Example Calculation:

Submerged filling

HC - 7.3 lb/10^3 gal x 965,655 gal/yr x 0.0024 x st/2000 lbs
= 0.008 st/yr

Breathing loss

HC - 1.0 lb/10^3 gal x 965,655 gal/yr x 0.0024 x st/2000 lbs
= 0.001 st/yr

Displacement losses (vehicle filling)

HC - 9.0 lb/10^3 gal x 965,655 gal/yr x 0.0024 x st/2000 lbs
= 0.01 st/yr

Total = 0.02 st/yr

Estimated emission totals for hydrocarbons (HC) from the underground fuel storage tanks are 0.02 st/yr.

Comment No. C3

How large will the emergency back-up electrical generators be? How often and how much fuel will be used when the generators are tested (page 1.2-11 of the EIR).

Response:

The use of 3 emergency (i.e. back-up) diesel generators are required to supply electrical power in the event transmission line service is interrupted to the Project facilities. For this purpose two 2500-and one 1000-kw units will supply emergency power for the mine and for the mill facilities, respectively. These units are intended for use only in emergencies. However, to assure their ability to perform, weekly operation of each unit is necessary for a maximum of 1 hour. Also, emergency operation was estimated to be 2.5 hours per year. Total diesel fuel usage will be 192 gallons per hour per 2500 kw unit, 461 gallons per day (i.e. weekly test), and 25,125 gallons per year including the weekly and emergency operation of each unit.

Emergency Diesel Generators:

Use of two 2500-kw for the mine and one 1000-kw generator for the mill for emergencies.

Emission Factors and Source: EPA, AP-42, Appendix-C, Internal combustion-electric generation-diesel, p. C-6.

TSP - 13.0 lbs/10^3 gal
SO_x - 140.0 lbs/10^3 gal
NO_x - 370.0 lbs/10^3 gal
HC - 37.0 lbs/10^3 gal
CO - 225.0 lbs/10^3 gal

Process Rate: 192 gal/hr, 461 gal/day, 25,125 gal/yr
Duration: Each unit will be operated a maximum of 1 hr/wk, and estimated emergency purposes are 2.5 hr/yr.
Control Method and Efficiency: None

Example Calculation:
TSP - 25,125 gal/yr x 13.0 lbs/10^3 gal x st/2000 lbs = 0.2 st/yr

Estimated emissions are as follows:

	st/yr
TSP:	0.2
SO_x:	1.8
NO_x:	4.7
HC :	0.5
CO :	2.8

D. Mine/Mill Surface Facilities Operation

Comment No. D1

The backfill storage facility will have area reserved for the storage of approximately 165,000 short ton of backfill (page 1.2-24 of the EIR). Estimate fugitive dust from the storage of backfill to determine if it will be a significant source of emission.

Response:

Current engineering design has eliminated the area for the backfill storage facility. A smaller area has been designed for storage of the preproduction ore. For estimated emissions from this area, see response A4.

Comment No. D2

Please provide a flow diagram of ore handling and treatment operations indicating pick-up points for dust generated and the emission control equipment.

Response:

The attached drawings (see Responses 2 and 3) and technical information below are the design specifications for the mill operation phase process, and air pollution control, equipment.

Mine/Mill Activities		Original	Revised
EER & WER*	Ventilation exhaust shafts (i.e., raises)	875 m^3/s(1.85 x 10^6 ft^3/min)	590 m^3/s (1.25 x 10^6 ft^3/min)
R.	Transport of ore to headframe	21,800 t(24,000 st)/day	Stack eliminated - insertable collector
P.	Waste rock storage bins	15,000 t(16,500 st)/day	Facilities eliminated
Q.	Waste rock crushing	3,600 t(4,000 st)/day	Facilities eliminated
A.	Coarse ore storage building	15,000 t(16,500 st)/day	Stack eliminated - insertable collectors
E.	Surge-bin to secondary & tertiary crushing and screening	15,000 t(16,500 st)/day	15,000 t (16,500 st)/day
F.	Secondary & tertiary crushing and screening	15,000 t(16,500 st)/day	15,000 t (16,500 st)/day
D.	Fine ore crushing transfer tower	15,000 t(16,500 st)/day	Stack eliminated - insertable collectors
B.	Cu-Pb-Zn fine ore bin loading**	15,000 t(16,500 st)/day	Ducted to single scrubber. Discharged through single common stack. Rates remain the same for B, G, C, and H.
G.	Cu-Pb-Zn fine ore bin unloading	5,300 t(5,800 st)/day	
C.	Cu-Zn fine ore bin loading**	15,000 t(16,500 st)/day	
H.	Cu-Zn fine ore bin unloading	4,500 t(5,000 st)/day	
I.	Milk of Lime storage	1,200 t(1,350 st)/day	Stack eliminated - insertable collectors on soda ash and lime silos.
S.	Reagent mixing facilities	25 t(27.5 st)/day	Stack eliminated
AA. & BB.	Concentrate handling and shipping	2,100 t(2,300 st)/day	Stack eliminated - material moisture content 10% minimum.
MN.	Backfill system	4,800 t(5,300 st)/day	Stacks and passive filters eliminated and replaced with insertable collectors on cement storage silo
O.	Batch plant	38.3 m^3(50 yd^3)/day	38.3 m^3(50 yd^3)/day

*See Air Permit Application, Figure 2-2, p. 2-4.
**Combined process and/or individual rates and resultant emissions will not exceed stated value of either one [i.e. 15,000 t (16,500 st)/day].

Comment No. D3

The emission calculations for the concrete batch plant (page B-18 of the air permit application appendix) appear to use an incorrect process flow rate. The flow rate given is 38.3 m^3 of concrete. If this is an hourly rate, then at 2400 kg per m^3 the process flow rate is 92 tons per hour. The rate used for the calculations is 10.7 tons per hour. Please recalculate these emissions.

Response:

The process rate for the concrete batch plant presented on page B-18 of the Air Permit Application Appendix B should have stated 50 yd^3 (38.3 m^3) per 8 hour shift (i.e. 1-shift per day or 38.3 m^3 concrete/day). The hourly process rate should have been 11.5 t/hr rather than the 10.7 t/d shown on p. B-19. Estimated TSP emissions are recalculated as follows and the Air Permit Application will be revised accordingly.

Concrete Batch Plant

Emission Factor and Source: AP-42, Table 8.10-1
TSP-EF = 0.12 kg/m^3

Process Rate: 38.3 m^3/shift, 1 shift/day, 5 days/wk, 52 wks/yr

Control Method and Efficiency: Baghouse with ducting - overall collection efficiency for "good controlled" batch plant is 90% (i.e. AP-42, Table 8.10-1).

Example Calculation:
TSP - 38.3 m ^{3}/day x 5 day/wk x 52 wks/yr x 0.12 kg/m^3 x (1-.90) x t/1000 kg = 0.1 t(0.1 st)/yr

Comment No. D4

Please provide a copy of the reference used to calculate the emissions from locomotive exhaust, or use AP-42 emissions factors in Section 3.2.2 instead.

Response:

The diesel locomotive used during mine/mill surface facilities operation has been resized. Present design will use a unit with emissions estimated using EPA, NEDS sources (see attached, source No. 45).

01	Residential Anthracite Coal
02	Residential Bituminous Coal
03	Residential Distillate Oil
04	Residential Residual Oil
05	Residential Natural Gas
06	Residential Wood
07	Comm-Inst Anthracite Coal
08	Comm-Inst Bituminous Coal
09	Comm-Inst Distillate Oil
10	Comm-Inst Residual Oil
11	Comm-Inst Natural GAs
12	Comm-Inst Wood
13	Industrial Anthracite Coal
14	Industrial Bituminous Coal
15	Industrial Coke
16	Industrial Distillate Oil
17	Industrial Residual Oil
18	Industrial Natural Gas
19	Industrial Wood
20	Industrial Process Gas
21	Residential On-Site Incineration
22	Industrial On-Site Incineration
23	Comm-Inst On-Site Incineration
24	Residential Open Burning

SOURCE NO. 45 FOR RESPONSE
TO COMMENT NO. D4

25	Industrial Open Burning
26	Comm-Inst Open Burning
27	Light Duty Gasoline Vehicles-Limited Access Roads
28	Light Duty Gasoline Vehicles-Rural Roads
29	Light Duty Gasoline Vehicles-Suburban Roads
30	Light Duty Gasoline Vehicles-Urban Roads
31	Medium Duty Gasoline Vehicles-Limited Access Roads
32	Medium Duty Gasoline Vehicles-Rural Roads
33	Medium Duty Gasoline Vehicles-Suburban Roads
34	Medium Duty Gasoline Vehicles-Urban Roads
35	Heavy Duty Gasoline Vehicles-Limited Access Roads
36	Heavy Duty Gasoline Vehicles-Rural Roads
37	Heavy Duty Gasoline Vehicles-Suburban Roads
38	Heavy Duty Gasoline Vehicles-Urban Roads
39	Off Highway Gasoline Vehicles
40	Heavy Duty Diesel Vehicles-Limited Access Roads
41	Heavy Duty Diesel Vehicles-Rural Roads
42	Heavy Duty Diesel Vehicles-Suburban Roads
43	Heavy Duty Diesel Vehicles-Urban Roads
44	Off Highway Diesel Vehicles
45	Railroad Locomotives
46	Military Aircraft LTO's
47	Civil Aircraft LTO's
48	Commercial Aircraft LTO's

SOURCE NO. 45 FOR RESPONSE TO COMMENT NO. D4

49	Coal Vessels
50	Diesel Oil Vessels
51	Residual Oil Vessels
52	Gasoline Vessels
53	Solvent Purchased
54	Gasoline Marketed
55	Unpaved Road Travel
56	Unpaved Air Strip LTO's
57	Construction
58	Miscellaneous Wind Erosion
59	Land Tilling
60	Forest Wild Fires
61	Managed Burning (Slash/Prescribed Burning)
62	Agricultural Field Burning
63	Frost Control (Orchard Heaters)
64	Structural Fires
97*	New Category Designated by Coder
98*	New Category Designated by Coder
99*	New Category Designated by Coder

*These codes may be used to add emissions for a category not included in sections 1-5 of the coding form. At present, a maximum of 3 categories may be added for any one county.

SOURCE NO. 45 FOR RESPONSE TO COMMENT NO. D4

EMISSION FACTORS FOR THE NATION

E M I S S I O N F A C T O R F I L E R E P O R T
FILE CREATE DATE: FRIDAY JULY 23, 1982

SOURCE CATEGORY	TSP	SOX	NOX	HC/VOC	CO	SOURCE CATEGORY	TSP	SOX	NOX	HC	CO
01	10.000	39.000	3.000	10.000	90.000	33	4.051	0.180	4.040	3.520	26.480
02	15.000	31.000	3.000	10.000	90.000	34	4.951	0.180	3.320	5.170	47.470
03	2.500	144.000	18.000	0.700	5.000	35	2.220	0.360	12.650	7.280	126.000
04	16.900	159.000	18.000	0.700	5.000	36	2.220	0.360	12.210	7.640	121.970
05	3.000	0.600	100.000	5.300	20.000	37	4.920	0.360	11.320	9.100	134.790
06	25.000	0.130	1.000	1.700	180.000	38	5.820	0.360	9.970	15.860	241.780
07	0.950	39.000	11.400	0.070	0.600	39	10.000	5.085	108.400	306.310	3530.000
08	0.500	36.200	12.100	0.550	7.200	40	4.330	2.800	26.930	2.040	6.350
09	2.000	144.000	20.000	0.300	5.000	41	4.330	2.800	24.440	2.180	6.400
10	18.800	159.000	55.000	1.100	5.000	42	7.030	2.800	22.380	2.650	7.450
11	3.000	0.600	100.000	5.300	20.000	43	7.930	2.800	25.800	4.280	13.430
12	8.800	0.130	1.500	1.700	4.000	44	39.350	31.000	376.200	56.400	112.300
13	0.500	39.000	12.300	0.070	0.600	45	25.000	57.000	370.000	89.860	130.000
14	0.700	39.000	19.400	0.070	2.500	46	16.170	1.080	8.320	19.400	39.660
15	15.200	38.000	10.000	0.200	5.000	47	0.073	0.044	0.330	1.060	21.110
16	2.880	144.000	32.500	0.490	7.700	48	0.967	2.220	22.440	21.680	64.560
17	19.200	159.000	55.000	0.300	5.000	49	60.000	62.000	3.000	10.000	90.000
18	3.000	0.600	140.000	2.800	35.000	50	24.000	30.000	224.000	35.280	78.400
19	1.900	0.130	1.500	1.700	4.000	51	19.300	254.400	41.800	1.990	1.400
20	60.000	250.000	280.000	6.000	7.000	52	0.000	6.300	23.800	887.040	3016.000
21	32.000	0.500	1.000	90.000	270.000	53	0.000	0.000	0.000	2000.000	0.000
22	12.500	2.500	2.500	11.300	16.800	54	0.000	0.000	0.000	19.000	0.000
23	7.600	2.400	3.600	4.400	10.400	55	0.000	0.000	0.000	0.000	0.000
24	21.500	0.800	5.500	29.000	92.000	56	0.000	0.000	0.000	0.000	0.000
25	16.300	0.700	5.500	28.400	99.600	57	0.000	0.000	0.000	0.000	0.000
26	16.000	1.000	6.000	30.000	85.000	58	0.000	0.000	0.000	0.000	0.000
27	1.339	0.130	3.140	2.440	17.200	59	0.000	0.000	0.000	0.000	0.000
28	1.339	0.130	3.020	2.500	17.780	60	17.000	0.150	4.000	24.000	140.000
29	4.039	0.130	3.510	3.230	27.100	61	20.000	0.150	4.000	18.000	112.000
30	4.939	0.130	2.860	4.700	48.400	62	14.300	0.000	2.000	16.900	94.000
31	1.351	0.180	3.600	2.650	16.540	63	0.200	0.100	0.000	43.000	22.000
32	1.351	0.180	3.460	2.720	17.100	64	143.000	0.400	17.000	107.000	582.000

∂ADD,PL TPF$.CONTROL-CARD

SOURCE NO. 45 FOR RESPONSE
TO COMMENT NO. D4

Diesel Locomotive - Used for on-site location and switching of railroad cars.

Emission Factors and Source: NEDS specific codes, emission factor file report, 7/23/82.

TSP - 25 lb/10^3 gal
SO_x - 57 lb/10^3 gal
NO_x - 370 lb/10^3 gal
CO - 130 lb/10^3 gal
HC - 90 lb/10^3 gal

Process Rate: 5 gal/hr, 30 gal/day, 10,800 gal/yr
Duration: 2 hrs/shift, 3 shifts/day, 360 days/yr (included in process rate).
Control Method and Efficiency: None

Example Calculation:
TSP - 10,800 gal/yr x 25.0 lb/10^3 gal x st/2000 lbs = 0.14 st/yr

Emission rates for the diesel locomotive are estimated to be as follows:

	st/yr
TSP:	0.14
SO_x:	0.3
NO_x:	2.0
CO :	0.7
HC :	0.5

Comment No. D5

Please recalculate the fugitive dust emissions from vehicle travel on paved roads using the attached emission factor - Figure 5-5 taken from Iron and Steel Plant Open Source Fugitive Emission Evaluation, U.S. EPA publication EPA-600/2-79-103, May, 1979. This is more recent and considered more accurate. Use 1000 pounds per mile for the surface dust loading (L) if better data is not available. Silt content of the paved road surface material should be near 20%. In addition, indicate how the total vehicle mileage of 5308 miles was obtained. Indicate which roads and areas of the mine site are paved and included in these calculations.

Response:

The estimated vehicle mileage of 5,308 miles/day was based on an assumption of approximately 400 employee vehicles traveling to the mine/mill site per day at 5 miles round trip, plus on-site plant operation daily vehicle traffic which was estimated to be approximately 155 hours per day at 19.6 miles/hour (AP-42, Chapter 3). Therefore, employee traffic was 400 vehicles x 5 miles/vehicle = 2,000 miles. Plant operation traffic was 155 hours at 19.6 miles/hour = 3,038 miles. Total estimated miles were presented as 5,308 miles, but should have read 5,038 miles. Paved roads within the site are shown on the attached Drawing No. 051-1-C-003 (Paving General Arrangement).

CONCENTRATE THICKENERS
WATER TREATMENT PLANT
CONCENTRATOR BUILDING
PUMP HOUSE
REAGENT STORAGE
PUMP CHAMBER
TAILINGS THICKENER
TRACK SCALE
FUEL STATION
BENTONITE STORAGE
WASTE ROCK STORAGE
TRANSFER TOWER
CRUSHING AND SCREENING
MAIN SUBSTATION
SUBSTATION BUILDING
LUBRICANT STORAGE
COLD STORAGE
COARSE ORE STORAGE BUILDING
COMPRESSOR STATION
COMPRESSOR COOLER
COVERED STORAGE
TIMBER & STEEL STORAGE
TOPSOIL STORAGE AREA
COLLAR HOUSE
HEAD-FRAME
MINE AIR HEATER
CORE PROCESSING & STORAGE
SERVICES BUILDING
STATIC VAR COMPENSATOR
VENTILATION AIR SHAFT
MULCH STORAGE AREA
NATURAL GAS METER STA.
TO WEST VENT SHAFT-SEE INSET
EXCESS WATER DISCHARGE PIPELINE
TO ACCESS ROAD
NOTE:
℄ ACCESS ROAD TO WEST VENT SHAFT 790 M±
N 35590.00
E 693240.00
WEST VENT SHAFT
BACKFILL HOLE #1
PARKING
BACKFILL HOLE #2
SURFACE DRAINAGE BASIN NO. 1
EAST VENT SHAFT
POTABLE WATER SUPPLY
E 35330.00
N 693730.00
BULK FUEL STORAGE
FUEL TANKS
FUEL DELIVERY BORE HOLE
SANITARY SEWAGE TREATMENT FACILITY (SEPTIC TANK)
SOIL ABSORPTION FIELD
E693800 M/L CONT'D ABOVE
E693800 M/L CONT'D BELOW
N35400
N35300
E693700
E693200
E693300
N 35600
SCALE 1:1000

LEGEND

- CONCRETE APRONS AND RAMPS
- ASPHALT PAVEMENT (CLASS A)*
- ASPHALT PAVEMENT (CLASS B)*
- ASPHALT PAVEMENT (CLASS C)*
- GRAVEL (CLASS D)*
- CUT OR FILL SLOPE
- FENCE LINE
- WORK POINT
- RAILROAD SPUR
- MAJOR BUILDING OR STRUCTURE

* SEE DWG. 051-C-002 FOR PAVEMENT CLASS DESCRIPTION

FIGURE FOR RESPONSE TO COMMENT NO. D5

3	1-16-84	DRS	GEN. REVISION
2	11-18-83	DRS	GEN. REVISION
1	10-4-83	DRS	GENERAL REVISION

Raymond Kaiser Engineers
RKE JOB NO. 89187

EXXON MINERALS COMPANY
CRANDON PROJECT

PAVING GENERAL ARRANGEMENT

1:1000 | WISCONSIN | FOREST

J DONAHOE | M. JOHNSON

051-1-C-003

The recalculation of fugitive dust (TSP) emissions from vehicle travel is based on the most recent EPA AP-42 update (i.e. May, 1983), and current estimates of employee traffic loads of 439 (703 ÷ 1.6; see response D7) vehicles per day (i.e. 439 x 5 = 2195 miles/day) and the currently estimated mine/mill plant operation traffic load of 186 miles/day. A conservative assumption was used in that the estimated plant operation miles traveled will be 186 miles/day on paved and 186 miles/day gravel roads. The calculations, therefore, overestimate the potential TSP emissions since only portions of the miles traveled will be on either road surface.

Mine/Mill Site Fugitive Dust TSP Emissions from Traffic During Operations:

Access Road

Emission Factors and Source: AP-42, Table 11.2.5-1
TSP-EF = 0.012 lb/veh-mile

Process Rate: 2195 miles/day for employee vehicles
(i.e. 439 vehicles x 5 miles/round trip)
100 miles/day for off-site delivery vehicles
(i.e. 20 vehicles x 5 miles/round trip)
Total miles traveled/day on access road =
2295 veh-miles/day

Duration: 230 dry days/yr
Control Method and Efficiency:

Example Calculation:

$$\text{TSP} = \frac{2295 \text{ veh-miles}}{\text{day}} \times \frac{230 \text{ dry days}}{\text{yr}} \times \frac{0.012 \text{ lbs}}{\text{veh-mile}} \times \frac{\text{st}}{2000 \text{ lbs}} = 3.2 \text{ st/yr}$$

Mine/Mill Site-Paved Roads

Emission Factors and Source: AP-42 (i.e. May 1983),
Section 11.2.6 - Industrial Paved Roads

$$\text{TSP-EF} = k(0.09)\ I\ (4/n)(s/10)(L/1000)(W/3)^{0.7} = \text{lb/veh-mile}$$

where:

k	=	particle size multiplier	= 0.86
I	=	industrial augmentation factor	= 3.5 for LDGV = 7.0 for HDGV and HDDV
n	=	number of traffic lands	= 2
s	=	surface material silt content (%)	= 20%
L	=	surface dust loading (lb/mile)	= 1000
W	=	average vehicle weight (tons)	= 2 st (i.e. 4000 lbs) - for light duty gasoline vehicles (LDGV) = 5 st avg. - heavy-duty gasoline vehicle (HDGV) = 15 st avg. - heavy-duty diesel vehicle (HDDV)

Light Duty Gas Vehicle (LDGV)

(Pick-up Trucks)
Assume: 20 miles/hr
4 wheels
W = 2 st
230 dry days per year

Duty	miles/day
Environmental	25
Inspections	45
Security	50
Maintenance	10
Warehouse	2.5
Total	132.5

Heavy Duty Gas Vehicle (HDGV)

Assume: 15 miles/hr
6 wheels
W = 5 st (average)
230 dry days per year

Duty	miles/day
Water Truck	20
Trucks	6.5
Total	26.5

Heavy Duty Diesel Vehicle (HDDV)

Assume: 10 miles/hr
6 wheels
W = 15 st (average)
230 dry days per year

Duty	miles/day
Grader	5
Backhoe	0.5
60 st Crane	0.5
10 st Crane	0.5
Tractor/trailer	0.5
Forklifts	20
Total	27

Control Method and Efficiency: Paving - asphalt.

Example Calculation:

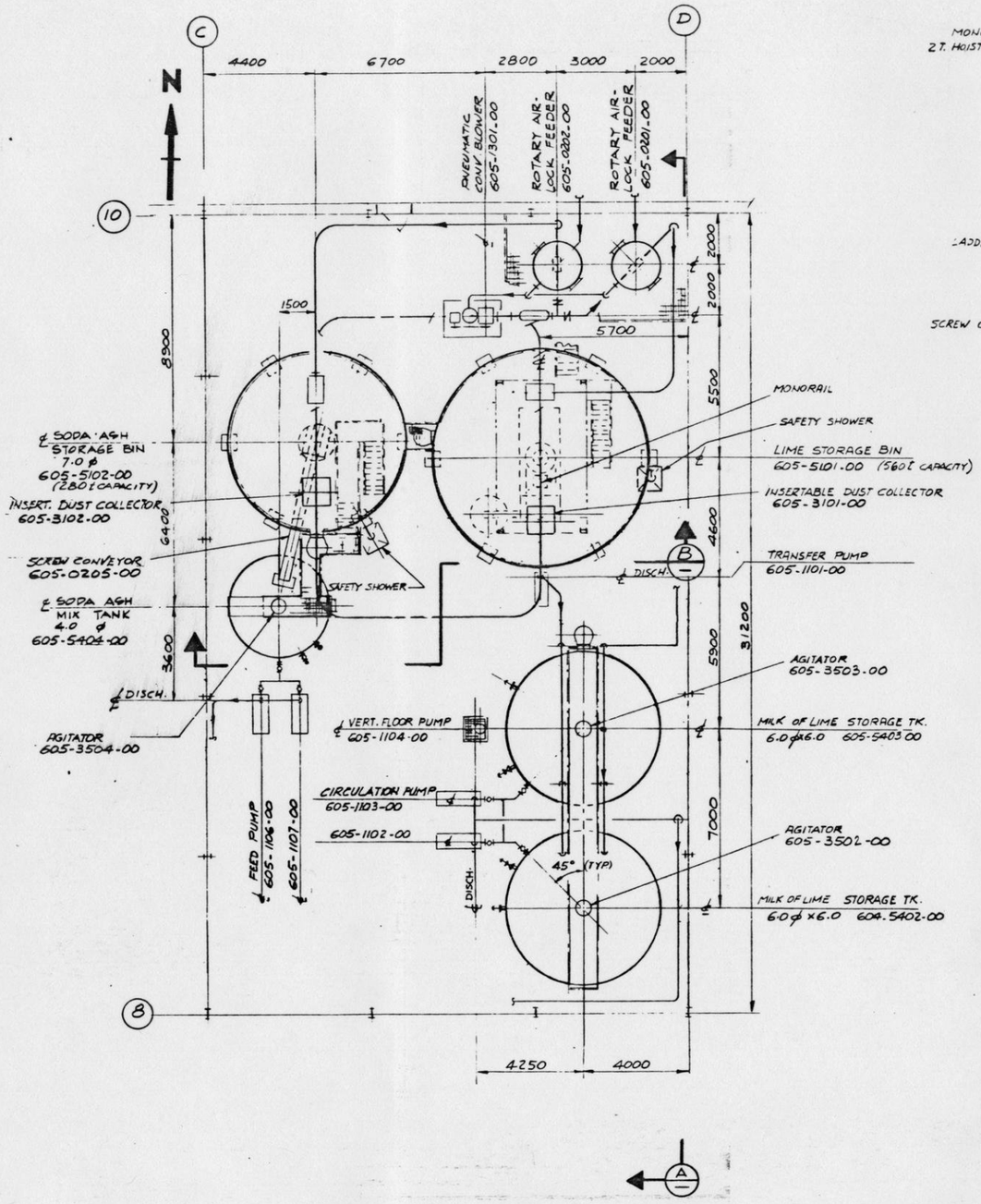
$$\text{LDGV TSP-EF} = k(0.09)\ I\ (4/n)(s/10)(L/1000)(W/3)^{0.7} = \text{lb/veh-mile}$$
$$= 0.86\ (0.09)\ 3.5\ (4/2)(20/10)(1000/1000)(2/3)^{0.7} = 0.8\ \text{lb/veh-mile}$$

$$\text{LDGV TSP} - \frac{0.8\ \text{lb}}{\text{veh-mile}} \times \frac{132.5\ \text{miles}}{\text{day}} \times \frac{230\ \text{dry days}}{\text{yr}} \times \frac{\text{st}}{2000\ \text{lbs}} = 12.2\ \text{st/yr}$$

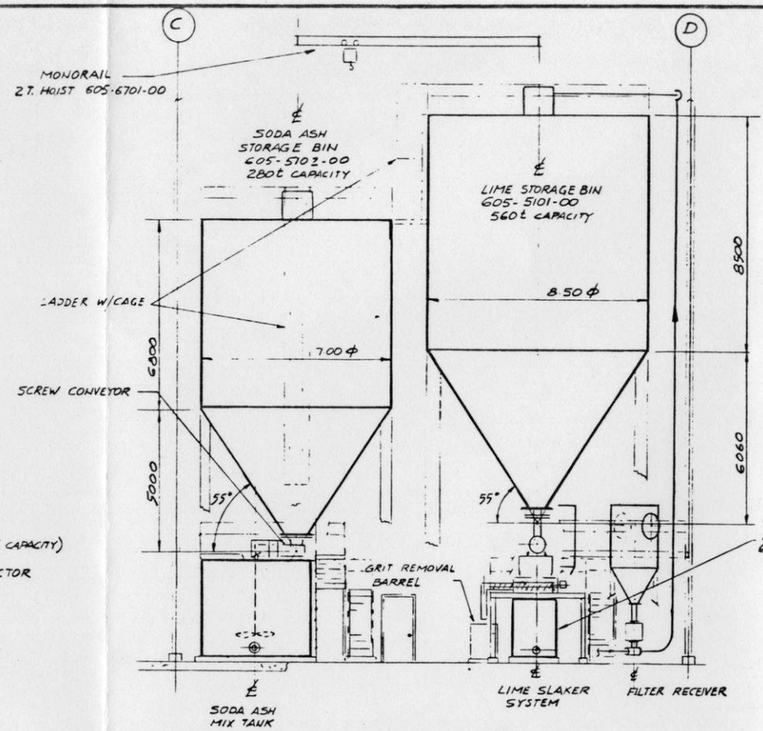
$$\text{HDGV TSP-EF} = 0.08 \times 7.0 \times 2 \times 2 \times 1 \times (5/3)^{0.7} = 3.2\ \text{lb/veh-mile}$$
$$\text{HDGV TSP} - 3.2 \times 26.5 \times 230 \div 2000 = 9.8\ \text{st/yr}$$

$$\text{HDDV TSP-EF} = 0.08 \times 7.0 \times 2 \times 2 \times 1 \times (15/3)^{0.7} = 6.9\ \text{veh-mile}$$
$$\text{HDDV TSP} - 6.9 \times 27 \times 230 \div 2000 = 21.4\ \text{st/yr}$$

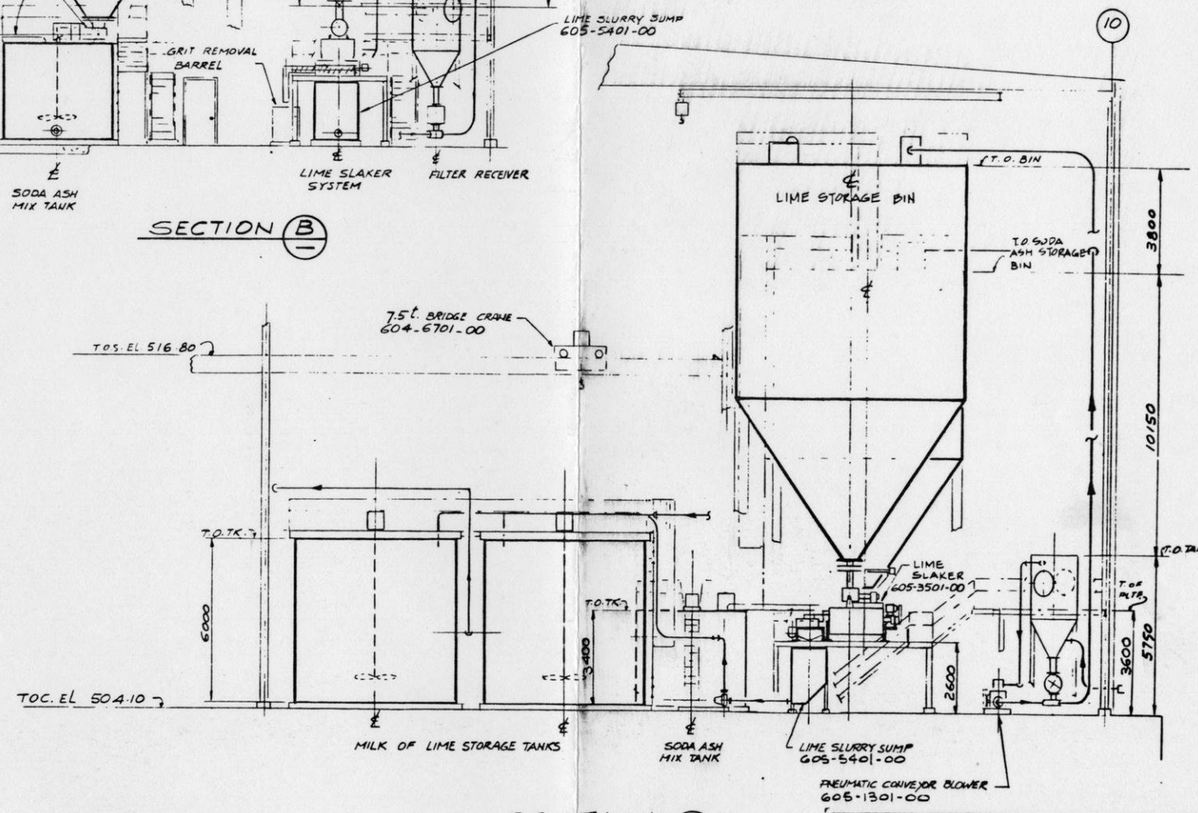
Total estimated TSP emissions = 43.4 st/yr



PLAN



SECTION B



SECTION A

FIGURE FOR RESPONSE TO COMMENT NO. D5

REVISED	DATE	BY	DESCRIPTION
1	11-16-83		GENERAL REVISION

EXXON PROPRIETARY

Raymond Kaiser Engineers
RKE JOB NO. 83157

EXXON MINERALS COMPANY - CRANDON PROJECT

TITLE: CONCENTRATOR BUILDING LIME PREPARATION FACILITY GENERAL ARRANGEMENT

SCALE	STATE	COUNTY
1:100	WISC.	

DRAWN BY	DATE	CHECKED BY	DATE
J. PAROL	7-7-83	S. SIMONTON	8-2-83
APPROVED BY	DATE	APPROVED BY	DATE
	8-15-83		8/24/83
APPROVED BY	DATE	EXXON	DATE
	8-16-83		

DRAWING NO. 051-6-G-008

SHEET NO.

N

CONTINUED ON PARTIAL PLAN (2)

LAB.

WATER SOFTENING

LIME PREPARATION

SOLUTION PUMP (TYP.)

DOWFROTH 250 MIX TK. 604-5429-00 PUMP 604-1172-00

FLOCCULANT STOR TK. 604-5478-00 PUMP 604-1178-00

SODIUM SILICATE MIX TK 604-5472-00 PUMP 604-1172-00

SODIUM SILICATE STOR. TK 604-5471-00 PUMP 604-1171-00

SODIUM DICHROMATE MIX TK. 604-5409-00 & PUMP 604-1109-00

COPPER SULFATE MIX. TK. 604-5542-00 PUMP 604-1142-00

5000 5300 8000 4950 2725

48000

21200

3700

4000

REAGENT PREPARATION

9200

18900

6000

DELUMPER 604-2142-00

A REAGENT STORAGE

EDUCTOR PUMP 604-1120-00

BLIND SUMP (TYP)

(A-325) (A-350) (A-343)

MIBC TRANSFER TK 604-5461-00 PUMP 604-1162-00

SODIUM SULFIDE MIX. TK 604-5535-00 & PUMP 604-1195-00

STARCH MIXING TANK 604-5404-00 & PUMP 604-1105-00

XANTHATE MIXING TANK 604-5446-00 PUMP 604-1146-00

XANTHATE MIXING TANK 604-5450-00 PUMP 604-1150-00

XANTHATE MIXING TANK 604-5459-00 PUMP 604-1159-00

XANTHATE MIXING TK. (SPARE) 604-5463-00 PUMP (SPARE) 604-1163-00

ZINC SULFATE MIXING TANK 604-5540-00 PUMP 604-1140-00

DEPRESSANT MIXING TANK 604-5412-00 & PUMP 604-1112-00

ACTIVATED CARBON MIX. TK. 604-5421-00 & PUMP 604-1121-00

EDUCTOR 604-3520-00

SODIUM CYANIDE MIX. TK. 604-5424-00 & PUMP 604-1124-00

1380 4375 4375 3265 2830 2830 2830 3265 3700 4175 5775 2600

42000

FILTER AREA

SUMPS & PUMPS

FLOTATION AREA

51900

Pb MIDDLINGS THICKENER

PLAN (1)

f/o

ACTIVATED CARBON DAY TANK 604-5422-00 — PUMP 604-1122-00

SODIUM SILICATE DAY TANK 604-5473-00 — PUMP 604-1173,74 & 75-00

COPPER SULFATE DAY TANK 604-5543-00 — PUMP 604-1143 & 44-00

SODIUM DICHROMATE DAY TANK 604-5410-00 — PUMP 604-1110 & 11-00

STARCH DAY TANK 604-5406-00 — PUMP 604-1106-00

SODIUM SULFIDE DAY TANK 604-5436-00 — PUMP 604-1136 & 37-00

XANTHATE DAY TANK (A-325) 604-5447-00 — PUMP 604-1148-00

XANTHATE DAY TANK (A-343) 604-5457-00 — PUMP 604-1157 & 58-00

XANTHATE DAY TANK (SPARE) 604-5482-00 — PUMP (SPARE) 604-1182-00

XANTHATE DAY TANK (A-350) 604-5451-00 — PUMP 604-1151,52,53 & 54-00

SODIUM CYANIDE DAY TANK 604-5425-00 — PUMP 604-1125,26 & 27-00

DOWFROTH 250 (FROTHER) DAY TANK 604-5430-00 — PUMP 604-1130,31,32 & 33-00

MIBC (FROTHER) DAY TANK 604-5463-00 — PUMP 604-1163,64,65,66,67 & 68-00

f/o (TYP)

3200 9200 2000

A

(8) (7) (6)

RETAINING WALL

4040 4040

R.R. TRACK

SULFER DIOXIDE STOR TK. 604-5416-00

PUMP 604-1116-00

SULFER DIOXIDE STOR. TK. 604-54 00

SODIUM SILICATE PUMP 604-1170-00

DOWFROTH 250 (FROTHER) STOR. TK. 604-5428-00 PUMP 604-1128-00

MIBC REAG. STOR. TK. (FROTHER) 604-5460-00 PUMP 604-1160-00

MIBC TRANS. PUMP 604-1161-00

SODIUM DICHROMATE STOR. TK 604-5408-00 PUMP. 604-1108-00

5290 2645 5945 5000 5500

CONTINUED ON PLAN (1)

PARTIAL PLAN (2)

EL. 509.28 EL. 504.1

300 4400 300

DOWFROTH 250 MIXING TK. FLOCCULANT STOR. TK. SODIUM SILICATE MIX. TK. SODIUM SILICATE STOR TK. SODIUM DICHROMATE MIX. TK. COPPER SULFATE MIX. TK.

SECTION (A)

TANKS

STEADY HEAD DAY TANK AREA

CRANE 10T 604-6701-00

CONTRGL RM., OFFICES, LUNCH RM., & TOILETS

MCC

OPEN

EL. 509.28 EL. 508.1

EL. 504.1

300 2700 1780 400 CURB

MIBC TRANSFER TK. SODIUM SULFIDE MIX TK. STARCH MIX. TK. XANTHATE MIX. TK (TYP 4) ZINC SULFATE MIX TK. DEPRESSANT MIX. TK. ACT. CARBON MIX. TK. SODIUM CYANIDE MIX. TK.

SECTION (B)

FIGURE FOR RESPONSE TO COMMENT NO. D5

Raymond Kaiser Engineers

RKE JOB NO. 83157

EXXON MINERALS COMPANY
CRANDON PROJECT

CONCENTRATOR BUILDING
REAGENT PREPARATION & DISTRIBUTION
GENERAL ARRANGEMENT

SCALE 1:200 STATE WISCONSIN

1	11-16-83		GENERAL REVISION

DRAWN R. HUM 6-14-83 S. SIMONIN

CHECKED J. Kwan 7-25-83

APPROVED J.X. Bulow 8-4-83

051-6-G-009

1

Gravel Roads

Emission Factors and Source: AP-42, Section 11.2.1.3

$$TSP\text{-}EF = k\ 5.9\ (s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}(d/365) = \text{lb/veh-mile}$$

k = 0.8
s = silt content, %
S = vehicle speed, mph
W = vehicle weight, st
w = number of tires
d = number of dry days

LDGV = 132.5 miles/day
HDGV = 26.5 miles/day
HDDV = 27.0 miles/day
s = 6%
Duration: 230 dry days/yr

Control Method and Efficiency: Watering as necessary.

Example Calculation:

$$LDGV\ TSP\text{-}EF = k\ 5.9\ (s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}(d/365) = \text{lb/veh-mile}$$
$$= (0.8)\ 5.9\ (6/12)(20/30)^2(2/3)^{0.7}(1)^{0.5}(230/365) = 0.5\ \text{lb/veh-mile}$$

LDGV TSP - 0.5 lb/veh-mile x 132.5 mi/day x 230 day/yr x st/2000 lbs = 7.6 st/yr

$$HDGV\ TSP\text{-}EF = 0.8\ (5.9)(6/12)(15/30)^2(5/3)^{0.7}(6/4)^{0.5}(0.6) = 0.6\ \text{lb/veh-mile}$$

HDGV TSP - 0.6 x 26.5 x 230 ÷ 2000 = 1.8 st/yr

$$HDDV\ TSP\text{-}EF\ 0.8\ (5.9)(6/12)(10/30)^2(15/3)^{0.7}(6/4)^{0.5}(0.6) = 0.5\ \text{lb/veh-mile}$$

HDDV TSP - 0.5 x 27.0 x 230 ÷ 2000 = 1.6 st/yr

Total estimated TSP emissions (uncontrolled) = 11.0 st/yr

Total estimated TSP emissions (controlled) = 11.0 st/yr x 0.5* = 5.5 st/yr

Total estimated TSP emissions for employee and plant operation traffic = 48.9 st/yr

* 50% control with watering

Comment No. D6

Table 1.4-5 of the EIR lists the methods by which reagent spills and emissions within the confines of the preparation and handling facilities will be controlled. Describe the ventilation and emission control systems for these facilities. Include a diagram which identifies the approximate mixing area for each reagent, the ventilation or hooding equipment for the operation and the control equipment for the operation.

Response:

The facilities for storage and mixing of reagents are presented in Drawings No. 051-6-G-008 and No. 051-6-G-009. Reagent facilities consist of 3 separate areas: (1) bulk reagent storage, (2) reagent preparation (i.e. includes lime and soda ash storage and mixing), and (3) steady-head day tanks.

(1) Reagents in the bulk reagent storage area will be stored in bulk tanks outside the concentrator building. Filling of these tanks will be conducted by directly connected flex hoses or piping, thus minimizing the remote possibility of spillage. In the event a spill does occur, liquid reagents and/or immediate water washdown of the affected area will be collected in a sump. Ventilation systems with hoods, ductwork,

and fans is therefore impractical and unnecessary. Rapid air dispersion of any residual odors will occur in the immediate area and render any emissions undetectable outside the plant property.

(2) Reagent tanks in the reagent preparation area are individually or collectively diked (i.e. when similar type reagent tanks are clustered) and any spillage within the dikes will be collected in "blind" sumps. From these sumps, any spills will be reclaimed with portable sump pumps and saved for use. Again immediate water washdown will reduce any residual emissions. Ventilation systems with hoods, ductwork, and fans are not required or necessary. The general mill facility ventilation system will disperse any generated odors and render them unnoticeable off plant property.

(3) The steady-head day tanks will receive reagent solutions from the reagent preparation area via directly connected piping, thus reducing the possibility of spillage. In the remote circumstance that a spill does occur, each tank or group of tanks is diked and gravity piped to blind sumps for reclamation. Day tanks will be constructed such that any overflow of solution will flow directly back to the mixing tank. Again a special ventilation system to exhaust or capture air emissions is not necessary. As before, the general ventilation system of the mill building will rapidly disperse any air emissions and render them unnoticeable off plant property.

Comment No. D7

The emissions from employee vehicular travel were estimated using 2,000 total miles traveled per day (page B-22 of the air permit application appendix). There will be 623 employee vehicles (p. 1.4-35 of the EIR) traveling the facilities access road which is approximately 3 miles long each day. At this rate, 3,738 miles (2 x 3 x 623) would be traveled each day. Based on these assumptions, the estimated emissions from employee vehicular should be revised.

Response:

Current estimates indicate that approximately 703 operation phase personnel will be employed by the Crandon Project. It is also assumed that there will be 1.6 employees/vehicle traveling 2.5 miles (one-way) of access road to the mine/mill site. Therefore, at this rate (2 trips/day x 2.5 miles/trip x 703/1.6 employees per vehicle), approximately 2,200 vehicle miles would be

traveled per day. Therefore, the estimates on p. B-22 of the air permit application, Appendix B, will be revised as follows:

Emission Factor and Source: AP-42, Appendix D, Table D.1-19 (1987)
Process Rate: Employee vehicles - 2200 mi/day (LDV)
Duration: 350 days/yr
Control Method and Efficiency: As per EPA vehicle emission controls.

Example Calculation: Process Rate x Emission Factor = Emission Rate
TSP: 2200 mi/day x 0.05 g/mi x 0.002 lbs/g x 350 days/yr x st/2000 lbs = 0.04 st/yr
SO_x: 2200 x 0.13 (Table D.1-21) x 0.002 x 350 ÷ 2000 = 0.1 st/yr
NO_x: 2200 x 0.40 x 0.002 x 350 ÷ 2000 = 0.3 st/yr
CO : 2200 x 3.6 x 0.002 x 350 ÷ 2000 = 2.8 st/yr
HC : 2200 x 0.43 x 0.002 x 350 ÷ 2000 = 0.3 st/yr
Emitting Device: Tailpipes of vehicles.

E. (D) Mine Waste Disposal Facility Construction

Comment No. E1

Please recalculate the fugitive dust emissions from vehicle travel on unpaved roads using the attached emission factor as requested for the surface facilities paved roads. The number of dry days per year should be 230 days. Silt content of the gravel road in northern Wisconsin should run 6-7% unless some soil is mixed with the gravel. The silt content of 12% used in the permit calculations is acceptable if some soil is mixed with the gravel.

Response:

Recalculation of emissions from vehicle travel on unpaved roads using the emission factor specified by WDNR in the September 12, 1983 letter are:

Emission Factor and Source: AP-42 (i.e. May, 1983), Section 11.2.1 - Unpaved Roads

$$\text{TSP-EF} = k\ 5.9\ (s/12)(S/30)^{2*}(W/3)^{0.7}(w/4)^{0.5}\ (d/365) = \text{lb/veh-mile}$$

where:
EF = Suspended particulate emissions - lb/veh-mile
k = Particle size multiplier - 0.8
s = Silt content of gravel road surface material in % - 6%**
S = Average vehicle speed - 15 mi/hr
W = Average vehicle weight - tons
w = Average number of wheels per vehicle
d = dry days per year - 230 days

---

* The factor (S/30) is valid for a speed range of 30 to 50 mph. Below 30 mph the square of the factor is recommended (WDEQ 1979. Fugitive dust emission factors. Cheyenne, WY: Wyoming Department of Environmental Quality, Division of Air Quality. January 24 Memorandum from Charles Collins).
** In accordance with WDNR recommendations.

Example Calculations:

Hauling of Excavated Till from Pond T2

S = 15 mi/hr
Assume loose wet density of till at 110 lb/ft^3 = 2,970 lbs/yd^3
Vehicle weight empty = 88,900 lb* (25 yd^3 scraper)
Vehicle weight loaded = 25 yd^3 x 2,970 lbs/yd^3 + 88,900 lb = 163,150 lb
= 81.58 st loaded

$$\text{Average W} = \frac{(163{,}150 + 88{,}900)}{2} \div 2000 = 63 \text{ st}$$

w = 4
d = 230
s = 15% for till
TSP-EF = $(0.8)5.9(15/12)(15/30)^2(63/3)^{0.7}(4/4)^{0.5}(230/365)$ = lb/veh-mile
= 7.8 lb/veh-mile

Total annual TSP emissions (uncontrolled) =
35,162** mi/yr x 7.8 lb/veh-mi x st/2000 lb = 135.4 st/yr

Total annual TSP emissions (controlled) = 135.4 st/yr x 0.5*** = 67.7 st/yr

* Empty weight of CAT 631D.
** See assumptions submitted in air permit application (p. B-26).
*** Watering.

Hauling of Waste Rock

Assume 35 st truck such as CAT 773B
Vehicle weight empty = 33 st
Vehicle weight loaded = 68 st
s = 6%
S = 15 mi/hr
W = 51 st avg.
w = 6
d = 230 days

TSP-EF = $(0.8)5.9(6/12)(15/30)^2(51/3)^{0.7}(6/4)^{0.5}(230/365)$ = lb/veh-mile
= 3.1 lb/veh-mile

Total annual TSP emissions (uncontrolled) =
7,915**** mi/yr x 3.1 lb/veh-mi x st/2000 lbs = 12.3 st/yr

Total annual TSP emissions (controlled) = 12.3 x 0.15***** = 1.9 st/yr

**** See assumptions submitted in air permit application (p. B-26).
***** 85% control with chemical stabilization of haul road.

Hauling of Bentonite From Mill To Batch Plant Area

Assume 12 st tractor/trailer
Vehicle weight empty = 10 st
Vehicle weight loaded = 22 st
s = 6%
S = 15 mi/hr
W = 16 st avg.
w = 18
d = 230 days

$TSP - (0.8)(5.9)(6/12)(15/30)^2(16/3)^{0.7}(18/4)^{0.5}(0.6) = 2.4$ lb/veh-mile

Total annual TSP emissions (uncontrolled) = 4,995* miles/yr x 2.4 lb/veh-mile x st/2000 = 6.0 st/yr

Total annual (TSP) emissions (controlled) = 6.0 st/yr x 0.15** = 0.9 st/yr

* See assumptions submitted in air permit application (p. B-26).
** 85% control with chemical stabilization of haul road.

Hauling of Bentonite/Soil Mix to Tailing Pond

Assume 12 st rear dump truck
Vehicle weight empty = 24 st
Vehicle weight loaded = 36 st
W = 30 st avg.
w = 6
S = 15 mi/hr
s = 6%
d = 230 days

$TSP - (0.8)(5.9)(6/12)(15/30)^2(30/3)^{0.7}(6/4)^{0.5}(230/365) = 2.3$ lb/veh-mile

Total annual TSP emissions (uncontrolled) = 7,575*** mi/yr x 2.3 lb/veh-mile x st/2000 lbs = 8.7 st/yr

Total annual TSP emissions (controlled) = 8.7 st/yr x 0.15**** = 1.3 st/yr

*** See assumptions submitted in air permit application (p. B-26).
**** 85% control with chemical stabilization of haul road.

Total fugitive dust (TSP) emissions from vehicle traffic on unpaved roads during the year of maximum MWDF construction is 71.8 st/yr.

Comment No. E2

An emission factor (EF) of 0.0275 pounds per short ton was used for material dumping (page B-27 of the air permit application appendix) based on the equation in Section 11.2.3 of U.S. EPA publication AP-42. Please show how this EF was derived.

Response:

Section 11.2.3 of U.S. EPA publication AP-42 addresses fugitive particulate (TSP) emissions from aggregate storage piles and is expressed in the form:

$$\text{TSP-EF} = \frac{0.33}{(\text{PE}/100)^2}$$

where:
PE = Thornwaite's precipitation/evaporation index - (120 for site area)

This equation estimates total emissions from aggregate storage piles obtained by combining emissions from:

	Activity	Fraction of Total Emissions
1)	Loading of aggregate	0.12
2)	Equipment traffic in storage area	0.40
3)	Wind erosion	0.33
4)	Loadout of aggregate for shipment	0.15
	Total	1.00

The relative percentage of aggregate emissions from loading onto piles is estimated to be 12% of the total. Therefore, the contribution from loading (i.e. material dumping) alone would be:

$$\text{TSP-EF} = \frac{(0.12)(0.33)}{(120/100)^2} = 0.0275 \text{ lb/st}$$

Comment No. E3

For the windblown emissions (page B-29 of the air permit application appendix) show how the parameters used to obtain the emission factor of 0.0275 lb/st were derived. The wind erosion losses (0.010 and 0.025) seem very low and should be supported with data from a soil analysis, as should the soil erodibility factor. Show how the unsheltered field wi(d)th of 0.7 was calculated and how the climate factor was determined.

Response:

The emission factor 0.0275 lb/st is not shown on page B-29 of the air permit application, Appendix B, nor is it used in these calculations. Emission factors for wind-blown emissions on page B-29 of the air permit application were determined as indicated using the formula E = aIKCLV.

The specific factors (a, I, K, C, L and V) used in the calculation were from guidelines in the referenced document (PEDCo, 1976) which specifies these factors as follows:

a" and "I"

Surface Soil Type	a	I (st/acre/yr)
Rocky, gravelly	0.025	38
Sandy	0.010	134
Fine	0.041	52
Clay loam	0.025	47

"K"

"K" is a surface roughness factor which accounts for wind resistance. It is a function of the height and spacing of ridges and varies from 1.0 (no reduction) for a field with a smooth surface to a minimum of 0.5 for a field with an optimum ratio of ridge height to ridge spacing. "K" was conservatively assumed to be 1.0 for the site area.

"C"

"C" is a dimensionless climatic factor which can be calculated or taken directly from prepared charts. The climatic factor of 0.05 for the site area was taken from the chart of climatic factors provided in the referenced report.

"L"

"L" is the unsheltered field width which is the distance across an open field between shelters. It depends on shelter height, if there is any, but is usually given a value of 0.7 for exposed areas approximately 1000 ft across, and 1.0 for areas greater than 2,000 ft in width. As the Crandon Project mine/mill site and MWDF exposed areas would be wider than 1,000 ft the factor for these areas should be assigned a value of 1.0. (This results in an increase in total wind-blown TSP emissions from the MWDF of 43% or 9.3 st/yr). Emission factors shown below were developed using a factor of 0.7. The revised air permit application will have TSP emissions calculated using "L" as 1.0.*

"V"

"V" is a factor to account for vegetative cover. It was conservatively assumed that the disturbed areas were unvegetated and a value of 1.0 was used.

The calculated emission factors are as st/acre/yr (short ton per acre per year) by area and were calculated to be:

Area	Emission Factor
1 - Haul Road	0.0333 st/acre/yr
2 - Storage Area	0.0469 st/acre/yr
3 - Ponds	0.0469 st/acre/yr (0.067*)

*Value calculated using "L" value of 1.0.

Comment No. E4

It appears the screening plant used to process materials for the liner and underdrain system, and the series of conveyors and radial stackers which distribute the processed materials to the appropriate stockpile in the construction support area could be significant emission sources (p. 1.3-15 of the EIR). Please address this concern by justifying that these are not significant sources (e.g. due to the use of wetted materials, etc.) or provide the throughput and calculate the emissions for these processes.

Response:

The emissions from the screening plant during construction for the year of maximum soil material processing are represented by estimates of screening (i.e. soil processing) plant emissions during MWDF operation (see air permit application, Table 4.7). For estimates of maximum emissions during construction, the emissions identified on Table 4.7 should be used (i.e. 1.02 + 0.028 = 1.04 st/yr).

Comment No. E5

Please provide a copy of the reference used to estimate mobile source emissions (p. B-24 of the air permit application appendix).

Response:

A copy of the reference is attached as part of response D4 (see source categories 31 and 44).

F. Mine Waste Disposal Facility Operation

Comment No. F1

Exposed areas of the tailings ponds such as waste rock between ponds or beach areas where the tailings slurry has dried could be sources of significant fugitive dust. Please address this concern justifying that these will not be significant sources by calculating the fugitive dust emissions from them.

Response:

Wind-blown emissions from the waste rock between ponds or beach areas where the tailings slurry has dried are assumed to be less than the wind-blown emissions estimated for MWDF construction. Wind-blown emissions calculated for MWDF construction represent emissions from the total Pond T2 and waste rock storage areas assuming both areas are disturbed and exposed. These wind-blown emissions for the entire area (Pond T2 plus waste rock storage area) are only 6.5 st/yr (see Table 2.6 of the Air Permit Application). A conservative estimate of 25% of the pond as open area was used for the dried beach and exposed waste rock; therefore, the estimated TSP emissions are less than 2 st/yr. Therefore, this does not consititute an important (i.e. "significant") source of fugitive dust (TSP).

Comment No. F2

The emissions from the bentonite liner batch plant should be considered a MWDF construction source and not an operation source if its use is primarily for construction.

Response:

Comment acknowledged.

Comment No. F3

Describe the purpose of the soil processing plant (Table 1.4-9, p. 7 of 7 of the EIR.

Response:

The purpose of the soil processing plant is to partition by screening the various particle sizes required for construction of the leachate (i.e. seepage) control system of the MWDF. These particle size distributions are necessary to produce the three soil size classifications required for the liner, drainage and filter layers of the leachate control system. The smallest particle size soil fraction will be used to mix with bentonite in the liner batch plant. The drainage and filter sized soil particles will be used directly in construction of the leachate control system.

Comment No. F4

Sufficient concern has been raised by the general public regarding the possibility of the tailings ponds being a significant source of odors due to the high sulfur content of the tailings. Please address this matter by contacting the operators of a similar facility to determine if such concerns are valid.

Response:

The tailing ponds will not be an important source of odors. Contained sulfur in the ponds is estimated to be 25 weight percent as determined by mineralogical examinations. This contained sulfur is present in a bonded form with iron (mineral pyrite). The potential to generate H_2S or SO_2 from this mineral is not likely with the planned overall tailings liquid pH of 10. Addition of lime at the tailings thickner will assure maintenance of an average tailings liquid pH of 10. The attached equilibrium diagram (i.e. Figure 5.5) for pyrite in aqueous solution shows no region of stability for H_2S or SO_2 in the tailing ponds range of pH's. (H_2S and SO_2 are generally the two gases associated with sulfur which have an odor) Contacts with experienced mine personnel, as well as EMC staff who have worked or visited at other plants, have indicated that odors are not a problem or concern at operating facilities.

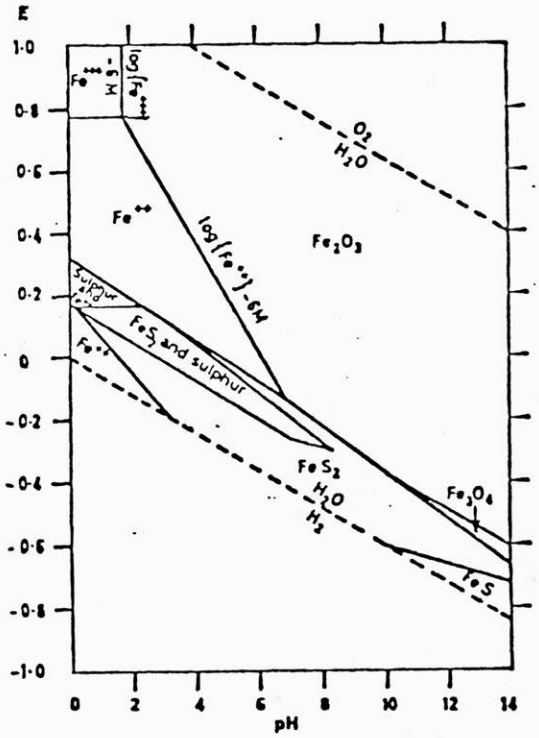


Figure 5,5 Iron oxides and sulphides in water. Equilibrium diagram for 25°C, 1 atm. pressure. Activities of ferrous and ferric ions: 10^{-6} M; activities of sulphur-containing ions in solution: 0·1M.

FIGURE FOR RESPONSE TO COMMENT NO. F4

G. General

Comment No. G1

Questions have been raised by the general public regarding the emission of trace elements from the Crandon Project. Elements of concern are aluminum, mercury, cadmium, copper, lead, arsenic and zinc. Potential public concerns should be addressed in the contents of the permit application. Please amend the permit application to include a section on the emission of trace elements. I suggest that for the worst case year during the life of the mine when particulate emissions are greatest, trace element emissions and impact be estimated. This could be done by assuming conservatively that emissions of aluminum, mercury, cadmium, copper and arsenic are proportional to their concentrations in the mine tailings fines provided in Table 3.9 of the Mine Waste Disposal Facility Feasibility Report. Similarly, the downwind concentration of these elements can be estimated by assuming conservatively that their contribution to the maximum 24-hour average particulate impact from the dispersion modeling is proportional to their concentration in the mine tailings fines. Lead and its impact are already being addressed as it is a criteria pollutant.

Response:

The amended air permit application will include a section on the estimated air emissions of the trace metal elements mentioned in the September 12, 1983 letter from the DNR. This section will utilize the "worst case" year during the operation phase for highest estimated particulate (TSP) emissions to evaluate any potential effects of aluminum, arsenic, cadmium, copper, mercury, and zinc. Further, the conservative assumptions indicated by the DNR will be incorporated in the evaluation. An example set of calculations are provided below. However, these estimates could change depending upon the results of the additional air quality dispersion modeling. As mentioned in the DNR's letter, particulate associated lead air emissions have already been addressed in the air permit application.

Estimation of Trace Metal Contributions in Particulates:

Assume: 36 $\mu g/m^3$ is the highest 24-hour average TSP concentration at the property boundary for all sources (see air permit application); also assume that suspended particulates have same trace metal analysis as impounded tailings.

Constituent	Concentration(*) in Tailings as ppm	Concentration(*) in Tailings as percent	Concentration in TSP $\mu g/m^3$
Al	45,000	4.5	1.62
Hg	2.2	.00022	0.00008
Cd	16	.0016	0.0006
Cu	1,690	.169	0.061
As	900	.09	0.032
Zn	5,410	.541	0.20

*From MWDF - Feasibility Report p. 3-22 (Table 3.9).

Example calculation:

$$\underline{Al} - 36\ \mu g/m^3 \times \frac{4.5}{100} = 1.62\ \mu g/m^3$$

Comment No. G2

Dispersion modeling for the Crandon Project will be conducted for the year when particulate emissions are highest. In order to clearly demonstrate which year represents the worst case, please provide a figure similar to Figure 1 - 1 of the air permit application which includes the total yearly particulate emissions for each stage of construction, operation and reclamation. These emissions should be totaled for each year so it is evident which year should be modeled.

Response:

Comment acknowledged. See also response to Comment No. 17.

Comment No. G3

It is expected that after emissions are recalculated based on comments raised during our discussions, Tables 2.1, 2.2, 2.3, 2.4, 2.5, 2.6 and 2.7 of the air permit application will be revised to include the new sources and emissions.

Response:

Comment acknowledged and the appropriate Tables will be revised as needed in the amended air permit application.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

February 22, 1984

File Ref: 1630 (Exxon)

Dear Librarian:

Please place the enclosed document (Comments on D'Appolonia's Flow Model and Hydrological Impact Analysis of the Crandon Site as Documented in Appendix 4.1A of the EIR, comments by Dr. Mary P. Anderson, August 1983, Revised January 1984) along with the Exxon Environmental Impact Report (EIR) material.

Dr. Anderson is one of the Department's consultants assisting our review of Exxon's EIR. This report represents her analysis of the groundwater flow model proposed by Exxon's consultant, D'Appolonia. The groundwater flow model has not been distributed to any of the EIR repositories. Interested persons may review it at the DNR North Central District office located in Rhinelander or here at the DNR central office in Madison. Please contact me if you have requests for this report.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:kk

Enclosure

COMMENTS ON D'APPOLONIA'S FLOW MODEL AND HYDROLOGIC IMPACT ANALYSIS OF THE CRANDON SITE AS DOCUMENTED IN APPENDIX 4.1A OF THE EIR

COMMENTS PREPARED BY

DR. MARY P. ANDERSON

AUGUST 1983

REVISED JANUARY 1984

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D'Appolonia's simulation of mine dewatering using an application of their finite element model GEOFLOW indicates that the effects of mine dewatering will be tolerable from an environmental standpoint. However, a number of factors affect the validity of their simulation including selection of values for recharge rate, hydraulic conductivity, aquifer thickness, storage coefficent and definition of boundary conditions.

The ways in which these five factors influence the simulation results are discussed under sections I-V below. Water balance calculations, required to establish confidence in the validity of the modeling results, are discussed under section VI below. Throughout sections I-VI questions are raised concerning the validity of the modeling results. Section VII summarizes the main concerns and list specific recommendations for improving the modeling study.

I. RECHARGE RATE

The choice of recharge rate is directly related to the choice of hydraulic conductivity. In other words, it is possible to achieve similar model calibrations with different combinations of hydraulic conductivity and recharge rate. For example, if recharge rate is increased, a higher hydraulic conductivity will be needed to produce a similar head distribution. In the flow component of the Golder screening model (Golder Project Rept. #8), calibration was achieved with a choice of 37 ft/day for hydraulic conductivity and 12.5 in/yr (318 mm/yr) for recharge rate. D'Appolonia used a hydraulic conductivity of 35 ft/day except in the area north of the ore body where values of 0.8 and 11 ft/day were used.

The lower hydraulic conductivity values explain in part why D'Appolonia used a lower overall recharge rate of 8.7 in/yr (220 mm/y). For the calibration phase of the study, recharge rates different from the overall rate were used in 5 areas:

(1) In the wetland area northeast of Rolling Stone Lake recharge was set to zero;
(2) beneath Little Sand Lake recharge was set to 4.6 in/yr (117 mm/yr);
(3) beneath Oak Lake recharge was set to 4.6 in/yr (117 mm/yr);
(4) beneath Deep Hole Lake recharge was set to 13.7 in/yr (347 mm/yr);
(5) beneath Duck Lake recharge was set to 15 in/yr (380 mm/yr).

In the mine dewatering simulation, a special set of recharge rates was used for the tailings ponds (Table A-2), for the drainage ditches around the pond (369 mm/y or 14.5 in/yr), and for the reclaim ponds (p. A-45).

A. VALIDITY OF THE OVERALL RECHARGE RATE OF 220 mm/yr: According to a water budget analysis based on baseflow measurements, the groundwater recharge rate was calculated to be between 137 to 228 mm/yr (Attachment A.3 and p. A-29 of Appendix 4.1A). According to the EIR: "Two different time periods for the water years 1978, 1979, and 1980 were used: (1) February-March (low baseflow conditions) and (2) May-June (high baseflow conditions). The February-March period also represents the time during which ground water levels used in the model calibration were measured" (p. A.3-3). Presumably the lower value of 137 mm/yr for the recharge rate is representative of low baseflow conditions typical during February and March while the higher value is typical of conditions in May and June.

1. During model calibration, the overall recharge rate was varied along with the hydraulic conductivity in zones 1 and 3; the hydraulic conductivity in the low permeability zone (zone 2) was held constant (Table A-14). It is of interest to examine the final two entries in Table A-14. Apparently heads were

calibrated to the Feb. 1982 potentiometric surface using a recharge rate of 240 mm/yr. However, for prediction of mine dewatering the recharge rate was reduced to 220 mm/yr. According to the comment in Table A-14: "The possible dewatering conditions in the mine area was to be examined and the precipitation recharge rate was reduced to 220 mm/yr." During a meeting with EXXON on Jan. 11, 1984, it was said that the recharge rate was reduced to achieve better agreement with estimates of the long term average groundwater discharge to Swamp Creek. According to the EIR (p. A-42) and to a baseflow analysis in the Supplement to Appendix 4.1A (p. 9-11), the long-term average contribution to baseflow in Swamp Creek from the study area, estimated from streamflow measurements, is 2.8 cfs. The last two entries in Table A-14 indicate that a recharge rate of 240 mm/yr yields a simulated baseflow discharge of 2.50 cfs while a recharge rate of 220 mm/yr yields 2.36 cfs. Either value of recharge gives a reasonably good comparison with the field estimate of 2.8 cfs. It is more noteworthy that according to the baseflow analysis in the Supplement to Appendix 4.1A, the contribution to baseflow in Swamp Creek from the study area could be as low as 1.3 cfs.

Given the many assumptions used in the baseflow calculations, the uncertainty regarding the groundwater recharge rate is high. For example, it is difficult to know whether 1978, 1979, and 1980 are representative of long term average hydrologic conditions in Northern Wisconsin. According to the EIR: "From an evaluation of precipitation records and gaging station records for the Wolf River, the water years 1978, 1979, 1980 were found to reflect average baseflow conditions in the study area." (p. A.3-3). THE ANALYSES THAT SUPPORT THIS STATEMENT SHOULD BE PROVIDED TO DNR. FURTHERMORE, JUSTIFICATION FOR ASSUMING THAT 1982 (SPECIFICALLY FEB. 1982) WAS REPRESENTATIVE OF LONG-TERM AVERAGE GROUNDWATER LEVELS SHOULD ALSO BE PRESENTED.

2. EXXON AND DNR SHOULD ESTABLISH A REASONABLE RANGE OF VALUES FOR THE AVERAGE ANNUAL GROUNDWATER RECHARGE RATE. THE SENSITIVITY OF THE MODEL TO CHANGES IN RECHARGE RATE SHOULD BE ASSESSED USING STEADY STATE CALIBRATION RUNS. THE TRANSIENT IMPACT SIMULATION SHOULD BE DONE USING THE LOWEST VALUE IN THIS RANGE IN ORDER TO SIMULATE A WORST CASE CONDITION FROM THE IMPACT STANDPOINT. (Simulations using the Prickett mine inflow model should include consideration of the highest recharge rate to simulate worst case conditions from the point of view of flow into the mine.)

3. According to the last line under the comment column in Table A-14: "calculated piezometric heads were in good agreement with measured in the dewatering calibration". It is unclear what is meant by this because there are no measured values for long term dewatering. Furthermore it is inappropriate to compare the heads from the steady state calibration to heads that represent dewatering. EXXON SHOULD CLARIFY WHAT IS MEANT BY THIS STATEMENT.

B. VALIDITY OF THE RECHARGE RATES FOR THE TAILINGS POND AREA: The recharge rates from the tailings pond area during and after mining that were used in the impact simulation are presented in Fig. A-3 of the EIR.

1. THE VALIDITY OF THE ESTIMATED SEEPAGE RATES FROM THE TAILINGS PONDS DURING MINING SHOULD BE REVIEWED BY DNR. Analyses and justification for the use of these rates were not presented in Appendix 4.1A and hence were not examined during my review.

2. Simulations in the EIR assume that drainage ditches surrounding the tailings ponds will intercept runoff from the reclaimed pond areas and that recharge

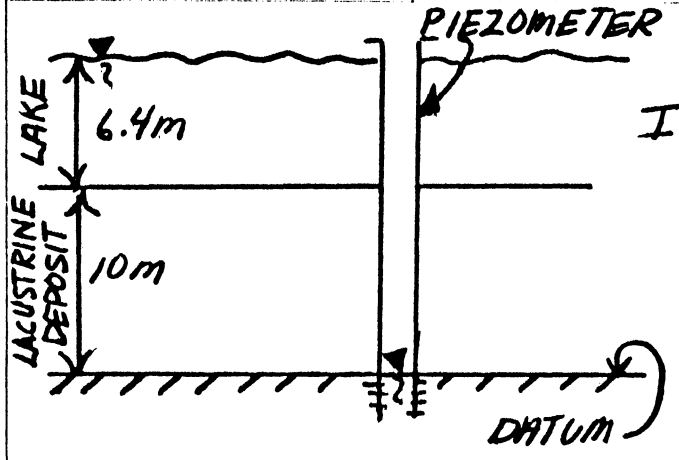
from the ditches will be 369 mm/yr (14.5 in/yr) after closure so that there is no net loss of groundwater recharge from the area. As a result, water levels are expected to return to pre-mining conditions, except for some reduction in the size of the groundwater mound in the MWDF recharge area (Fig. A-30). It may not be reasonable to assume that drainage ditches can be maintained after closure. THE FEASIBILITY OF THE PROPER OPERATION OF THESE DITCHES IN PERPETUITY SHOULD BE EXAMINED FROM A DESIGN STANDPOINT. As a point of interest it should be noted that simulations using the Golder Screening Model (Golder Project Rept. #8) assume that a reduction in net recharge will occur in the MWDF (Fig. 8.16-8.17 in Proj. Rept. #8). Golder's comment on these simulations is as follows: "Note that the groundwater mound beneath the Site 41 area has not fully recovered to its original configuration. This is because the reclamation cap limits the infiltration to a level much lower than the present rate." (p. 127 of Project Rept. #8).

C. VALIDITY OF THE LAKE RECHARGE RATES: The model uses recharge rates different from 220 mm/yr for the areas beneath Oak, Little Sand, Deep Hole and Duck Lakes. The model assumes that these four lakes will recharge the aquifer at constant rates throughout the simulation. In effect it is assumed that the potentiometric surface beneath the lakes will drop instantaneously to the bottom of the lacustrine deposit at the start of mine dewatering. Recharge rates are calculated based on a hydraulic gradient equal to the sum of the depth of the lake and the thickness of the lacustrine deposit divided by the thickness of the lacustrine deposit (S. Haji-Djafari, personal communication, July 28, 1983; also see p. A-29 and A-65 and Table A-12 of Appendix 4.1A).

The assumptions made regarding the treatment of the lakes is critical in view of the potential for mine dewatering to effect lake levels.

1. According to Table A-12 of Appendix 4.1A, the lake level of Little Sand Lake is currently 2.5-3.5m above the potentiometric surface. This information is said to be taken from cross sections in Golder Project Report #8. However, there are no cross sections of this type in that report. I assume the cross sections intended are those in Golder's Geohydrologic Characterization Report. According to information on p. 90 of that report, the lake level in Little Sand Lake is about 2.51 m (8.23 ft) above the surrounding groundwater level. Additional data on lake relationships are given in Table 5.2 of Project Report #8. However, these data do not agree with the numbers in Table A-12. For example, according to Table 5.2 groundwater levels beneath Little Sand Lake are 1.8 to 4.9 meters lower than lake level. Moreover, the EIR assumes that the water level differences beneath Oak Lake are the same as beneath Little Sand Lake. However, according to Table 5.2, the groundwater levels at Oak Lake are "at least" 14.9 to 19.2 m below lake level. Data for Deep Hole and Duck Lakes show similar discrepancies. THE DISCREPANCIES BETWEEN TABLE 5.2 IN THE GOLDER GEOHYDROLOGIC CHARACTERIZATION REPORT AND TABLE A-12 IN THE EIR SHOULD BE RESOLVED.

2. I was not able to reproduce the numbers for maximum and minimum recharge rates given in Table A-12. Little Sand Lake is used as an example. I assumed a maximum lake depth of 6.4 m (from Table A-10) and an average depth of 10 m for the lacustrine deposit beneath the lake (from Table A-12). The vertical hydraulic conductivity of the lacustrine deposit was assumed to be 3E-9 m/s (from Table A-6). My calculations are shown in Figure 1.



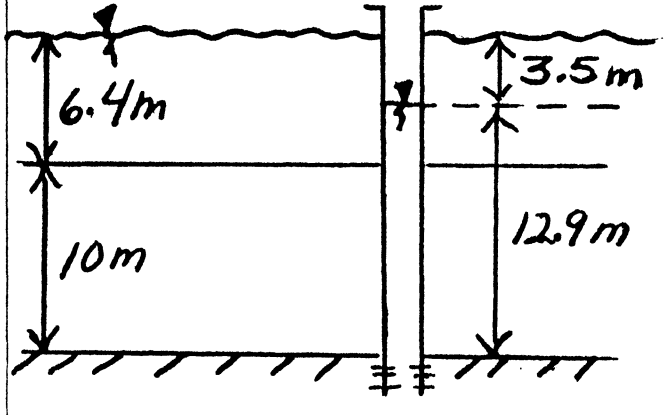
$$I = \frac{\Delta h}{\Delta z} = \frac{16.4}{10} = 1.64$$

$$q = KI$$

$$= (3 \times 10^{-9} \tfrac{m}{s})(1.64)(86400)(365)(1000)$$

$$= \underline{155}\ mm/yr$$

A. MINING CONDITIONS (CASE II)



$$I = \frac{\Delta h}{\Delta z} = \frac{3.5}{10} = .35$$

$$q = KI$$

$$= (3 \times 10^{-9})(.35)(86400)(365)(1000)$$

$$= \underline{33}\ mm/yr$$

B. PRE-MINING CONDITIONS

FIGURE 1. LAKE RECHARGE RATES

According to my calculations the recharge rate beneath Little Sand Lake would be 155 mm/yr if the potentiometric surface drops to the base of the lacustrine layer (my Fig. 1A). Under pre-mining conditions the recharge rate is only 33 mm/yr (my Fig. 1B). EXXON used a value of 117 mm/yr for seepage from Little Sand Lake both before and during mine dewatering. My calculations indicate instead that seepage rate will increase by 122 mm/yr during mining. This increase translates to a drop in lake level of 0.122 m/yr, assuming no net inflow of water to the lake (i.e., assuming that precipitation equals evaporation and that there is no surface runoff to the lake). If the potentiometric surface drops to the base of the lacustrine layer after 3 years, the lake level will drop 0.122 m/yr for 30 years or a total of 3.66 meters, again assuming no net inflow of water to the lake. Given that precipitation exceeds evaporation in Wisconsin, it would be expected that contributions of water from precipitation and possibly from surface runoff would mitigate any decline in lake level. EXXON SHOULD PROVIDE WATER BUDGET ANALYSES FOR ALL THE INTERNAL LAKES TO DEMONSTRATE THE EFFECT OF DEWATERING ON LAKE LEVEL. Without results of lake water budget analyses, there is no justification for the statement that: "The results showed a small increase in recharge from the lakes and a negligible variation in lake levels." (p. A-65 of Appendix 4.1A).

3. Furthermore, it does not make sense to use lake recharge rates based on dewatering conditions to calibrate the model. The Feb. 1982 potentiometric surface was used for calibration; consequently, estimates of current (1982) lake recharge rates should be used for calibrating the model. Yet, the model could be calibrated to Feb. 1982 water levels using the lake recharge rates shown in Table A-12, which are based on dewatering conditions. This suggests that either these rates are more or less in the right order of magnitude for pre-mining recharge rates or that the model is insensitive to these paramters

at the lake nodes. Still the fact remains that lake seepage rates during mining must be greater than current rates. All this suggests to me that the value assumed for the hydraulic conductivity of the lacustrine material is too low. If a value of 3E-8 m/sec is used for the hydraulic conductivity of the lacustrine material instead of 3E-9 m/sec, the current lake recharge rate would be 330 mm/yr, which is not unreasonable if 220 mm/yr is assumed for the overall recharge rate. One would expect the current recharge rate beneath Little Sand Lake to be higher than the overall recharge rate if the placement of the 482 m contour line shown on Fig. A-10 is correct. (The 482 m contour line shows that a slight groundwater mound exists beneath Little Sand Lake.)

AS PART OF A SENSITIVITY CHECK, THE STEADY STATE CALIBRATION AS WELL AS THE TRANSIENT IMPACT ANALYSIS SHOULD BE DONE USING A HIGHER VALUE (e.g., 3E-8 m/sec) FOR THE HYDRAULIC CONDUCTIVITY OF THE LACUSTRINE DEPOSITS.

4. The recharge rates for the lakes supposedly were calculated based on the assumption that the potentiometric surface would drop to the base of the lacustrine layer in response to mine dewatering. My Figure 1B shows that this means that the potentiometric surface is expected to drop 12.9 m beneath Little Sand Lake. However, the results of the model simulations in Fig. A-25 show that at Project Year 33 drawdown beneath most of Little Sand Lake will be less than 5 m for the Case I simulation. Hence, the validity of the Case I simulation is suspect. For the Case II simulation, Fig. A-29 shows that drawdowns beneath Little Sand Lake range from 6 - 22 m, with most of the lake area showing less than 13 m. Prickett's mine inflow model indicates that inflow rates cannot be reduced to 1000 gpm. Therefore, only the Case II simulation is relevant. Hence, an assumed average drop in water level of 12.9 m beneath Little Sand Lake is not unreasonable for the Case II simulation.

However, in view of the importance of establishing the impact of mine dewatering on the lakes, a more elegant treatment of lake seepage is warranted. THE MODEL SHOULD BE CONSTRUCTED TO ALLOW PREDICTION OF LAKE RECHARGE RATES BY THE MODEL, BY TREATING THE LAKES AND THEIR UNDERLYING LACUSTRINE DEPOSITS AS SOURCES AND LEAKY CONFINING LAYERS. This treatment of partially penetrating surface water bodies is a standard option in both the Prickett-Lonnquist (1971) flow model and the USGS two-dimensional flow model (Trescott et al. 1976). In this way the necessity of estimating lake seepage a priori would be avoided. Furthermore, it would be possible to input arrays of values representing the hydraulic conductivities and thicknesses of the lake sediments for all elements beneath each lake. The model would calculate variable seepage rates using the variable head conditions beneath the lake.

II. HYDRAULIC CONDUCTIVITY

A. ZONES OF LOW HYDRAULIC CONDUCTIVITY NORTH OF THE OREBODY: The isopach map of the coarse-grained stratified drift was apparently revised subsequent to Golder Project Report #8. The map shown in Project Report #8 (Fig. 8.10) does not show the thinning of the drift north of the orebody, which is a prominant feature on Fig. A-11 of Appendix 4.1A. Fig. A-11 is, in part, the basis for the introduction into the GEOFLOW model of two zones of low hydraulic conductivity north of the orebody (zones 2 and 3 on Fig. A-18). These zones have hydraulic conductivities considerably lower (11 and 0.8 ft/day) than the rest of the modeled area (35 ft/day). It is likely that an acceptable model calibration could have been achieved without the introduction of these zones of low hydraulic conductivity. In fact, the Golder Screening Model was calibrated without using these low hydraulic conductivity zones. Fig. 8.12 of Project Report #8 shows that equipotential lines predicted by the Golder model mimic the lines drawn using measured head values in the area north of the orebody.

1. Justification for introduction of the areas of low hydraulic conductivity must be based not on model calibration but on field evidence. Comparison of the boring location maps in Golder Project Report #8 (Fig.5.2) and Fig. A-8 of Appendix 4.1A does not show any new borings. EXXON SHOULD PROVIDE AN EXPLANATION FOR THE DIFFERENCE IN THE ISOPACH MAPS USED IN THE GOLDER SCREENING MODEL (report dated Jan. 1983) AND THE EIR WHICH BEARS AN EARLIER DATE (Dec. 1982).

2. The existence of the zones of low hydraulic conductivity is probably critical to the validity of the model simulations. The model simulations show that the cone of depression is flattened to the north of the orebody (e.g., Fig. A-25)

and that a groundwater divide forms between the ore body and Swamp Creek during dewatering (e.g., see Fig. A-24). This suggests that the areas of low hydraulic conductivity act to restrict the spread of the cone of depression and cause it to expand preferentially to the south. According to the isopach maps in both the Golder report and the EIR, the aquifer is thicker to the south of the ore body. Therefore, even if the areas of low hydraulic conductivity were removed from the model, the cone would still spread preferentially to the south. However, without the results from a sensitivity analysis of the effect of these zones of low hydraulic conductivity, it is unclear how important they are in restricting the movement of the cone of depression to the north and in minimizing impacts on the flow in Swamp Creek. SENSITIVITY ANALYSES, INCLUDING A TRANSIENT DEWATERING SIMULATION, SHOULD BE PERFORMED IN WHICH THE AREAS OF LOW HYDRAULIC CONDUCTIVITY ARE REMOVED FROM THE MODEL.

B. COARSE-GRAINED STRATIFIED DRIFT: Most of the modeled area (zone #1) was assumed to have a hydraulic conductivity of 35 ft/day. A hydraulic conductivity of 35 ft/day is reasonable for the coarse grained stratified drift of Northern Wisconsin and has been used for simulation of a lake/groundwater system centered around Snake Lake in Vilas County (Anderson and Munter, 1981). Their simulation was based on field data from Born et al. (1973) who estimated the hydraulic conductivity of the sandy outwash aquifer in the area around Snake Lake to be in the range of 20-80 ft/day.

C. LACUSTRINE MATERIALS: The lacustrine materials for Snake Lake were estimated to be around 1.34 ft/day whereas the lacustrine materials in the Crandon area are estimated to be 0.00085 ft/day but range from 0.00085 to 11.3 ft/day (Table

A-6). A value of 0.00085 ft/day (3E-9 m/sec) is in the middle of the range of suggested values for the hydraulic conductivity of glacial till recommended by Freeze and Cherry (1979, p. 29). Values of 1-11.3 ft/day are at the high end of range. The hydraulic conductivity of the lacustrine materials is critical in predicting the effect of mine dewatering on lake level. For example if a value of 3E-8 m/sec instead of 3E-9 m/sec (0.00085 ft/day) is used in the calculations shown in my Fig. 1, the decline in lake level would be 1.22 m/yr for 30 years or 36.6 m total, assuming no net inflow of water to the lake. This can be compared to 3.66 m total if hydraulic conductivity of the lake sediments is assumed to be 3E-9 m/sec. SEE RECOMMENDATION UNDER SECTION I-C.3 OF THIS REPORT.

III. AQUIFER THICKNESS

The GEOFLOW simulation assumes that flow occurs only through the coarse-grained stratified drift. Movement of water through and release of water from storage in the till is neglected.

It could be argued that much of the till is nearly as permeable as the coarse-grained stratified drift and that part of the till should be included in the model. However, by using only the thickness of the coarse-grained stratified drift, the model simulates a worse case in terms of impact. Hence, for the hydrologic impact analysis, this assumption is justified. HOWEVER, THE TILL LAYER, OR AT LEAST PORTIONS OF THE TILL SHOULD BE INCLUDED IN THE PRICKETT MINE INFLOW MODEL IN ORDER TO SIMULATE A WORST CASE FROM THE POINT OF VIEW OF FLOW INTO THE MINE.

IV. STORAGE COEFFICIENT (S)

A. RATIONALE FOR CHOICE OF S=0.05: In the GEOFLOW model a storage coefficient of 0.05 was used for zones 1 and 3 and a value of 0.054 was used for zone 2. In the Golder Screening Model, two values of storage coefficient were used: 0.07 was used for the unconfined portions of the aquifer and 0.054 was used where the aquifer is semi-confined by saturated till (Fig. 8.11). According to the EIR, p. A-17, "Since the majority of the planned hydrologic actions are in the area of the semiconfined aquifer, the value of 0.05 was selected as the storage coefficient for use in the hydrologic analysis." However, Fig. A-13 shows that more than half of the mine area is located below the unconfined aquifer. Hence, if only one value were to be used, it would seem more reasonable to select a storage coefficient representative of unconfined conditions. Values of S in the range of 0.1 - 0.2 are more reasonable values for unconfined aquifers. EXXON SHOULD COMMENT AND PROVIDE ADDITIONAL JUSTIFICATION FOR THE CHOICE OF 0.05.

B. MODEL CALIBRATION TO S=0.05: The D'Appolonia model was not calibrated to transient conditions. Therefore, the validity of the value for storage coefficient was not tested in the calibrations reported in the EIR. However, the model was later used to simulate the Golder pumping test of well TW-41, which is in the semi-confined portion of the aquifer. The results of this simulation are reported in the supplement to Appendix 4.1A and suggest that the value of 0.05 could be reasonable for the semi-confined portion of the aquifer.

A transient calibration was performed by Prickett for his mine-inflow model. He found that in order to match drawdown curves from a pumping test in the ore body, it was necessary to use values of storage coefficient of 0.001 for the semi-confined portion of the glacial aquifer and 0.15 for the unconfined portion. The pumping test that Prickett used for calibration purposes was only 7 days in duration and it may be that the value of 0.001 is too small to be representative of long-term pumping. However, the value of 0.15 is larger than the value of 0.05 assumed by D'Appolonia. Moreover, 0.15 is a more reasonable value for the storage coefficient of an unconfined aquifer. Prickett switched to D'Appolonia's values for impact assessment in order to be consistent with the GEOFLOW model. EXXON SHOULD COMMENT ON WHY MR. PRICKETT WAS INSTRUCTED TO SWITCH FROM 0.15 TO 0.05 AND WHY D'APPOLONIA DID NOT INSTEAD SWITCH FROM 0.05 TO 0.15.

C. EFFECT OF S ON IMPACT ANALYSIS: It could be argued that the use of a storage coefficient of 0.05 is a conservative assumption because a smaller value of storage coefficent will cause the cone of depression to spread more rapidly. For impact analysis, the choice of storage coefficient is less critical than estimates of hydraulic conductivity and recharge rates because the steady state solution is independent of storage coefficient. However, it is also true that the use of a higher storage coefficient would increase the time to reach steady state and in this sense 0.05 is not a conservative choice for storage coefficient. Yet, comparison of Fig. A-23 and A-25 shows that the configuration of the cone of depression does not change significantly between Project Years 5 and 33. Prickett shows that mine inflow rates reach steady state after about 1100 mine plan days (3 years). It is probable that the time

to steady state would not be significantly longer with a somewhat higher storage coefficient (e.g., 0.15).

More importantly, it should be noted that use of a small storage coefficient is not a conservative assumption in predicting the volume of mine inflow before steady state is reached. Lower values of storage coefficient mean that less water will flow into the mine at early times. Hence, the choice of value for storage coefficient could be important in predicting mine inflow rates. SENSITIVITY TO CHOICE OF S IS BETTER EVALUATED USING THE PRICKETT MINE INFLOW MODEL.

V. BOUNDARY CONDITIONS

D'Appolonia used all specified head boundary conditions. Specified head boundaries are favored by modelers because they speed up the calibration process. Fixing the boundaries at the "correct" head values, will keep the edges of the model calibrated while adjustments are made to the parameters in the interior of the model. Rarely are specified heads justified for use in a two-dimensional areal model based on hydrogeologic field data. An example of a true specified head boundary would be a stream or lake that fully penetrates the aquifer. Most streams and inland lakes are not fully penetrating. However, some specified heads are necessary in most modeling applications. Therefore, one tries to specify heads in areas where field conditions most nearly approximate a constant head condition or where the choice of boundary will not affect the model results.

A. STREAMS AND BOUNDARY LAKES: The information at my disposal suggests that none of the lakes and streams in the study area fully penetrate the aquifer. The simulation for Case II dewatering (unmitigated mine inflow) (Fig. A-28) suggests that the impacts are largely confined to the northern portion of the study area, roughly north of an east-west line drawn across the area from Walsh Lake. Therefore, only the boundaries north of this line will be examined.

Assuming that the head will remain constant in time along the boundary means that heads along the boundary cannot be affected by dewatering. Furthermore, these boundary nodes provide a source of water to the model which could act to "give" the model "extra" water. For example, consider the area along the eastern boundary of the model, immediately north of Walsh Lake. Fig.

A-19 shows that under pre-mining conditions water flows eastward across this segment of the boundary. Comparison of Fig. A-19 (pre-mining) and A-28 (year 33 of Case II) shows that during mining, water flows westward across this boundary. In the real world (in contrast to the world of the model) water levels might decline in this area. Keeping the heads at a constant level here could act to provide a source of water in the model that doesn't exist in the real world. Such a source could act to minimize flow diversions from Hemlock Creek.

Similar sorts of effects in the model could be acting to draw water to Swamp Creek and Pickerel Creek rather than to the mine area, thereby minimizing impacts on the creeks. The model's use of constant head boundaries and the corresponding assumption of fully penetrating streams could create a higher horizontal gradient toward the stream in the model than a partially penetrating stream. If the streams were simulated as partially penetrating, the head in the aquifer below the stream would be higher than the head in the stream. This might induce a lower horizontal head gradient toward the stream which would cause more of the regional flow to flow toward the mine rather than to the streams.

AS A SENSITIVITY CHECK, THE MODEL SHOULD BE RE-RUN USING NO FLOW BOUNDARY CONDITIONS ALONG THE STREAM.

B. ROLLING STONE WETLAND AREA: A similar sort of boundary effect is evident in the wetland area northeast of Rolling Stone Lake. This wetland is assumed to act as an internal specified head boundary (see Fig. A-18). It is unclear why this is necessary. These constant head nodes seem to act to keep the cone of

depression away from Rolling Stone Lake. This effect is evident in Fig. A-29 (note the indentation in the cone of depression northeast of the lake). Not surprisingly Table A-18 indicates that mining will not divert any flow from segment EF which includes Rolling Stone Lake and the lower portion of Pickerel Creek (Fig. A.3-1). In fact, the simulation predicts that there will be a slight increase in discharge rate. In the real world, it would be expected that water levels in the wetland area would decline during dewatering if the cone of depression reaches this area.

THE WETLAND AREA SHOULD BE SIMULATED SIMILAR TO THE WAY RECOMMENDED FOR THE INTERNAL LAKES. SEE SECTION I-C.4 OF THIS REPORT.

VI. WATER BALANCE

A. DOCUMENTATION OF THE WATER BALANCE CALCULATION: According to the GEOFLOW user's manual (May 1983): "No subprogram evaluating the mass balance of the simulation system is presently included in GEOFLOW." During a meeting with EXXON on Jan. 11, 1984, it was stated that such a subprogram now exists. THE PROGRAM LISTING AND DETAILED DOCUMENTATION SHOULD BE PROVIDED TO DNR.

B. ACCURACY OF THE WATER BALANCE CHECK: The results of a water balance check for the application of GEOFLOW to the Crandon Site is given in the Supplement to Appendix 4.1A. According to information on p. 7 of the supplement, the percent error in the water balance for the horizontal flow model for the steady state simulation (no mine inflow) is 14.5%. This is quite a large error for a flow model. The USGS two-dimensional model routinely has less than 1% error. During the Jan. 11th meeting with EXXON, it was indicated that an error in accounting for outflow from the model had been detected in the water balance calculation. THE NEW MASS BALANCE RESULTS FOR THE STEADY STATE CALIBRATION AS WELL AS FOR THE TRANSIENT SIMULATION REPORTED IN THE EIR SHOULD BE PROVIDED TO DNR.

C. "CREATION" OF WATER DURING THE DEWATERING SIMULATION: Because of the way in which the model treats elements that go dry, the error in the water balance could be higher for the simulations that involve mine dewatering. If the model predicts that the aquifer has a saturated thickness less than 0.457 m in response to mine dewatering, the model is directed to re-set the saturated

thickness in that element to 0.457 m. This is necessary because if the heads were not re-set, the element would have zero transmissivity and soon the area around the mine would be surrounded by a zone of zero transmissivity and no water could reach the mine. This is clearly unrealistic. Therefore, it is necessary to maintain some transmissivity in the elements around the mine by re-setting the saturated thickness periodically and allowing the model to "create" water at these elements.

Elements go dry fairly quickly. During the first four years of the simulation, the saturated thicknesses in four elements (#367, 397, 430, 431) are re-set to 0.457 m (Printout 2.1), causing the "creation" of approximately 60,000 cubic meters (gal) of water in the first four years of the simulation. Of the four elements that are re-set, only one is directly over the mine area (#430). The other three are north of the mine area (see Fig. A-18). In the simulation for years 32- 33, twelve nodes are re-set (Printout 2.12) and of these only three are over the mine area; the other nine are north of the mine.

These adjustments are necessary because a two-dimensional model is being used to represent a three-dimensional flow system. It is difficult to assess the amount of error caused by manipulating the model in this way. The amount of water "created" during the simulation may be insignificant in relative terms. If so, results of a water budget analysis for the transient simulation (see, Section B above) will be helpful in evaluating the errors introduced by these head manipulations.

Another concern is that the model as constructed does not accurately reflect the flow regime. For example, in the field the glacial aquifer north

of the mine site could de-saturate and water might flow from the glacial aquifer through fractures in the surrounding bedrock and then laterally through the sides of the orebody to the mine. (See discussion on this subject in my report on Prickett's mine inflow model.) IN ORDER TO ADDRESS THE POTENTIAL FOR THE CREATION OF THIS TYPE OF FLOW SYSTEM, MORE INFORMATION ABOUT THE CURRENT THREE-DIMENSIONAL FLOW SYSTEM THAT INCLUDES THE GLACIAL AQUIFER, THE OREBODY AND THE SURROUNDING BEDROCK IS NEEDED. This issue is best addressed through compilation and analysis of existing field data on hydraulic conductivities and heads in the orebody as well as additional simulations using the Prickett mine inflow model.

VII. SUMMARY

In my opinion a number of assumptions used in the simulation of the Crandon site are questionable, including the treatment of Little Sand, Oak, Deep Hole and Duck Lakes, the use of specified head boundary conditions in the northern half of the modeled area, and the creation of water in elements that go dry during the simulation. In addition, a detailed sensitivity analysis is needed in order to determine the effects of uncertainties in the model parameters.

1. The lakes should be treated as source bed aquifers so that variable seepage rates from the lake are automatically calculated by the model. In this way, seepage rates will accurately reflect the variable head distribution beneath the lake. The model will then be capable of accounting for spatial variations in thickness and hydraulic conductivity of the lakebed sediments. Furthermore, a priori assumptions about the magnitude of lake seepage during dewatering will be avoided.

2. No flow boundary conditions should be imposed along segments of Swamp Creek and possibly Hemlock Creek, in successive runs of the transient model in order to determine the sensitivity of the impact predictions to assumed boundary conditions. The wetland NE of Rolling Stone Lake should be treated as in #1, above.

3. Detailed water budget analyses should be provided for each run of the model. These analyses should include documentation of the way in which the budget was calculated as well as the calculations and final results. A careful accounting of the volume of water "created" at nodes that go dry during the dewatering simulation should also be provided.

4. Detailed documentation of the results of a sensitivity analysis should be prepared. The sensitivity analysis should address the sensitivity of the model's impact predictions to changes in:

   (a) recharge rate;
   (b) hydraulic conductivity in zones 1, 2, and 3, with special attention to zones 2 and 3;
   (c) leakance of the lakebed sediments, where leakance is defined to equal the ratio of hydraulic conductivity to thickness;
   (d) storage coefficient with special attention to the effect of storage coefficient on the time needed to reach steady state conditions.

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State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

January 25, 1984

1630 (Exxon)

Dear Interested Citizen:

On December 29, 1983, the Department of Natural Resources (DNR) sent Exxon Minerals Co., the second of several detailed letters reviewing Exxon's Environmental Impact Report (EIR) for their proposed zinc-copper mine near Crandon. Comments in this second letter supplement the first letter sent to Exxon May 11, 1983. The EIR was submitted December 22, 1982, and additional technical information continues to be received and reviewed.

The comments in the second letter are those of DNR staff, other governmental agencies, Indian Tribes, environmental groups and the general public.

Although this is a significant step in the project review, there remain several areas where information is still lacking. DNR and Exxon are working to resolve these issues.

Copies of the second letter will be available for public review at the 13 libraries serving as public repositories for project documents. Individual copies may be obtained by contacting William Tans, (608) 266-3524 or by writing Tans at DNR, Bureau of Environmental Impact, P.O. Box 7921, Madison, Wisconsin 53707.

Also available for public review are a number of reports, prepared by Exxon or their consultants, which provide the technical information upon which the EIR was based. These technical reports have been provided to the 13 library repositories. (See attached list of documents and the 13 libraries.) The DNR will accept public comments on these documents (indicating additional information which should be requested) and will include any appropriate comments in our next letter to Exxon. Any comments should be sent to William Tans by April 2, 1984.

For more information about comments in the review letter and the other documents, contact Robert Ramharter, Project Coordinator at (608) 266-3915 or Terry McKnight, DNR Rhinelander office, (715) 362-7616.

Sincerely,
Bureau of Environmental Impact

Howard S. Druckenmiller
Director

4504Y

cc: Repository Libraries

All of the above documents may be reviewed with other project documents at the following 13 libraries: Antigo Public Library, Vaughn Public Library (Ashland), Crandon Public Library, Brown County Public Library (Green Bay). City and County Library (Ladysmith), Madison Public Library, Milwaukee Public Library, Platteville Public Library, Rhinelander Public Library, Charles M. White Public Library (Stevens Point), Nicolet College Learning Resources Center (Rhinelander) and L.E. Phillips Memorial Library (Eau Claire).

Documents Written by Exxon or Exxon's Consultants Supporting Exxon's EIR and/or Permit Applications Available at EIR Repositories

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Golder Associates, 1982. Report on Groundwater Impact Screening Model. Crandon project waste disposal system. Project Report No. 9. Golder Associates, Atlanta, Georgia.

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Tisdel, L., September 18, 1982. Letter to James Winnen re: set of 3 plots and 1 table providing data obtained from alkaline leaching studies on samples 2, 3 and 5.

Research and Planning Consultants, 1983. Forecast of Future Conditions, Socioeconomic Assessment, Crandon Project, and Data Summary.

Correspondence Regarding Exxon's EIR
between Exxon and the Department
Available at the EIR Repositories

DNR's May 11, 1983 initial review comments on Exxon's EIR

Exxon's response to DNR's initial comments on Chapter 1, including the following attachments:

1. CHAPTER 1.0, COMMENT NO. 39, ATTACHMENT NO. 1 - UTILITY PLOT PLAN

2. CHAPTER 1.0, COMMENT NO. 53, ATTACHMENT NO. 2 - PLOT PLAN FOR MINE/MILL FACILITIES

3. CHAPTER 1.0, COMMENT NO. 56, ATTACHMENT NO. 3 - DUST CONTROL SYSTEM FOR THE PRIMARY CRUSHER AND RELATED ORE HANDLING FACILITIES (5 drawings)

4. CHAPTER 1.0, COMMENT NO. 59, ATTACHMENT NO. 4 - PLOT PLAN FOR MINE/MILL SURFACE FACILITIES

5. CHAPTER 1.0, COMMENT NO. 59, ATTACHMENT NO. 5 - FUEL OIL STORAGE PLAN

6. CHAPTER 1.0, COMMENT NO. 70, ATTACHMENT NO. 6 - REAGENT STORAGE AND MIXING FACILITIES (2 drawings)

7. CHAPTER 1.0, COMMENT NO. 101, ATTACHMENT NO. 7 - GENERAL ARRANGEMENT OF THE ELECTRIC POWER SUBSTATIONS AND COMMUNICATIONS DUCT SYSTEM

8. CHAPTER 1.0, COMMENT NO. 109, ATTACHMENT NO. 8 - PRELIMINARY DESIGN FEATURES OF THE RECLAIM WATER PONDS, INCLUDING BASIC MATERIAL AND CONSTRUCTION SPECIFICATIONS (4 drawings)

9. CHAPTER 1.0, COMMENT NO. 125, ATTACHMENT NO. 9 - PAVING, GRADING AND DRAINAGE DETAILS IN THE MINE/MILL SITE (3 drawings)

10. CHAPTER 1.0, COMMENT NO. 129, ATTACHMENT NO. 10 - LOGS OF AUGER HOLES ALONG THE ACCESS ROAD AND RAILROAD SPUR. PRELIMINARY PLAN AND PROFILE DRAWINGS FOR THE ACCESS ROAD AND RAILROAD SPUR

11. CHAPTER 1.0, COMMENT NO. 131, ATTACHMENT NO. 11 - PRELIMINARY DESIGNS FOR THE CRANDON PROJECT SHAFT COLLARS (4 drawings)

12. CHAPTER 1.0, COMMENT NO. 139, ATTACHMENT NO. 12 - PROCEDURE FOR IN-SITU PERMEABILITY TESTING OF LANDFILL LINER/SEAL SOIL MATERIAL

13. CHAPTER 1.0, COMMENT NO. 143, ATTACHMENT NO. 13 - EXAMPLE OF PROCESS FLOWSHEETS AND DESCRIPTIONS FOR BATCHING AND MIXING OPERATIONS AND TYPE OF EQUIPMENT USED

14. CHAPTER 1.0, COMMENT NO. 145, ATTACHMENT NO. 14 - MINE WASTE DISPOSAL SYSTEM EROSION CONTROL - PHASES 1-6 (6 drawings)

15. CHAPTER 1.0, COMMENT NO. 176, ATTACHMENT NO. 15 - FINE ORE CRUSHING AND STORAGE CRUSHING AND SCREENING GENERAL ARRANGEMENT PLAN AND SECTIONS

Correspondence available at EIR Repositories, cont.

16. CHAPTER 1.0, COMMENT NO. 179, ATTACHMENT NO. 16 - PROCESS FLOW DIAGRAM ILLUSTRATING THE METHOD OF STORING AND HANDLING CYCLONED SANDS FOR MINE BACKFILL

Exxon's response to DNR's initial comments on Chapters 2 and 3, including the following attachments:

1. Chapter 2, Comment Number 1, Attachment Number 1 (a map delineating the areas that Exxon has mapped at varying scales)

2. Chapter 2, Comment Number 18, Attachment Number 2, Glacial Testing

3. Appendices Comment Number A19, Attachment A3, Benthic Macroinvertebrate Data

4. Appendices Comment Number 21, Attachment A4, Fish Length Frequency

5. Appendices Comment Number A1, Attachment A1, Grounwater Elevations List Computer Printout

6. Appendices Comment Number A4, Attachment A2, Water Quality Data, Duck Lake (a letter transmitted from Dames and Moore to Exxon regarding field and laboratory analysis of water samples from Duck Lake and adjacent areas)

7. Chapter 2 Comment Number 24, Attachment 3 (a letter from Skyline Labs, Inc., to Exxon oulining the procedures for handling and analyses of geologic samples)

DNR September 19 and October 10, 1983 review letter on Exxon's Mining Permit Application.

DNR October 28, 1983 review letter on Exxon's Wisconsin Pollution Discharge Elimination System (WPDES) Permit Application.

Exxon's November 11 response to DNR's October 11, 1983 Mining Permit Application comments.

Exxon's December 11, 1983 response to DNR's October 28, 1983 WPDES comments.

DNR's December 29, 1983 letter containing additional comments on Exxon's EIR.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

January 26, 1984

File Ref: 1630 (Exxon)

Dear Librarian:

The Department has received a response from Exxon on our October 28, 1983 comments on the firm's Wisconsin Pollutant Discharge Elimination System (WPDES) permit application.

Please place the enclosed copy of Exxon's response in the red binder kept with the rest of the Exxon Environmental Impact Report material.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:mgr

Enclosure

RESPONSES TO DNR COMMENTS

ON

WPDES DISCHARGE PERMIT APPLICATION

EXXON MINERALS COMPANY
CRANDON PROJECT

Comment No. 1

For each outfall, review the attached tables 1 and 2 and place an "X" adjacent to any of the pollutants which you know or have reason to believe may be present in the effluent. If their presence is due solely as a result of the intake water, write "intake" next to the pollutant. For any pollutant marked as being present, please provide a projected effluent concentration of that pollutant.

Response:

We have examined the material presented in Tables 1 and 2 (attached) and have no reason to believe that any of the listed pollutants, with the possible exception of strontium, will be present in any of the outfalls from the Crandon Project. Except for strontium, we have no reason to believe that any of these substances are in the intake water (ground water) as defined in the October 28, 1983 letter from M. D. Witt, WDNR, to Barry Hansen, Exxon Minerals Company. Although strontium was not analyzed in the ground water sampling program, it commonly occurs in rocks and waters of the earth's surface and would likely be present in the ground water in low concentrations. Strontium is not used in the mining or milling process, but it is probable that it would be present in low concentrations in the ore and as such may be present in the intake water. We would expect this concentration to be less than 1 mg/l based on the strontium: calcium ratio range for Wisconsin waters shown in Patty's Industrial Hygiene and Toxicology (3rd edition, John Wiley and Sons, 1981). There are no data available to suggest that any of the listed pollutants are currently present in Swamp Creek at the discharge point.

TABLE 1.

VOLATILE COMPOUNDS

1V. Acrolein (107-02-8)	
2V. Acrylonitrile (107-13-1)	
3V. Benzene (71-43-2)	
5V. Bromoform (75-25-2)	
6V. Carbon Tetrachloride (56-23-5)	
7V. Chlorobenzene (108-90-7)	
8V. Chlorodibromomethane (124-48-1)	
9V. Chloroethane (75-00-3)	
10V. 2-Chloroethylvinyl Ether (110-75-8)	
11V. Chloroform (67-66-3)	
12V. Dichlorobromomethane (75-27-4)	
14V. 1,1-Dichloroethane (75-34-3)	
15V. 1,2-Dichloroethane (107-06-2)	
16V. 1,1-Dichloroethylene (75-35-4)	
17V. 1,2-Dichloropropane (78-87-5)	
18V. 1,3-Dichloropropylene (542-75-6)	
19V. Ethylbenzene (100-41-4)	
20V. Methyl Bromide (74-83-9)	
21V. Methyl Chloride (74-87-3)	
22V. Methylene Chloride (75-09-2)	
23V. 1,1,2,2-Tetrachloroethane (79-34-5)	
24V. Tetrachloroethylene (127-18-4)	
25V. Toluene (108-88-3)	
26V. 1,2-Trans-Dichloroethylene (156-60-5)	
27V. 1,1,1-Trichloroethane (71-55-6)	
28V. 1,1,2-Trichloroethane (79-00-5)	
29V. Trichloroethylene (79-01-6)	
31V. Vinyl Chloride (75-01-4)	

ACID COMPOUNDS

1A. 2-Chlorophenol (95-57-8)	
2A. 2,4-Dichlorophenol (120-83-2)	
3A. 2,4-Dimethylphenol (105-67-9)	
4A. 4,6-Dinitro-O-Cresol (534-52-1)	
5A. 2,4-Dinitrophenol (51-28-5)	
6A. 2-Nitrophenol (88-75-5)	
7A. 4-Nitrophenol (100-02-7)	
8A. P-Chloro-M-Cresol (59-50-7)	
9A. Pentachlorophenol (87-86-5)	
10A. Phenol (108-95-2)	
11A. 2,4,6-Trichlorophenol (88-06-2)	

BASE/NEUTRAL COMPOUNDS

1B. Acenaphthene (83-32-9)	
2B. Acenaphtylene (208-96-8)	
3B. Anthracene (120-12-7)	
4B. Benzidine (92-87-5)	
5B. Benzo *(a)* Anthracene (56-55-3)	
6B. Benzo *(a)* Pyrene (50-32-8)	
7B. 3,4-Benzofluoranthene (205-99-2)	
8B. Benzo *(ghi)* Perylene (191-24-2)	
9B. Benzo *(k)* Fluoranthene (207-08-9)	
10B. Bis *(2-Chloroethoxy)* Methane (111-91-1)	
11B. Bis *(2-Chloroethyl)* Ether (111-44-4)	
12B. Bis *(2-Chloroisopropyl)* Ether (39638-32-9)	
13B. Bis *(2-Ethylhexyl)* Phthalate (117-81-7)	
14B. 4-Bromophenyl Phenyl Ether (101-55-3)	
15B. Butyl Benzyl Phthalate (85-68-7)	
16B. 2-Chloronaphthalene (91-58-7)	
17B. 4-Chlorophenyl Phenyl Ether (7005-72-3)	

BASE/NEUTRAL COMPOUNDS

18B. Chrysene (218-01-9)	
19B. Dibenzo *(a,h)* Anthracene (53-70-3)	
20B. 1,2-Dichlorobenzene (95-50-1)	
21B. 1,3-Dichlorobenzene (541-73-1)	
22B. 1,4-Dichlorobenzene (106-46-7)	
23B. 3,3'-Dichlorobenzidine (91-94-1)	
24B. Diethyl Phthalate (84-66-2)	
25B. Dimethyl Phthalate (131-11-3)	
26B. Di-N-Butyl Phthalate (84-74-2)	
27B. 2,4-Dinitrotoluene (121-14-2)	
28B. 2,6-Dinitrotoluene (606-20-2)	
29B. Di-N-Octyl Phthalate (117-84-0)	
30B. 1,2-Diphenylhydrazine *(as Azobenzene)* (122-66-7)	
31B. Fluoranthene (206-44-0)	
32B. Fluorene (86-73-7)	
33B. Hexachlorobenzene (118-71-1)	
34B. Hexachlorobutadiene (87-68-3)	
35B. Hexachlorocyclopentadiene (77-47-4)	
36B. Hexachloroethane (67-72-1)	
37B. Indeno *(1,2,3-cd)* Pyrene (193-39-5)	
38B. Isophorone (78-59-1)	
39B. Naphthalene (91-20-3)	
40B. Nitrobenzene (98-95-3)	
41B. N-Nitrosodimethylamine (62-75-9)	
42B. N-Nitrosodi-N-Propylamine (621-64-7)	
43B. N-Nitrosodiphenylamine (86-30-6)	
44B. Phenanthrene (85-01-8)	
45B. Pyrene (129-00-0)	
46B. 1,2,4-Trichlorobenzene (120-82-1)	

PESTICIDES

1P. Aldrin (309-00-2)	
2P. α-BHC (319-84-6)	
3P. β-BHC (319-85-7)	
4P. γ-BHC (58-89-9)	
5P. δ-BHC (319-86-8)	
6P. Chlordane (57-74-9)	
7P. 4,4'-DDT (50-29-3)	
8P. 4,4'-DDE (72-55-9)	
9P. 4,4'-DDD (72-54-8)	
10P. Dieldrin (60-57-1)	
11P. α-Endosulfan (115-29-7)	
12P. β-Endosulfan (115-29-7)	
13P. Endosulfan Sulfate (1031-07-8)	
14P. Endrin (72-20-8)	
15P. Endrin Aldehyde (7421-93-4)	
16P. Heptachlor (76-44-8)	
17P. Heptachlor Epoxide (1024-57-3)	
18P. PCB-1242 (53469-21-9)	
19P. PCB-1254 (11097-69-1)	
20P. PCB-1221 (11104-28-2)	
21P. PCB-1232 (11141-16-5)	
22P. PCB-1248 (12672-29-6)	
23P. PCB-1260 (11096-82-5)	
24P. PCB-1016 (12674-11-2)	
25P. Toxaphene (8001-35-2)	

DIOXIN

2,3,7,8-Tetrachlorodibenzo-P-Dioxin (1764-01-6)	

TABLE 2.

TOXIC POLLUTANT

Asbestos

HAZARDOUS SUBSTANCES

Acetaldehyde
Allyl alcohol
Allyl chloride
Amyl acetate
Aniline
Benzonitrile
Benzyl chloride
Butyl acetate
Butylamine
Captan
Carbaryl
Carbofuran
Carbon disulfide
Chlorpyrifos
Coumaphos
Cresol
Crotonaldehyde
Cyclohexane
2,4-D (2,4-Dichlorophenoxyacetic acid)
Diazinon
Dicamba
Dichlobenil
Dichlone
2,2-Dichloropropionic acid

HAZARDOUS SUBSTANCES

Dichlorvos
Diethyl amine
Dimethyl amine
Dinitrobenzene
Diquat
Disulfoton
Diuron
Epichlorohydrin
Ethion
Ethylene diamine
Ethylene dibromide
Formaldehyde
Furfural
Guthion
Isoprene
Isopropanolamine
Kelthane
Kepone
Malathion
Mercaptodimethur
Methoxychlor
Methyl mercaptan
Methyl methacrylate
Methyl parathion
Mevinphos
Mexacarbate
Monoethyl amine
Monomethyl amine

HAZARDOUS SUBSTANCES

Naled
Naphthenic acid
Nitrotoluene
Parathion
Phenolsulfonate
Phosgene
Propargite
Propylene oxide
Pyrethrins
Quinoline
Resorcinol
* Strontium (INTAKE)
Strychnine
Styrene
2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)
TDE (Tetrachlorodiphenyl ethane)
2,4,5-TP (2-(2,4,5-Trichlorophenoxy) propanoic acid)
Trichlorfon
Triethanolamine
Triethylamine
Trimethylamine
Uranium
Vanadium
Vinyl acetate
Xylene
Xylenol
Zirconium

NOTE: The previous tables were taken from the May 19, 1980 Federal Register.

If you have reason to believe that none of these pollutants will be present in the effluent as a result or your operations/manufacturing processes, place an "X" in the adjacent blank. _____

This Addendum must be signed by the official representative of the facility who is: the owner, the sole proprietor for a sole proprietorship, a general partner for a partnership, or an executive officer of at least the level of vice president for a corporation, having overall responsibility for the operation of the facility.

_____ _____

Typed Name of Official Representative Title

_____ _____

Signature of Official Representative Date Signed

Chpt. 147.21(4), Wisc. Stats., provides that: Any person who knowingly makes any false statement, representation or certification in this Addendum shall upon conviction be punished by a fine of not more than $10,000 or by imprisonment for not more than 6 months or both.

Comment No. 2

1) On pages II-6, II-7 and II-8, item 17, please provide projected minimum and maximum effluent values (columns 4 and 5) expected during the discharge activity for each parameter listed including pH.

2) Also provide minimum, maximum and average values for total hardness.

3) The TSS value for the untreated intake water seems high if the source of intake water is ground water. The values reported in this column (no. 1) should be consistent with uncontaminated ground water before it has been used in the mill or mine processes. While the narrative provided in the application on pages II-8a and II-8b explains that the make-up water for the mill is contaminated mine water, the quality of the original source of the water before it is affected by any aspect of the mine/mill facility are the values which should be reported in column 1. Please revise these values as discussed.

Response:

1) Since the Crandon Project is not in operation, it is not possible to use existing operating data to provide minimum and maximum discharge water quality information. Therefore, in the WPDES permit application, we elected to provide a conservative projection of daily average water quality in lieu of speculating on minimum and maximum concentrations for all parameters. Maximum concentrations for all parameters can only be obtained using long term data from the operation of the water treatment plant for the Crandon Project. The daily average effluent quality in the WPDES permit application is an estimate for lime treatment and discharge of mine water with no allowance for mixing the treated water with uncontaminated ground water from the mine water control (interceptor) system. However, to comply with the DNR request for additional data, Table 1 has been prepared with the following information:

   - Untreated intake: ground water quality currently existing in the project area as requested by the DNR.

   - Effluent quality-daily average; same as presented in the original WPDES application. As stated previously, this is a conservative estimate for lime treatment and discharge of mine water with no allowance for mixing with uncontaminated ground water from the mine water control (interceptor) system. These data are based on expected performance of the treatment system and were used as daily average in the permit application.

   - Effluent quality-minimum; assumes quality equal to the mean values for existing ground water quality (Table 2.3-8 from EIR Chapter 2.0, attached). If a ground water value was higher than the projected daily average values, the value for that parameter was revised to indicate that the minimum would be less than the average value.

No data for maximum concentration of effluents are provided at this time. We are currently re-evaluating the data used to make effluent quality estimates. Although we feel that maximum concentrations can only be obtained from operating data, if some estimate of maximum concentration levels can be determined, they will be provided to the DNR.

2) Minimum and average values for total hardness are shown below as equivalent total $CaCO_3$.

Minimum:	124 mg/l
Average:	615 mg/l

3) Data in the first column of the Table 1 shows the data for ground water quality currently existing in the project area.

TABLE 1

WATER QUALITY DATA FOR RESPONSE TO WPDES APPLICATION LETTER

All Values as mg/l unless otherwise stated.

Constituent	Untreated Intake	Daily Average	Minimum
pH	7.6	6-9	6-9
Temp., °F	45	<70	45
BOD, 5-day, mg/l	-	<20	-
COD, mg/l	<29	4	<29
TSS (nonfilt.), mg/l	-	<20	-
Sp. Cond., mmhos/cm, 25°C	237	-	237
Settleable Matter, ml/l	-	-	-
NH_3	-	1	-
NO_3	<1.64	5	<1.6
PO_4	<0.06	0.05	<0.05
SO_4	<9	660	<9
S_2O_3	-	<86	-
Cl	<4	7	<4
CN	<0.001	0.009	<0.001
F	<0.20	1	<0.2
Al	<0.53	1	<0.5
As	<0.001	0.02	<0.001
Ba	<0.02	0.02	<0.02
Cd	<0.002	0.02	<0.002
Ca	29.8	220	30
Cr	<0.002	0.06	<0.002
Cu	<0.011	0.02	<0.01
Fe	<1.74	0.5	<0.5
Pb	<0.01	0.09	<0.01
Mg	12.0	16	12
Mn	<0.423	0.05	<0.05
Hg	<0.0001	0.0003	<0.0003
Se	<0.001	0.07	<0.001
Ag	<0.001	0.01	<0.001
K	-	6	-
Na	-	78	-
Zn	<0.052	0.7	<0.05
TOC	-	3	-

Comment No. 3

The Phase III - Water Management Report (CH_2M Hill) emphasizes differences between early operations and mature operations. The application only discusses projected effluent quality during mature operations. Please provide data (flow, effluent quality, etc.) for the early operations.

Response:

During the development of the water management system for the Crandon Project, an evaluation was made to determine if water management practices and water treatment requirements during mill start-up were significantly different than for normal or mature operation of the project. The results of this work and other subsequent project engineering studies lead to the conclusion that water management practices and water treatment requirements, particularly for water discharge, will be the same during mill start-up and mature operations.

The volume of contaminated water pumped from the mine to the water treatment plant is expected to be about the same during mill start-up and mature operations. Some of this water will be used as make-up water for the mill during start-up (either treated or untreated) and the remainder will be treated and discharged. We do not expect that the quality of water being discharged from the project will change appreciably from mill start-up through mature operation. However, the calcium and sulfate concentration may be lower during start-up and increase with time to the levels predicted in the WPDES Permit Application.

During start-up, water flows between the mill, tailings pond, and reclaim ponds will be gradually increasing until the design capacity of the mill is reached. Treatment of water for recycle will be started when it is determined that the concentration of soluble metals in the recycle water will be detrimental to the mill process, or when gypsum scaling becomes a problem in the mill.

The real difference between early and mature operations is merely the rate at which ore is processed through the mill. For example, during the first three months of mill operation, it is expected that ore will be processed at a rate of 27 to 30 percent of annual design capacity. During the next six months, the mill throughput will increase to a rate equal to about 85 percent of annual capacity. During the next 1.5 to 2 years of operating, the mill throughput will gradually increase until the mill reaches its intended operating capacity. The point to be emphasized is that water management practices during this time are intended to remain the same, but water flow rates between facilities will gradually change. However as stated previously, the quality of the discharge water from the project will not change significantly from start-up through mature operations.

Comment No. 4 (Outfall 002, erosion control discharges)

On pages II-5 and II-6, items 16 and 17, only TSS is projected to be in any of the erosion control facility discharges. The information on Section II, Figures 7 and 8 suggests that it is possible for other contaminants such as oil and grease, sulfates, copper, lead, zinc, etc., to also be in the discharge given the areas which would contribute runoff to the sedimentation basins (i.e. preproduction ore storage areas, areas which drain to an

oil/water separator, etc.). Please discuss this concern and provide projected minimum, maximum, and average effluent values for these and any other parameters believed present.

Response:

TSS is the only contaminant expected in the discharge from the erosion control facilities to be above existing levels in surface runoff. Although it is possible that trace amounts of oil and grease could be present in the discharge streams, we do not expect this to be the case since influent to the ponds from areas where oil and grease may be present will pass through oil/water separators prior to flowing into the sedimentation pond. As a result, no visible sheen of oil and grease is anticipated in the discharge.

With regard to the other contaminants listed (sulfates, copper, lead, zinc, etc.) from areas such as the preproduction ore storage area, there will be no direct discharge from these areas. Drainage from the preproduction ore storage area will be pumped to the water treatment plant feed tank. Drainage from the waste rock pile (when it exists) will be pumped to the tailing thickener pump chamber and pumped to the reclaim pond. As a result, concentrations of these other contaminants are not expected to be above the present levels found in overland runoff (see response to Question 5).

Comment No. 5 (Outfall 002, erosion control discharges)

Drainage basin #3 has a triangular shape. Such a design is generally not appropriate if the basin is to be used for sedimentation.

Response:

The purpose of drainage basin #3 is to collect and divert runoff from the preproduction ore storage area to a sump pump inside the basin. The runoff will then be pumped to the water treatment plant feed tank. There will be no direct discharge from this facility.

As the facility is not intended primarily to trap sediment, the actual layout of the facility was guided more by the need to provide sufficient storm runoff volume consistent with the existing topography. Sediment deposition is a secondary consideration.

Comment No. 6 (Outfall 002, erosion control discharges)

Section II, Figure 7 shows a bulk fuel storage area. Provisions are not shown for an oil water separator from this area and the fuel unloading area. Please explain how spilled fuel will be contained and treated.

Response:

The bulk fuel storage and unloading area, and the fuel tank area near the fuel delivery borehole will be bermed and have sufficient capacity to contain the entire contents of the tanks. The outlet from the bermed area will be closed. During or after a precipitation event, the valve controlling the discharge must be opened manually. The outlet will have an oil/water separater. This arrangement provides assurance that any small spills and washdown water will be contained in a sump within the berm. Oil-contaminated water will be pumped out as required and transported by tank truck to one of the on-site oil/water separators for treatment before the water drains to surface drainage basin No. 1. Drawing 051-1-G-003 in Attachment 1 shows the current design for these facilities.

Because fuel spills will be infrequent, permanent facilities (sumps, pumps, and piping) are not considered to be necessary to transport water contaminated with fuel to one of the oil/water separators. This function will be handled on an as needed basis. However, there will be no instance where water contaminated with fuel is discharged.

Comment No. 7 (Outfall 002, erosion control discharges)

Where will solids which accumulate in the 3 drainage basins be disposed of?

Response:

Each of the three referenced drainage basins will have a sediment storage depth of one meter which should provide sufficient sediment storage capacity for the life of the facility. However, should the accumulated sediment in any of the surface drainage basins require removal to maintain capacity, the removed sediment will be placed in the tailings pond.

Comment No. 8 (Outfall 002, erosion control discharges)

Design of drainage basins 1 and 2 specify a rainfall/runoff ratio of 0.75 (see Figure 7). What is the basis for each of these values?

Response:

The basis for the runoff/rainfall (not rainfall/runoff) ratios was a conservative engineering judgment with guidance provided in ASCE - Manuals and Reports on Engineering Practice - No. 37 "Design and Construction of Sanitary and Storm Sewers." This runoff coefficient represents the decimal fraction of precipitation that would not be intercepted by vegetation, infiltrate into permeable soils, be retained in surface depressions, or evaporate during the design storm event.

The coefficients of 0.75 for surface drainage basins 1 and 2, and 1.0 for the preproduction ore collection basin were used to size the basins to ensure they would be adequate to contain runoff from the design storm (25 year, 24-hour event). The preproduction ore collection basin is used only to collect runoff to be diverted to the water treatment plant feed tank. To ensure adequate capacity in this pond, 100 percent of the rainfall is assumed to runoff (runoff/rainfall coefficient of 1.0).

Surface drainage basins 1 and 2 will drain paved and unpaved areas and a portion of the precipitation will infiltrate the soil and will not constitute runoff. However, a relatively high runoff coefficient of 0.75 was used and combined with the assumption that pre-storm soil saturation conditions exist. Use of these conservative runoff coefficients ensure adequate capacity exists in the sedimentation basins to contain runoff from the design storm event.

Comment No. 9

The treatment facility discharge scheme in the WPDES application for mill process water and mine water appears to have changed from what was proposed in the Phase II Water Management Study by CH_2M Hill. If the CH_2M Hill report is to be referenced in the WPDES permit application, it must be revised to reflect the most current treatment proposal. Since the CH_2M Hill study provides conceptual plans and alternatives as well as effluent information, the report should be updated.

Response:

A "Phase III Water Management Study" (December 1982) was prepared for Exxon Minerals Company by CH_2M Hill as a report that documents the water management studies undertaken in 1981 and 1982 for the Crandon Project. We are preparing an Engineering Report for the water treatment plant as proposed in the WPDES Permit Application which combines pertinent material from the Phase III Water Management Study and the recently completed engineering work. This will be a revision of Volume 2 of the "Phase III Water Management Study" and will be expanded to include other information including the design basis for the treatment plant and influent and effluent quality data. This engineering report should be available in early 1984.

Comment No. 10

Within the treatment facility as presented in the WPDES application, there appear to be 4 treatment modes available to produce a discharge. These include:

a. Handling of the uncontaminated mine water which may or may not require treatment prior to discharge.

b. Treatment of contaminated mine water through a lime precipitation/filtration/neutralization treatment system with treated effluent routed through the filter clear well and then to the excess discharge tank.

c. Treatment of process water via the reverse osmosis (RO) and vapor compression evaporator (VCE) units with treated water recycled to the mill, but with provisions for discharge of treated water to the excess discharge tank.

d. Treatment of both process water and contaminated mine water which, after separate treatment, are combined prior to the cartridge filter for treatment in the RO and VCE units, prior to recycle or discharge.

Response:

A revised blockflow diagram for the treatment plant is shown in Figure 1.

There are three water treatment modes available for the Crandon Project. These include:

a. Handling of uncontaminated water pumped from the ground water interceptor system used to control inflow to active workings of the mine. Although this water will normally be discharged, pumps and piping will be installed so that this water can be used as process make-up water if needed.

b. Treatment of approximately two-thirds of the contaminated mine water through lime precipitation, clarification, filtration, and pH adjustment. This treated water will normally be combined and discharged with the uncontaminated mine water.

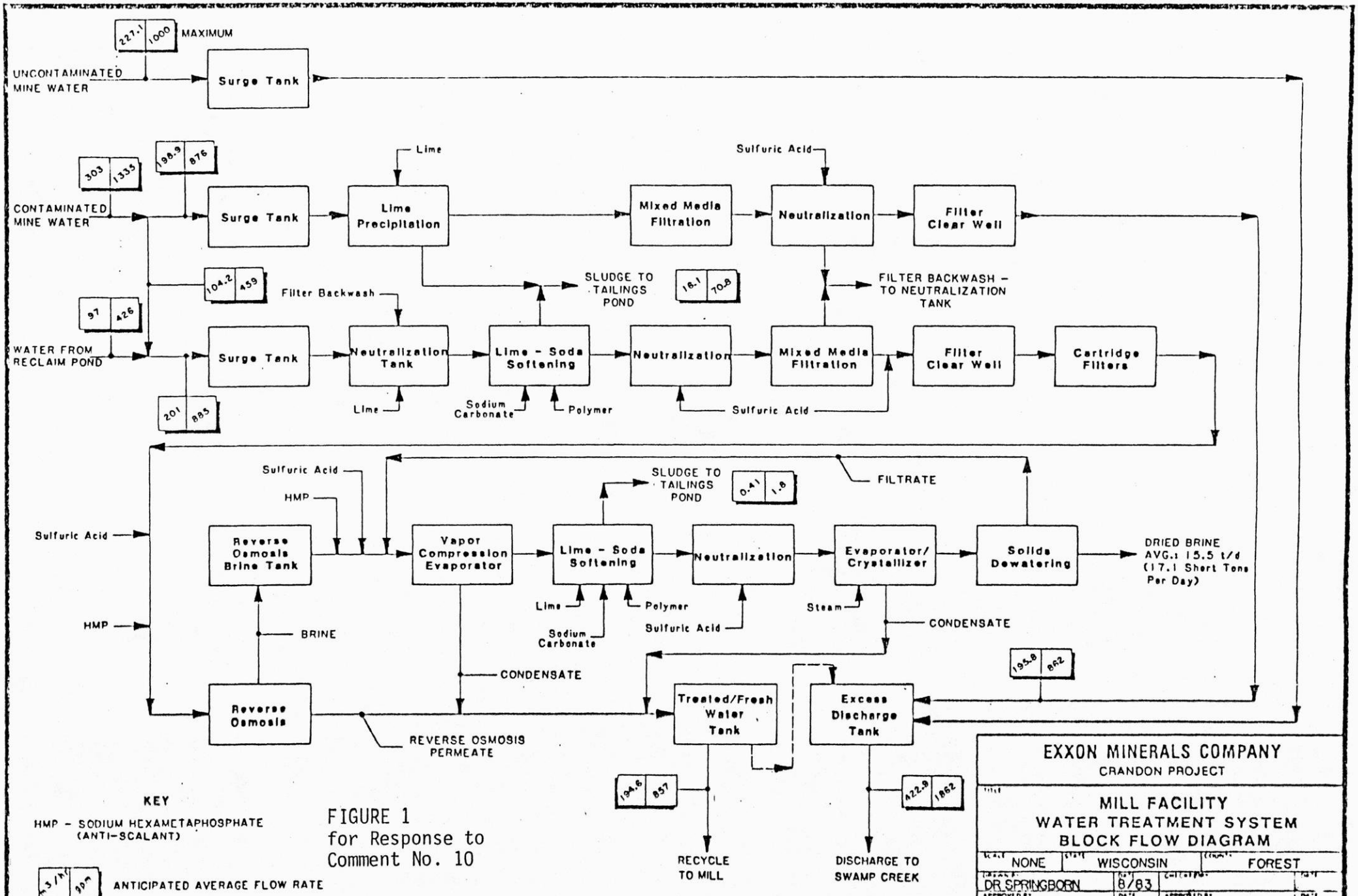


FIGURE 1
for Response to
Comment No. 10

c. Treatment of the remaining one-third of contaminated mine water and a quantity of reclaimed process water through lime/soda ash softening (neutralization and reactor/clarifier), filtration, pH adjustment reverse osmosis, and vapor compression evaporation. This water will be recycled to the mill as process water. This will provide enough high quality water to control gypsum scaling in the mill process. Provision will be made to enable discharging this water on a non-routine basis if required.

Item (d) in the comment states that "both process water and mine water which, after separate treatment, are combined prior to the cartridge filter for treatment in the RO and VCE units, prior to recycle or discharge". Although piping will be provided in the treatment plant to make this a true statement, this will not be a routine process mode. The reason for installing this piping is to allow for treatment flexibility when either the lime treatment section or the lime/soda softening sections are shut down for maintenance. The process equipment used for lime treatment and filtering of mine water is identical to the equipment used in the lime/soda softening and filtering of process water prior to treatment with reverse osmosis. When the equipment normally used for treating mine water is shut down for maintenance, treatment of process water will stop and mine water will continue to be treated with lime using the pretreatment equipment normally used to treat process water. This kind of flexibility is difficult to show in blockflow diagrams. Piping flexibility and equipment sparing for the treatment plant will be discussed with the DNR during a review of the engineering drawings.

Comment No. 11

Pilot plant data demonstrating the long term feasibility of each of these modes of treatment must be collected before the preliminary plans are submitted for review. Such pilot plant work would be part of the engineering report submitted with the preliminary plans. The preliminary plans are not required for the EIS process but must be part of the master hearing. Therefore, preliminary engineering plans could be submitted after the Department has prepared a draft EIS for the project but before the hearings. The earlier the submittal the better because of review times and subsequent resolution of concerns.

Response:

The technologies proposed for use in the water treatment plant are well proven and do not involve the use of any processes or equipment considered to be new or innovative. Lime precipitation treatment of water discharged from mining operations is well accepted technology. Lime precipitation is considered BACT by the US EPA (40 CFR Part 440, December 3, 1982, Attachment 2) and the proposed design for the Crandon Project is consistent with accepted engineering practice. Reverse osmosis and vapor compression evaporation, although not commonly used in the mining industry, are used in many industries to provide clean water both for reuse and disposal.

NR 108.05, Design Requirements, states that:

> "Final plans and specifications shall incorporate accepted engineering practices. If new or innovative equipment or methods are proposed in the plans, sufficient data, based upon practical application, experimental or otherwise, shall be submitted to show that satisfactory results can be secured."

Since the proposed technology is well proven, and the equipment to be used in the plant is conventional, with proven performance, pilot plant testing is not needed.

In addition to information in Attachment 2, the performance of lime precipitation technology is well documented in the technical literature.

1. Gauthier, J. L., "Removal of Heavy Metals from Tailings Recycle Water at Mattabi Mines, Ltd.", Canadian Mineral Processors Twelfth Annual Meeting, Ottawa, Ontario, January 22-24, 1980.

2. Kuit, W. J., "Mine and Tailings Effluent Treatment at the Kimberly, B.C. Operations of Cominco, Ltd.", Canadian Mineral Processors Twelfth Annual Meeting, Ottawa, Ontario, January 22-24, 1980.

3. Temmel, F. M., "Treatment of Acid and Metal-Bearing Wastewaters by the High-Density Sludge Process", San Francisco Regional Technical Meeting of American Iron and Steel Institute, November 18, 1971.

Reverse osmosis (RO) represents well established technology used for many industrial applications. There are estimated to be over 1,000 RO systems in operation world wide. Pretreatment of the process water will be provided to assure maximum recovery of high quality water from the RO membranes.

The following data is provided to demonstrate the effectiveness of RO in removing cations and anions from water.

Percent Rejection of Various Ions With Reverse Osmosis

Constituent	Percent Rejection
Cations	
Aluminum	98.3
Ammonium	91.5 - 94.6
Arsenic	98.0 - 99.5
Cadmium	98.0 - 99.0
Calcium	98.0 - 99.6
Copper	98.2 - 99.1
Iron	98.8
Lead	99.5
Magnesium	98.0 - 99.6
Nickel	98.1
Potassium	88.0 - 97.2
Silver	94.6
Sodium	90.0 - 98.0
Zinc	98.5 - 99.6
Anions	
Bicarbonate	93.0 - 98.5
Chloride	95.0 - 98.0
Chromate	98.4 - 99.5
Cyanide	95.2 - 96.7
Flouride	94.4 - 96.3
Nitrate	80.0 - 96.5
Phosphate	98.0 - 99.3
Selenate	98.3 - 99.0
Sulfate	98.0 - 99.6
TDS	95 - 97

Source: "Industrial Application of Reverse Osmosis Technology: Optimizing Performance", Bulletin 608, Trace Metal Data Institute, El Paso, Texas, 1981.

Data from RO pilot testing of a waste stream from a brass finishing mill indicates metal rejection from influent water of 99.5 to 99.9 percent(1). Reverse osmosis has been shown to be successful in treating acid drainage from coal mining regions(2).

Vapor compression evaporation (VCE) also represents well developed technology as an energy-efficient method of evaporating and recovering water from brines. Since this is established technology used by many industries for a variety of purposes, we see no need for pilot testing for evaporation.

Based on the information presented above, we feel that there is no need to perform pilot or bench scale testing of the processes using "synthetically prepared" influent water as a condition of permit approval.

(1)Cruver, J. E., "Reverse Osmosis for Water Reuse", Reuse in Water Management, no further reference data available.

(2)Ecology Division of Rex Chainbelt, Inc., "Reverse Osmosis Demineralization of Acid Mine Drainage" prepared for Commonwealth of Pennsylvania, Department of Environmetnal Resources, Harrisburg, PA, March 1972.

Comment No. 12

The excess discharge tank as proposed in the Phase III report, will provide a retention time of one hour at a flow of 3,000 gpm. This is not sufficient time to provide for adequate effluent equalization and storage for detection and correction of a problem should equipment fail or malfunction in the treatment process. We strongly recommend that Exxon provide at least 24 hours retention time (at 3,000 gpm flow) before treated wastewater is discharged to the pipeline leading to Swamp Creek. This could be accomplished using a lined storage pond.

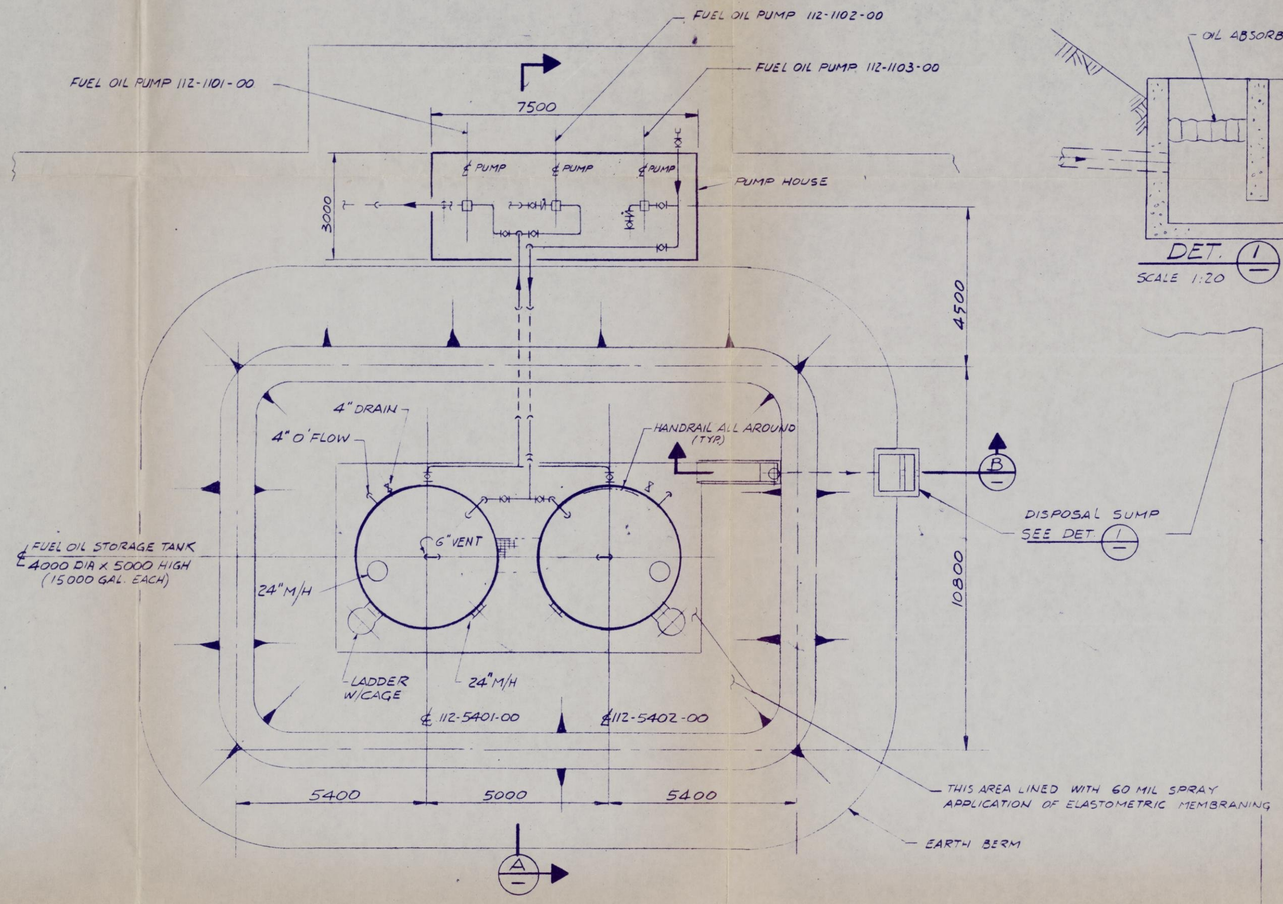
Response:

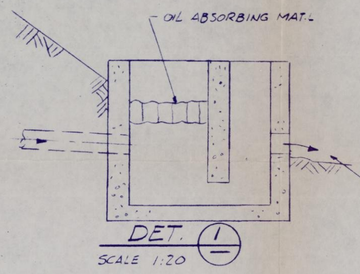
The excess water discharge tank, as currently designed, has a capacity of 1892.5 m^3 (500,000 gallons). Assuming a normal discharge rate of 454.2 m^3/h (2,000 gallons per minute), the residence time in the tank is about 4.2 hours. At a discharge rate of 681 m^3/h (3,000 gallons per minute), the residence time in the tank is 2.8 hours.

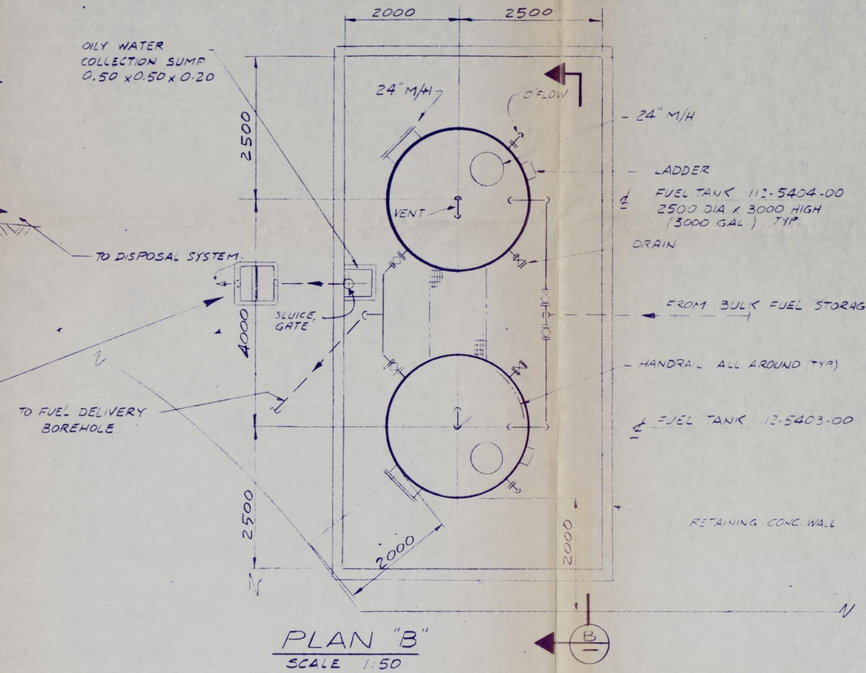
Exxon is currently considering using a lined storage pond in place of the excess water discharge tank. A pond to provide 24 hour residence time for the normal discharge rate of 454.2 m^3/hr. (2,000 gallons per minute) would require an area about 91 to 107 m (300 to 350 feet) square. This decision will be provided to the DNR when the evaluation is complete.

BULK FUEL STORAGE

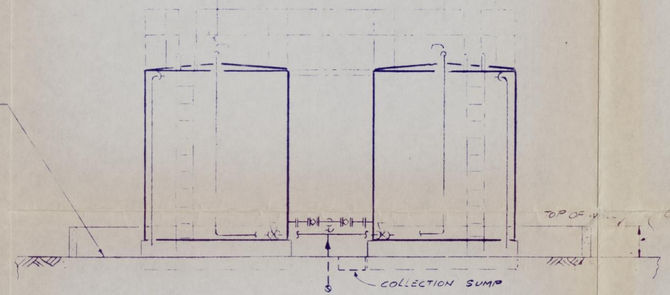
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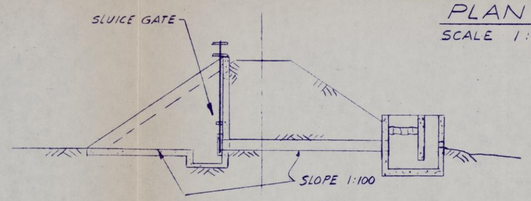




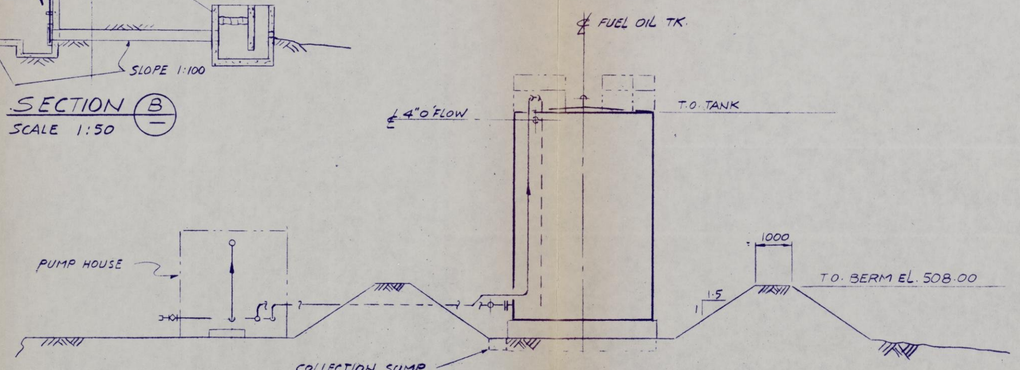
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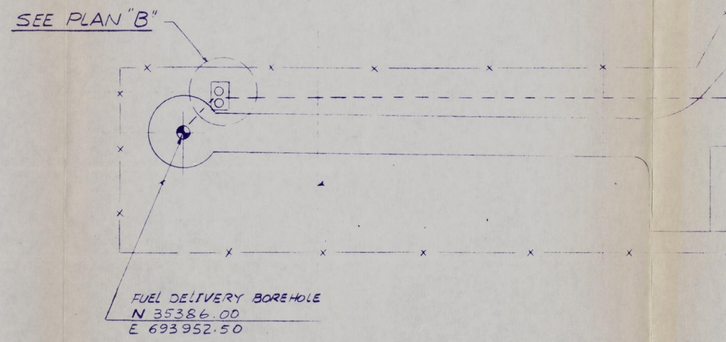
SECTION (B)
SCALE 1:50



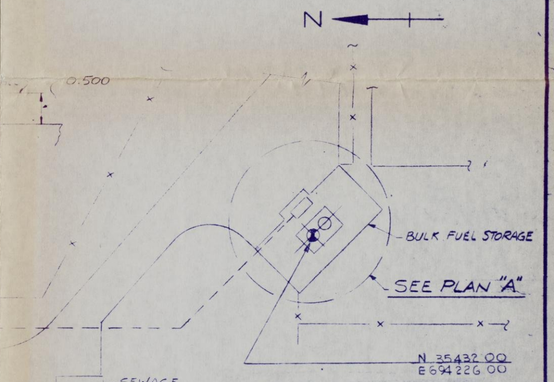
SECTION (B)
SCALE 1:50



SECTION (A)
SCALE 1:80



PLAN
SCALE 1:1000



WPDES PERMIT APPLICATION
COMMENT NO. 6
ATTACHMENT NO. 1

REVISED	DATE	BY	DESCRIPTION
1	9-14-83	C-S	ADDED SECT "B", REV. PLAN A&B

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Raymond Kaiser Engineers
RKE JOB NO. 83157

EXXON MINERALS COMPANY
CRANDON PROJECT

FUEL OIL STORAGE
GENERAL ARRANGEMENT
PLAN & SECTION

SCALE: AS SHOWN	STATE: WISCONSIN		COUNTY: USA		
DRAWN BY: T. FAROL	DATE: 6-17-83	CHECKED BY: C. SAMONIN	DATE: 7-15-83
APPROVED BY: [signature]	DATE: 7-15-83	APPROVED: [signature]	DATE: 7/20/83
APPROVED BY: [signature]	DATE: 7-22-83	EXXON	DATE
DRAWING NO: 051-1-G-003		SHEET 1 OF 1	REVISION NO: 1

GBB 5/1981

WPDES PERMIT APPLICATION

COMMENT NO. 11

ATTACHMENT NO. 2

ENVIRONMENTAL PROTECTION AGENCY
40 CFR Part 440

Ore Mining and Dressing Point Source
Category Effluent Limitations;
Guidelines and New Source Performance Standards

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 440

[WH-FRL 2232-1]

Ore Mining and Dressing Point Source Category Effluent Limitations Guidelines and New Source Performance Standards

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This regulation limits the discharge of pollutants into navigable waters of the United States from exisitng and new sources in the ore mining and dressing industry. The Clean Water Act and a Consent Decree require EPA to issue this regulation.

The purpose of this regulation is to establish "best available technology" limitations (BAT) and "new source performance standards" (NSPS) for direct dischargers. Pretreatment standards for both existing and new sources are not being issued since no known indirect dischargers exist nor are any known to be planned. Effluent limitations for "best conventional technology" (BCT) are reserved pending application of the new BCT cost methodology.

DATES: In accordance with 40 CFR 100.01 (45 FR 26048), this regulation will be considered issued for purposes of judicial review at 1:00 P.M. Eastern time on December 17, 1982. It will become effective January 17, 1983 publication date, except § 440.104(b)(2)(ii) which contains information collection requirements which are under review at OMB.

Under Section 509(b)(1) of the Clean Water Act, any petition for judicial review of this regulation must be filed in the United States Court of Appeals within 90 days after the regulation is considered issued for purposes of judicial review. Under Section 509(b)(2) of the Clean Water Act, the regulation may not be challenged later in civil or criminal proceedings brought by EPA to enforce its requirements.

ADDRESS. Technical information may be obtained from Mr. B. Matthew Jarrett, at the address listed below, or by calling (202) 382-7164. The economic information may be obtained from Mr. John Kukulka, Office of Analysis and Evaluation (WH-586), Environmental Protection Agency, 401 M Street SW., Washington, D.C. 20460, or by calling (202) 382-5388.

On December 24, 1982, copies of the development document and the NSPS economic analysis will be available for public review in EPA's Public Information Reference Unit, Room 2404 (Rear) (EPA Library), 401 M Street SW., Washington, D.C. On February 7, 1983, the complete Record, including the Agency's responses to comments on the proposed regulation will be available for review at the Public Information Reference Unit. The EPA information regulation (40 CFR Part 2) allows the Agency to charge a reasonable fee for copying. Copies of the development document and the economic analysis may also be obtained from the National Technical Information Service, Springfield, Virginia 22161 (703) 487-6000. A notice will be published in the Federal Register announcing the availability of these documents from NTIS. (This should occur within 60 days of today's date.)

SUPPLEMENTARY INFORMATION:

Organization of this Notice

I. Legal Authority
II. Scope of This Rulemaking
  A. Overview
  B. Prior EPA Regulations
  C. Description of This Regulation
III. Summary of Legal Background
  A. The Clean Water Act
    1. Best Practicable Control Technology Currently Available (BPT)
    2. Best Available Technology Economically Achievable (BAT)
    3. Best Conventional Pollutant Control Technology (BCT)
    4. New Source Performance Standards (NSPS)
    5. Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS)
IV. Methodology and Data Gathering Efforts
V. Summary of Promulgated Regulation and Changes From Proposal
  A. Subcategorization
  B. Applicability
  C. Best Practicable Technology Limitations
  D. Best Available Technology Limitations
  E. Best Conventional Technology Limitations
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I. Legal Authority

The regulations described in this notice are promulgated under authority of Sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 USC 1251 et seq., as amended by the Clean Water Act of 1977, P.L. 95-217) (the "Act"). These regulations are also promulgated in response to the Settlement Agreement in *Natural Resources Defense Council, Inc.*, v. *Train*, 8 ERC 2120 (D.D.C. 1976), *modified*, 12 ERC 1833 (D.D.C. 1979).

II. Scope of This Rulemaking

A. *Overview.* This regulation applies to facilities engaged in mining and processing of metal ores. The industry includes facilities which mine or process the ores of 23 separate metals and is segregated by the U.S. Bureau of the Census Standard Industrial Classification (SIC) into nine major codes: SIC 1011, Iron Ore; SIC 1021, Copper Ores; SIC 1031, Lead and Zinc Ores; SIC 1041, Gold Ores; SIC 1044, Silver Ores; SIC 1051, Aluminum Ore; SIC 1061, Ferroalloy Ores including Tungsten, Nickle, and Molybdenum; SIC 1092 Mercury Ores; SIC 1094 Uranium, Radium, and Vanadium Ores; and SIC 1099 Metal Ores, Not Elsewhere Classified including Titanium and Antimony.

Over 500 active mining and over 150 milling operations are located in the United States and most are in remote areas.

The industry includes facilities that mine ores to produce metallic products and all ore dressing and beneficiating operations at mills operated either in conjunction with a mine operation or at a separate location. A detailed overview of the ore mining industry can be found in the proposed regulation (47 FR 25682).

B. *Prior EPA Regulations.* On November 6, 1975, EPA published interim final regulations establishing BPT requirements for existing sources in the ore mining and dressing industry (see 40 FR 51722). These regulations became effective upon publication. However, concurrent with their publication, EPA solicited public comments with a view to possible revisions. On the same date, EPA published proposed BAT, NSPS, and pretreatment standards for this industry (see 40 FR 51738). Comments were also solicited on these proposals.

On May 24, 1976, as a result of the public comments received, EPA suspended certain portions of the interim final BPT regulations and solicited additional comments (see 41 FR 21191). EPA promulgated revised, final BPT regulations for the ore mining and dressing industry on July 11, 1978, (see 43 FR 29711, 40 CFR Part 440). On February 8, 1979, EPA published a clarification of the BPT regulations as they apply to storm runoff (see 44 FR 7953). On March 1, 1979, the Agency amended the final BPT regulations by deleting the requirements for cyanide applicable to froth flotation mills in the base and precious metals subcategory (see 44 FR 11546).

On December 10, 1979, the United States Court of Appeals for the Tenth Circuit upheld the BPT regulations, rejecting challenges brought by five industrial petitioners. *Kennecott Copper Corp.* v. *EPA*, 612 F. 2d 1232 (10th Cir. 1979).

The Agency withdrew the proposed BAT, NSPS, and pretreatment standards on March 19, 1981 (see 46 FR 17567). On June 14, 1982 the Agency proposed the BAT, BCT, and NSPS limitations and standards which are the subject of this rulemaking.

C. *Description of This Regulation.* As a result of the Clean Water Act of 1977, the emphasis of EPA's program has shifted from "classical" pollutants to the control of a list of toxic substances. Therefore, in this rulemaking, EPA efforts are primarily directed toward ensuring the achievement of limitations based upon the best available technology economically achievable (BAT) by July 1, 1984.

The BPT effluent limitations are included as part of this regulation for the convenience of the reader. Since there are no substantive changes in the BPT effluent limitations as sustained by the 10th Circuit, the BPT effluent limitations are not subject to further judicial review.

BAT limitations are established for seven subcategories in the ore mining and dressing point source category. The BAT effluent limitations are being promulgated as they were proposed on June 14, 1982 (47 FR 25682). The technology basis for BAT is discussed in the proposed regulation and is discussed in greater detail in the development document supporting the proposed regulation and in the development document supporting this final regulation.

BCT effluent limitations are not being promulgated in this rulemaking. As discussed further in Section V, Changes from Proposal, BCT for this point source category is instead being included as part of the proposed regulation on the new BCT cost methodology. (47 FR 49176, October 29, 1982).

NSPS are established for seven subcategories. A NSPS for froth flotation mills extracting copper, lead, zinc, gold, silver, or molybdenum was proposed as zero discharge, but the standard is being amended to allow for a bleed in the mill circuit. Also, the upset and bypass storm provision for new sources requiring zero discharge is being changed and made identical to the provision for existing sources. All other standards of performance and general provisions are established essentially as proposed. This is discussed further in Section V, Changes from Proposal.

Finally, this regulation does not establish pretreatment standards because, as discussed in the proposed regulation, the Agency knows of no existing facilities which discharge to publicly owned treatment works and does not expect that any new sources will do so.

III. Summary of Legal Background

A. *The Clean Water Act.* The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical and biological integrity of the Nation's waters" (Section 101(a)). To implement the Act, EPA was required to issue effluent limitations guidelines, pretreatment standards and new source performance standards for industrial dischargers.

The Act included a timeable for issuing these standards. However, EPA was unable to meet many of the deadlines and, as a result, in 1976, it was sued by several environmental groups. In settling this lawsuit, EPA and the plaintiffs executed a court-approved "Settlement Agreement." This Agreement required EPA to develop a program and adhere to a schedule in promulgating effluent limitations guidelines and pretreatment standards for 65 "priority" pollutants and classes of pollutants, for 21 major industries. [*See Natural Resources Defense Council, Inc.* v. *Train*, 8 ERC 2120 (D.D.C. 1976), *modified*, 12 ERC 1833 (D.D.C. 1979)].

Many of the basic elements of this Settlement Agreement were incorporated into the Clean Air Water Act of 1977 ("the Act"). Like the Settlement Agreement, the Act stressed control of the 65 classes of toxic pollutants. In addition, to strengthen the toxic control program, Section 304(e) of the Act authorizes the Administrator to prescribe "best management practices" (BMP) to prevent the release of toxic and hazardous pollutants from plant site runoff, spillage or leaks, sludge or waste disposal and drainage from raw material storage associated with, or ancillary to, the manufacturing of treatment process.

Under the Act, the EPA program is to set a number of different kinds of effluent limitations. These are discussed in detail in the proposed regulation and development document. The following is a brief summary:

1. Best Practicable Control Technology Currently Available (BPT). BPT limitations generally are based on the average of the best existing performance at plants of various sizes, ages and unit processes within the industry or subcategory. In establishing BPT limitations, we consider the total control of applying the technology in relation to the effluent reduction derived, the age of equipment and facilities involved, the process employed, the engineering aspects of the control technologies, process changes and the nonwater-quality environmental impacts (including energy requirements). We balance the total cost of applying the technology against the effluent reduction.

2. Best Available Technology Economically Achievable (BAT). BAT limitations, in general, represent the best existing performance in the industrial subcategory or category. The Act establishes BAT as the principal national means of controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. In arriving at BAT, the Agency considers the age of the equipment and facilities involved, the process employed, the engineering aspects of the control technologies, process changes, the cost of achieving such effluent reduction and nonwater-quality environmental impacts. The Administrator retains considerable discretion in assigning the weight to be accorded these factors.

3. Best Conventional Pollutant Control Technology (BCT). The 1977 Amendments added Section 301(b)(2)(E) to the Act establishing "best

conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in Section 304(a)(4) [biological oxygen demanding pollutants (e.g., BOD5) total suspended solids (TSS), fecal coliform and pH] and any additional pollutants defined by the Administrator as "conventional," i.e., oil and grease. (See 44 FR 44551: July 30, 1979.)

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. *American Paper Institute* v. *EPA*, 660 F. 2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the cost of publicly owned treatment works (POTWs) for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA published its methodology for carrying out the BCT analysis on August 29, 1979 (44 FR 50732). In the case mentioned above, the Court of Appeals ordered EPA to correct data errors underlying EPA's calculation of the first test, and to apply the second cost test. (EPA had argued that a second cost test was not required.)

EPA recently proposed a new methodology on October 29, 1982 and simultaneously proposed BCT limitations for ore mining and dressing. (47 FR 49176).

4. New Source Performance Standards (NSPS). NSPS are based on the best available demonstrated technology. New plants have the opportunity to install the best and most efficient production processess and wastewater treatment technologies.

5. *Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS).* Pretreatment standards (PSES and PSNS) are designed to control the discharge of pollutants into publicly owned treatment works. Pretreatment standards were not proposed for the ore mining and dressing category since no known indirect dischargers exist nor are any known to be planned. Ore mines are located in rural areas, generally far from a POTW. EPA expects that the cost of pumping mine and mill wastewater to a POTW would be prohibitive in most cases, and on-site treatment is more cost effective in virtually every instance.

IV. Methodology and Data Gathering Efforts.

The methodology and data gathering efforts used in developing the proposed regulation were discussed in the preamble to the proposal, 47 FR 25682 (June 14, 1982). In summary, before publishing the proposed regulation the Agency conducted a data collection, analytical screening, and analytical verification program for the ore mining and dressing industry. This program stressed the acquisition of data on the presence and treatability of the 65 toxic pollutants and classes of toxic pollutants discussed previously. The 65 toxic pollutants and classes of pollutants potentially include thousands of specific pollutants. EPA selected 129 specific toxic pollutants for study in this rulemaking and other industry rulemakings. (Analytical methods are discussed in *Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants* (U.S. E.P.A., April 1977)). Based on the results of that program, EPA identified several distinct treatment technologies, including both end-of-pipe and in-plant technologies, that are or can be used to treat ore mining and dressing industry wastewaters.

For each of these technologies, the Agency (i) compiled and analyzed historical and newly-generated data on effluent quality, (ii) identified its reliabilities and constraints, (iii) considered the nonwater quality impacts (including impacts on air quality, solid waste generation and energy requirements), and (iv) estimated the costs and economic impacts of applying it as a treatment and control system. Costs and economic impacts of the technology options considered are discussed in detail in two separate documents, *The Economic Impact Analysis of Promulgated New Source Performance Standards for the Ore Mining and Dressing Industry* and *The Economic Impact Analysis of Promulgated BAT Effluent Limitations and Standards for the Ore Mining and Dressing Industry*. A more complete description of the Agency's study methodology, data gathering efforts and analytical procedures supporting the regulation can be found in the *Final Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category* (U.S. EPA, November 1982).

V. Summary of Promulgated Regulation and Changes From Proposal

The final regulation does not change the proposed BAT regulations but does change the standards for new sources. The changes are the result of the Agency's consideration of public comments provided in response to the proposal and further evaluation of the information upon which the proposal was based.

A. Subcategorization. The proposed subcategorization scheme was similar to the subcategorization scheme found in the 1978 BPT regulations. That scheme subcategorizes the industry primarily on the basis of ore type. Each subcategory is further subdivided on the basis of whether the discharge is from a mine or a mill and, in some cases, according to the type of beneficiation process employed. In these final regulations the Agency is retaining the proposed subcategorization scheme with a few modifications resulting from comments received on the proposed regulation.

The 1978 BPT regulations contained a Ferroalloy Ores subcategory that addressed discharges from facilities mining or milling chromium, cobalt, columbium, tantalum, manganese, molybdenum, nickel, tungsten, and vanadium (recovered alone, rather than as a by-product of uranium mining or milling). The BPT regulations also contained a Base and Precious Metal Ores subcategory that addressed the discharges from facilities mining or milling copper, lead, zinc, gold, or silver. Prior to proposing the BAT and NSPS regulations, EPA found that the wastewater discharges from molybdenum mines and mills were more like the discharges from facilities in the Base and Precious Metals Ores subcategory than the discharges from the Ferroalloy subcategory. Consequently the proposed BAT and NSPS regulations placed molybdenum mines and mills into the Base and Precious metals subcategory, which was renamed the Copper, Lead, Zinc, Gold, Silver, Platinum and Molybdenum Ores subcategory. The proposal also eliminated the Ferroalloy subcategory and replaced it with the Nickle Ores subcategory, the Tungsten Ores subcategory, and the Vanadium Ores subcategory (recovered alone, not as a by-product of uranium mining and milling). For clarification, however, the proposal retained the old subcategorization scheme for the BPT limitations.

From the comments received, it is apparent that retention of the old BPT subcategorization scheme for the BPT

limitations has only confused, rather than clarified matters. The commenters suggested that, to eliminate this confusion, the Agency should use an identical subcategorization scheme for all the limitations and standards. Accordingly, in this final regulation, the Agency is eliminating a separate subcategorization scheme for the BPT limitations, and is, instead, using the same scheme for all the BPT, BAT, and NSPS limitations. This change is solely for the purpose of clarification and will not alter in any way the actual numerical limitations which apply to facilities covered by the BPT regulations.

One additional modification to the subcategorization scheme is being made. The Agency is taking platinum ore out of the new Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores subcategory and establishing a new subcategory for these mines and mills. The Agency received comments that a new platinum mine and mill is being considered that will be substantially different than the existing mines and mills upon which the Agency based best demonstrated technology. The Agency is, therefore, establishing a new subcategory addressing platinum ore mines and mills and is reserving the new source performance standard.

B. Applicability. As discussed in the proposal, the Ore Mining and Dressing effluent guidelines limitations and standards are applicable to facilities discharging wastewater from ore mining and milling operations. They do not, however, provide a complete basis for calculating the limitations of operations known as "complex facilities," which combine wastestreams from processes such as refining and smelting with ore mining and milling wastestreams and then treat this combined stream before discharge. Each facility will be given effluent limitations that are derived from the BAT mine and mill guidelines and the smelter and refining guidelines and other applicable guidelines.

The Agency received voluminous comments from developers of a molybdenum mine and mill in southeastern Alaska. The developers argued that the mill differs substantially from the existing molybdenum mills upon which the Agency based the proposed NSPS. Specifically, they argue that precipitation is greater than at other facilities and that the terrain is unusually steep, necessitating the construction of a dam much larger than tailings impoundments at existing facilities. They further argue that since the mine and mill are located in the environmentally sensitive Misty Fjords National Monument, construction of a massive tailings impoundment may result in greater long term environmental degradation than at existing facilities. In a related vein, they point out that the mine and mill are being developed in accordance with the dictates of the Alaska National Interest Lands Conservation Act (ANILC), which requires an intensive study of the overall environmental impact of the mine and mill before construction begins. Finally, they note that the mine and mill are in an earthquake area, and that construction of a large tailings dam raises concerns for safety of the population below the dam.

The Agency disagrees with the commenter's assertions that the proposed molybdenum mine and mill differ significantly in topography and climate from existing mines and mills. Nevertheless, given the possibility that compliance with the zero discharge NSPS would result in substantial non-water quality environmental impacts, and given the fact these impacts are being subjected to an intense environmental scrutiny, the Agency believes it would be premature to subject the mine and mill to regulation at this time, before the environmental review process is fully completed.

Also, as the Agency stated in the preamble to the BPT regulations and in the proposed regulation for BAT and NSPS, under no circumstances will an owner or operator be required to violate applicable safety standards to meet the requirements of BPT, BAT, or NSPS. As discussed in these regulations, the Agency is confident that the national applicable effluent limitations guidelines and standards of performance do not pose a concern for the overall safety related to the water impoundments that may be required by the regulations. However, it would be premature to regulate this mine and mill before the potential for earthquake and avalanches in a deep mountain terrain has been completely evaluated by Federal and State agencies and others responsible for conducting a thorough study of the impacts of this proposed new mine and mill. Accordingly, the Agency is excluding this mine and mill from the regulations applicable to molybdenum mines and mills, thereby postponing consideration of the appropriate limitations for this facility until the permit proceedings.

The BPT limitations established a subpart for gold placer mines, but reserved effluent limitations because the Agency did not have sufficient technical or economic data. The proposal similarly reserved effluent limitations and standards for the gold placer mine subpart because the data generated prior to proposal were not sufficiently comprehensive.

EPA still has no data upon which to base an economic assessment of gold placer mines and does not have sufficient technical data to promulgate or propose limitations for gold placer mines. The Agency is, therefore, continuing to reserve the subpart for gold placer mines in the promulgated regulation.

C. Best Practicable Technology Limitations. The BPT limitations for the ore mining industry were promulgated in 1978, were completely upheld in the Courts, and are repeated in this regulation solely for clarity. EPA received a few comments which recommended that the Agency relax the current BPT regulations. These comments are discussed in the response to public comments document.

D. Best Available Technology Limitations. EPA proposed BAT limitations equal to the BPT regulations currently applicable to this industry.

The rationale for setting BAT effluent limitations equivalent to BPT effluent limitations is discussed in the proposal (47 FR 25682), the development document supporting the proposed rule, and the development document supporting this final rule. In summary, the Agency established BAT equal to BPT either because BPT already specified zero discharge of process wastewater, or because application of candidate BAT did not reduce the level of the toxic or nonconventional pollutants, or because BPT removed a very high percentage of the relevant pollutants. Almost all the commenters agreed with EPA's decision to propose BAT equal to BPT. Accordingly, the Agency is finalizing the BAT limitations as proposed. The comments addressing the BAT limitation are discussed in the response to public comments document.

E. *Best Conventional Technology Limitations.* The Agency proposed BCT limitations equal to the BPT limitations for conventional pollutants. This was done even though the Agency had not established a new cost effectiveness test for conventional pollutant removal as directed by the Fourth Circuit Court of Appeals decision in *American Paper Institute* v. *EPA*, F. 2d (4th Cir. 1981). In the proposal the Agency reasoned that since BPT is the minimum level of control required by law, no possible reassessment of BCT pursuant to the Court's remand could result in BCT limitations for conventional pollutants less stringent than the BPT limitations.

A number of commenters took issue with the Agency's decision to propose BCT limitations in the absence of a new BCT methodology. The Agency agrees with these criticisms and has accordingly decided to withdraw the BCT limitations proposed on June 14, 1982. Instead, BCT Limitations for the ore mining and dressing point source category are being included as part of the proposed regulation on the new BCT methodology. This proposed regulation was published in the Federal Register on October 29, 1982. (47 FR 49176). Comments on the proposed BCT limitations must be submitted during the comment period for the BCT rulemaking.

F. New Source Performance Standards. EPA proposed new source performance standards (NSPS) equal to the BAT limitations for all elements of the ore mining and dressing industry with the exception of froth flotation mills in the copper, lead, zinc, gold, silver, platinum and molybdenum subcategory and the uranium mill subcategory. The Agency proposed NSPS requiring zero discharge for these latter two segments as discussed below.

1. Froth Flotation Mills. The proposed zero discharge requirement for new froth flotation mills was based on the fact that 46 out of 90 existing facilities for which we have data achieve zero discharge through total recycle and evaporation of process wastewater.

Industry commenters raised a number of objections to this proposal. First, they argued that most of the mills achieving zero discharge are in net evaporation areas with flat topography and that it was inappropriate to extrapolate from the treatment performance of mills in these areas to mills located in rainy or mountainous areas. They contended that in rainy or mountainous areas, the costs of constructing the tailings impoundment necessary to achieve zero discharge and the costs of transporting recycle water back to the mill could be prohibitive. They implied that this problem was greatly exacerbated by the proposed storm exemption for new sources, which granted relief to a facility only upon the occurrence of a ten year, twenty-four hour storm.

Second, they argued that EPA improperly assumed that new sources, unlike existing sources, would not experience extensive retrofit costs. They pointed out that the Agency's proposed definition of new source embraces both virgin or "greenfield" facilities and facilities constructed in conjunction with existing sources. These latter facilities, they stated, will incur substantial retrofit costs to achieve zero discharge.

Finally, they asserted that the Agency neglected to take into account the buildup of reagents and other contaminants in the recycle water of a total recycle system. They claimed that these contaminants would interfere with the froth flotation process and cause severe loss of product, necessitating either the addition of fresh make up water or the treatment of the recycle water. They added that treating the recycle water may not always prove to be an effective solution because of the buildup of contaminants from the treatment of the recycle water. They pointed out the Agency had not calculated the costs of treating the recycle water or building the bigger impoundment to hold and recycle the wastewater.

The Agency disagrees with the commenters' first criticism that EPA failed to adequately take into account topographical and climatic constraints in proposing a zero discharge requirement for new sources. Mills currently achieving zero discharge are located in areas ranging from flat to extremely steep and mountainous. Zero discharge is thus demonstrated for a wide spectrum of topographical constraints. Similarly, although the majority of mills achieving zero discharge are located in dry areas, 15 are located in relatively wet areas. Zero discharge is thus demonstrated for wet areas as well as dry areas. Moreover, the standards promulgated for new source froth flotation mills allow a discharge of wastewater equivalent to the net precipitation (precipitation less evaporation) subject to the discharge limitations for mine drainage, e.g. 440.104(2)(i). By permitting the discharge of excess rainwater and runoff, this provision substantially minimizes the effect of climate on a facility's ability to meet zero discharge.

An assumption of the commenters' arguments is that the zero discharge requirement imposes significantly greater costs than the BPT requirement under the same set of topographical, climatic and land availability constraints. Many commenters implied that constructing a tailings pond necessary to achieve zero discharge in mountainous or rainy areas would be much more expensive than constructing a similarly situated pond to meet BPT requirements. Although there might have been some merit to this argument under the Agency's proposed storm exemption for new sources, this is no longer the case. Now that the Agency has amended the proposed storm provision to make it identical to the provision for existing sources, the pond required to meet BPT requirements will be approximately the same size as the pond required to meet zero discharge. (See Development Document for further discussion).

One commenter, whose existing tailings pond is located several miles from the mill and several thousand feet below it, argued that, if this mill were a new source, the costs of recycling water to the mill to achieve zero discharge would prove much more expensive than meeting the BPT requirements. The Agency, however, considers such situations to be extremely rare. If a new source had to operate under similar constraints, the Agency would entertain a petition to modify the new source standard or create a new subcategory for this type of facility.

With respect to industry commenters' second criticism, EPA agrees with their claim that there would be retrofit costs associated with meeting zero discharge where a new source is constructed at the site of an existing source. It is not clear, however, whether this problem is anything but theoretical. EPA specifically asked industry to provide it with examples of construction at the site of an existing source which might constitute a new source under EPA's proposed criteria for "new source" (45 FR 59343, September 9, 1980). After evaluating these examples, EPA has concluded that only one of the examples provided by industry would constitute a "new source" under the proposed criteria—and this example involved construction at a "green field" site. (These examples are specifically discussed in the Response to Comments document). Nevertheless, EPA has redone its economic analysis to embrace situations where construction at the site of an existing source would clearly create a new source (i.e. total replacement of a mill). EPA has concluded that in such situations, the costs of achieving zero discharge will not cause an adverse economic impact.

EPA agrees with the commenters' third contention that we did not adequately consider the buildup of contaminants in the recycle water. Commenters have come forward with data demonstrating that the buildup of reagents and other contaminants can in fact interfere with the extractive process, causing severe loss of product. They have also demonstrated that treatment of the recycle water may not always be an economically viable option for dealing with this interference problem. Unfortunately, this interference is a complex phenomenon, which appears to be related to the characteristics of the ore at particular sites, making it impossible to carve out a subcategory of facilities afflicted with this problem. Accordingly, to

accommodate the problem, the final NSPS contains a special "bleed" provision which will allow facilities to discharge wastewater (subject to the NSPS mine drainage standards) if they can demonstrate to the permitting authority that total recycle would cause a major interference in the extractive metallurgical process and that appropriate treatment of recycle water is not adequate to remedy this interference. This provision will allow such facilities to substitute some fresh water for recycle water as industry stated and their data indicated was necessary, thereby avoiding the losses associated with buildup of contaminants in the recycle water. Specification of the exact amounts of water discharged and the appropriate treatment of recycle water will, of course, be left to the permitting authority. The Agency has, however, evaluated the costs and economic impact of at least two forms of treatment of recycle water. The first is pH adjustment (lime addition) and settling. Assuming a 24-hour retention time and a 10 percent safety factor, the Agency has concluded that the costs of such treatment of recycle water would not be significant enough to deter investment for a new mill with a tailings pond used for primary settling. The Agency has further determined that additional treatment consisting of a ixed media filter would not constitute barrier to entry for such mills. The development document and economic document supporting this regulation discuss in more detail the Agency's considerations in creating the bleed provision and what treatment was considered as appropriate treatment of recyle water.

2. Uranium Mills. The Agency proposed zero discharge for new uranium mills based on data demonstrating that 18 of 19 existing mills do not discharge wastewater. The single existing mill which discharges, recycles over 80 percent of the requirement for its intake water. Zero discharge for new uranium mills is based on recycle, evaporation, and a combination of recycle and evaporation.

Industry commented that our data represented mills in arid areas and that we did not consider new mills that may locate in areas of high rainfall. They also requested that flexibility should be allowed to accommodate changes in the extractive processes currently used to recover uranium. Finally they commented that we should allow an effluent discharge because such a harge is considered a valuable modity in water short areas.

The ability of uranium mills to achieve zero discharge is well demonstrated and is recognized by Federal and State regulating authorities dealing with the uranium industry. It is true that existing uranium mills are located in arid areas. However, we know of no plans for construction of new mills in non-arid areas, although some firms have conducted exploration in such areas. Should any new mills locate in areas of high net precipitation, they can take advantage of the net precipitation provision and the storm exemption. If, despite these provisions, a uranium mill locates in an area where it is impossible to achieve zero discharge the facility can petition the Agency to change NSPS or create a separate subcategory for that type of facility.

The Agency does not believe that it needs to provide any additional flexibility to accommodate changes in the extractive processes used to recover uranium. Industry commenters failed to provide EPA with any information concerning new or different extractive processes. Furthermore, the current regulations only apply to certain identified extractive processes and thus would not apply to processes unrelated to processes used today.

Nor does the Agency believe that the zero discharge requirement will adversely affect water conservation. Even if there were a slight increase in water consumption attributable to compliance with zero discharge, that increase would not be significant when compared to the benefits derived from the use of recycle and evaporation systems. Accordingly, the zero discharge requirement for new uranium mills is promulgated as proposed.

3. *Storm Exemption.* The Agency proposed a storm exemption for new sources subject to zero discharge which would allow a discharge of excess wastewater upon the occurrence of a 10-year 24-hour precipitation event. Industry stated that the provision of the exemption imposed an impossible design requirement on them and should be changed to the requirement for existing sources.

After reviewing the industry comments, and data developed by the Agency, EPA has concluded that the industry comments are valid. Conditioning the storm exemption on the actual occurrence of a 10-year, 24-hour storm is inappropriate because overflows can occur from facilities designed, maintained, and operated to handle a 10-year, 24-hour precipitation event as a result of recurring storms or excessive snowmelt even though no individual event were equivalent to a 10-year, 24-hour precipitation event. The proposal would have required facilities to engage in the extremely difficult task of anticipating all such combinations of precipitation events. Accordingly, we have modified the storm exemption for new sources subject to zero discharge so that it is identical to the exemption for existing sources.

The Agency received requests for further explanation of the considerations to be taken into account in the design and construction of a facility which may be granted relief under the storm exemption. As a result of these requests we have made some clarifying changes in the language of the exemption. The first change is designed to clarify the nature of the operator's responsibilities during an upset or bypass overflow event. The storm exemption is designed to provide a limited exception to the requirements applicable to mines and mills under normal operating conditions. It grants relief from excess discharges which occur during and immediately after any precipitation or snowmelt—the intensity of the event is not specified. The storm exemption was not intended to grant the operator the option of ceasing or reducing efforts to contain or treat the runoff resulting from a rainfall or snowmelt, i.e., the operator does not have the option of turning off the lime feed to a facility at the start of or during a precipitation event, regardless of the design and construction of the facility. The operator must, instead, take all reasonable steps during and after the precipitation event to treat or contain the wastewater discharge and to limit the amount of overflow or excess discharge.

The second change is intended to clarify the nature of the design requirement for sources subject to a zero discharge limitation and to emphasize the fundamental differences between that requirement and the requirement for sources not subject to zero discharge. The storm exemption applicable to sources which are allowed to discharge requires the facility to be able to contain the maximum volume of wastewater which would be generated by the facility during a 24-hour period plus the volume of water which would result from a 10-year, 24-hour rainfall or treat the flows associated with these volumes. The rationale behind the containment requirement is that a facility with such capacity, even if full at the beginning of the storm, would be able to treat the storm runoff and normal plant discharge by providing at least a 24-hour retention time for settling

of the wastewaters before the water is discharged.

The design concept for the storm exemption applicable to sources subject to zero discharge requirements must, however, be different, because such sources are not permitted to discharge. Such sources must, therefore, be able to contain the amount of water equal to the volume of water in the pond under normal operating conditions (which includes water which is recycled or will be evaporated) plus the volume generated from a 10-year, 24-hour rainfall. In other words, the source must provide a freeboard over and above normal pond levels which can accommodate the water generated by a 10-year, 24-hour rainfall. Simply being able to hold the normal volume of wastewater from the mill process without discharge plus the 10-year, 24-hour rainfall will not suffice, unless the normal process wastewater is a fair measure of the volume of water in the pond under normal operating conditions.

The third change is designed to clarify the relationship between the storm exemption and the general upset and bypass provisions set in the consolidated permit regulations [See, 40 CFR 122.60]. The relationship between them should be set out more clearly. In the preamble to the proposal, we said that the storm exemption supersedes the general upset and bypass provisions with respect to precipitation events; that is, an operator wishing to obtain an excursion from the BAT or NSPS requirements during precipitation events must comply with the the prerequisites of the storm exemption. We did not, however, state whether an operator also had to comply with any of the upset and bypass provisions contained in the consolidated permit regulations as well. To clarify this, the storm exemption is being changed to specifically require compliance with the notice provisions of the general upset and bypass provisions, in accordance with the Agency's original intent. In addition, we have added a sentence to clarify that the storm exemption, like the general upset and bypass provision, simply provides an affirmative defense to an enforcement action. Consequently, the burden of proving compliance with the conditions of the storm provision rests with the operator, just as in the case of the general upset and bypass exemptions.

Additional explanation of the storm exemption is offered in the development document supporting this rulemaking.

G. *General Provisions and Definitions.* As the result of the comments received on the proposed BAT and NSPS, the Agency is adding a definition for "in situ leach methods" applicable to the Uranium, Radium and Vanadium Ores subcategory. This definition makes it clear that the no discharge standard of performance for in situ leach methods is applicable to the process wastewater used in and resulting from the actual in situ operation itself. In situ mine and mill process wastewater does not include discharges from wells from within or surrounding in situ mines used to restore aquifers after all actual mining activity (extraction of the ore, or pregnant liquor from the in situ process) has been completed. Such discharge would be from an inactive mine area and effluent limitations guidelines and standards of performance would not be directly applicable. Effluent limitations and standards are directly applicable to "active mining areas." During the actual working of the mine, if the discharge originates from an area outside of the in situ process area but directly associated with the "active mine area" such discharges are considered "mine drainage" and are subject to the effluent limitations or standards of performance for mine drainage from uranium mines. Mine drainage from areas outside of the areas used for the in situ process area include: drainage from development areas of a deep mines, and surface mine and runoff from mine and mill areas that are not directly involved in in situ leaching. Additional explanation is offered in the development document supporting this rulemaking.

The Agency received comments requesting that the Agency further explain the general provision having to do with waste streams which are combined for treatment from various subparts and segments of Part 440. We stated in the original provision that the quantity and quality of each pollutant or pollutant property in the combined discharge shall not exceed the quality and quantity of each pollutant or pollutant property that would have been discharged had each waste stream been treated separately. Further, the flow from the combined discharge shall not exceed the volume that would have been discharged had each wastestream been treated separately. An example that industry wished clarified is whether mine drainage commingled with the discharge from a new froth flotation mill is subject to the zero discharge requirements for new froth flotation mills. Such combined waste streams may be discharged subject to the limitations on mine drainage but the volume of the discharge cannot exceed the volume of mine drainage that would have been discharged had the mine drainage and the mill discharge been treated separately. It is immaterial whether the mine drainage is introduced to the treatment system simultaneously with the discharge from the mill, e.g. two separate pipes leading to the tailings pond, or whether the mine drainage is introduced as part of the feed water and intake to the mill itself. Further explanation and guidance is provided in the development document supporting this final regulation.

One commenter suggested that EPA provide a special allowance, similar to the net precipitation provision, for underground water which seeps into the tailings impoundment, this commenter asserted that such seepage constituted a large portion of the water collecting in its impoundment. The Agency knows of only this one example of underground seepage at existing facilities subject to zero discharge and believes that the fundamentally different factors variance provision provides an avenue of relief for existing sources. To accommodate new sources, however, the Agency is adding a provision which will allow the permit writer to grant an additional discharge allowance in the case of significant groundwater infiltration, subject to the limitations on mine drainage.

There were requests from industry that a separate definition for "new source" applicable to ore mines and mills be included in the final regulation. The Agency feels that there is no reason to do so. As part of the consolidated permit regulations, Paragraph 122.66(b), the Agency promulgated criteria for determining what is a new source. On September 9, 1980, these criteria were withdrawn and new criteria were proposed. When finalized, these criteria will apply to the mining industry.

VI. Costs and Economic Impact

Executive Order 12291 requires EPA and other agencies to provide regulatory impact analyses for rules that result in an annual cost to the economy of $100 million dollars or more, cause major price increases to the consumer and cause significant adverse effects on competition, employment, investment, productivity and the balance of trade. In addition, the Clean Water Act specifies that best available technology limitations must be economically achievable. The Regulatory Flexibility Act requires EPA to consider the effects of this rule on small entities, and if they are significant and affect a substantial number of small entities, to prepare a Regulatory Flexibility Analysis. The Agency has concluded that this is not a major rule and will not have a significant impact on a substantial number of small entities and, therefore,

a Regulatory Impact Analyses and a Regulatory Flexibility Analysis are not required.

The BAT limitations promulgated today do not reflect any treatment requirements beyond the treatment required for existing direct dischargers under the BPT rule promulgated July 11, 1978 (43 FR 29711). Additionally, EPA is not establishing pretreatment standards because no known indirect dischargers exist nor are any known to be in the planning stage. Accordingly, EPA expects no incremental costs or impacts for existing plants from this rulemaking. The costs for New Source standards are not expected to be a deterrent to investment and are not expected to change the rate of entry into the industry or slow the industry growth rate.

In developing this rule, the Agency considered various technology options and analyzed their economic impacts. This economic analysis is presented in two documents. One is the *Economic Impact Analysis of Promulgated New Source Performance Standards for the Ore Mining and Dressing Industry* which addresses new sources. The second document is *The Economic Impact Analysis of Promulgated BAT Effluent Limitations Guidelines for the Ore Mining and Dressing Industry* which addresses existing sources and is presently subject to a confidentiality requirement discussed previously. For each of the options considered during rulemaking, these analyses detail the investment and annual costs for the industry as a whole and for typical plants; assesses the impact of effluent control in terms of price and production changes, plant closures and employment effects; and assesses the potential impacts on the small plants in this industry.

VII. Nonwater Quality Environmental Impacts

The elimination or reduction of one form of pollution may aggravate other environmental problems. Therefore, sections 304(b) and 306 of the Act require EPA to consider the nonwater quality environmental impacts (including energy requirements) of certain regulations.

In compliance with these provisions, EPA has considered the effect of these regulations on air pollution, solid waste generation, land requirements, water consumption and energy requirements.

Because this regulation does not impose any additional pollution control requirements on existing sources, implementation will not result in any substantial increase in air pollution, energy use, solid waste generation, land requirements or water consumption.

The Agency similarly, determined that the pollution control requirements for new sources, where they differ from existing sources requirements, will not result in adverse non-water quality impacts which would require alteration of the requirements.

In those subparts for which NSPS is more stringent than BAT, the increase in solid waste generated should not be greater than one percent.

In addition, section 7 of the Solid Waste Disposal Act Amendments of 1980 has exempted under Subtitle C of RCRA solid waste from the extraction, beneficiation, and processing of ores and minerals. This exemption will remain in effect until at least six months after the Administrator submits a study on the adverse environmental effects of solid waste from mining. The study is required to be submitted by October 21, 1983 (see 42 U.S.C. 6982).

Imposition of NSPS is not expected to create any significant adverse impacts on land requirements beyond those associated with BAT effluent limitations.

Achievement of NSPS will not result in a significant net increase in energy requirements. The main use of energy is for pumping, mixing, and control instrumentation. Wherever feasible, gravity flow is used in treatment facilities for mine drainage and mill process wastewater. Recycle at new froth flotation mills and new uranium mills will require electric power for pumps, but the Agency concludes that the impact of the energy consumed from compliance with the standards is justified by the benefits derived from the standards.

There should be no net water loss attributable to compliance with zero discharge of process wastewater from froth flotation mills and uranium mills. Moreover, even if there were a slight loss, it would not be significant when compared to the benefits derived from the use of recycle and evaporation systems.

VIII. Pollutants and Subcategories Not Regulated

Paragraph 8 of the modified Settlement Agreement, approved by the District Court for the District of Columbia on March 9, 1979 (12 ERC 1833), contains provisions authorizing the exclusion from regulation, in certain circumstances, of toxic pollutants and industry categories and subcategories.

A. Exclusion of Pollutants. As discussed in greater detail in the proposal June 14, 1982 and in the development document supporting the rule, paragraph 8[a][iii] of the Revised Settlement agreement allows the Administrator to exclude from regulation toxic pollutants not detectable by Section 304(h) analytical methods or other state-of-the-art methods. This provision includes pollutants below EPA's nominal detection limit. In addition, Paragraph 8[a][iii] allows the exclusion of pollutants that were detected in amounts too small to be effectively reduced by technologies known to the Administrator. Pollutants excluded under these provisions are listed in Appendices B, C and D. One hundred and thirteen toxic organics, cyanide and six toxic metals are excluded from regulation under these provisions.

Paragraph 8[a][iii] also allows the Administrator to exclude from regulation pollutants detected in the effluent of only a small number of sources within the category and uniquely related to those sources. The toxic organic pollutant, 2,4-dimethylphenol, was detected in the effluent at only one facility and 2,4-dimethylphenol is excluded under this provision.

Paragraph 8[a][iii] also allows the Administrator to exclude from regulation pollutants that are effectively controlled by the technology upon which other effluent limitations and guidelines are based. Effluent limitations for TSS will effectively control the toxic pollutant asbestos (chrysotile). Arsenic and nickel found in discharges from ore mining and dressing are adequately controlled by the incidental removal associated with the control and removal of other metals found in the discharges from this industry, e.g., copper, lead, mercury, and zinc.

In addition to the toxic pollutants excluded for all subcategories, EPA is excluding certain toxic pollutants from particular subcategories and subparts because they were either not detected or detected in amounts too small to be effectively reduced by technologies known to the Administrator. See Appendix G for pollutants excluded by subcategory and subpart.

B. Exclusion of Subcategories. Paragraph 8(a)(iv) of the revised settlement Agreement allows the Administrator to exclude a category or subcategory from regulation if the amount and toxicity of each pollutant in the discharge does not justify developing national requirements in accordance with the schedule contained in the agreement. EPA is excluding the mill subpart in the Uranium, Radium and Vanadium subcategory from development of BAT regulations

because there is only one existing discharger and development of national regulations are not warranted for this single plant. EPA is excluding the Nickel subcategory, the Vanadium subcategory (mined alone and not as a byproduct) and, the Antimony subcategory from development of BAT and NSPS because there is only one known discharger in each of these subcategories and no new sources are expected. EPA is excluding the Platinum subcategory from development of NSPS because the one identified new source must use an entirely different treatment system than what was identified as best demonstrated technology and EPA lacks data on the system. EPA is differing regulations of the gold placer mine subpart of the Copper, Lead, Zinc, Gold, Silver, and Molybdenum subcategory until it completes data gathering efforts for this subpart.

Paragraph 8(b) of the Settlement Agreement allows the Administrator to exclude from regulation pretreatment standards for all point sources within a point source category. Pretreatment standards for both existing and new sources in this point source category are not justified because no indirect dischargers exist nor are any known to be planned.

IX. Best Management Practices

Section 304(e) of the Clean Water Act gives the Administrator authority to prescribe "best management practices" (BMPs). BMPs are not addressed in this regulation.

X. Upset and Bypass Provisions

A recurring issue is whether industry guidelines should include provisions authorizing noncompliance with effluent limitations during periods of "upset" or "bypass." An upset, sometimes called an "excursion," is an unintentional noncompliance occurring for reasons beyond the reasonable control of the permittee. It has been argued that an upset provision in EPA's effluent limitations is necessary because such upsets will inevitably occur even in properly operated control equipment. Because technology-based limitations require only what technology can achieve, it is claimed that liability for such situations is improper. When confronted with this issue, courts have disagreed on whether an explicit upset or excursion exemption is necessary, or whether upset or excursion incidents may be handled through EPA's exercise of enforcement discretion. Compare *Marathon Oil Co.* v. *EPA*, 564 F. 2d 1253 (9th Cir. 1977) with *Weyerhaeuser* v. *Costle*, 590 F. 2d 1011 (D.C. Cir. 1978) and *Corn Refiners Assn., et al.* v. *Costle*, 594 F. 2d 1223 (8th Cir. 1979). [See also *American Petroleum Institute* v. *EPA*, 540 F. 2d 1023 (10th Cir. 1976); *CPC International, Inc.* v. *Train*, 540 F. 2d 1320 (8th Cir. 1976); *FMC Corp.* v. *Train*, 539 F. 2d 973 (4th Cir. 1976).]

An upset is an unintentional episode during which effluent limits are exceeded; a bypass, however, is an act of intentional noncompliance during which waste treatment facilities are circumvented in emergency situations. We have, in the past, included bypass provisions in NPDES permits.

We determined that both upset and bypass provisions should be included in NPDES permits and have promulgated Consolidated Permit Regulations that include upset and bypass provisions. [See 40 CFR 122.60, 45 FR 33290 (May 19, 1980).] The upset provision establishes an upset as an affirmative defense to prosecution for violation of technology-based effluent limitations. The bypass provision authorizes bypassing to prevent loss of life, personal injury, or severe property damage.

The Agency has received several inquiries on the relationship between the general upset and bypass provisions set forth in the consolidated permit regulations and the storm exemption contained in the regulations for ore mining and dressing. This relationship is discussed in Section V of this preamble.

XI. Variances and Modifications

Upon the issuance of this regulation, the effluent limitations for the appropriate subcategory must be applied in all Federal and State NPDES permits thereafter issued to direct dischargers in the ore mining and dressing industry. For the BPT effluent limitations promulgated on July 11, 1978, the only exception to the binding limitations is EPA's "fundamentally different factors" variance. [See *E.I. du Pont de Nemours & Co.* v. *Train*, 430 U.S. 112 (1977); *Weyerhaeuser Co.* v. *Costle, supra.*] This variance recognizes factors concerning a particular discharger that are fundamentally different from the factors considered in this rulemaking. Although this variance clause was set forth in EPA's 1973–1976 industry regulations, it is now included in the NPDES regulations and will not be included in the ore mining and dressing industry BAT regulation. (See the NPDES regulations at 40 CFR Part 125, Subpart D.)

The BAT limitations in this regulation are also subject to EPA's "fundamentally different factors" variance. BAT limitations for nonconventional pollutants are subject to modifications under Sections 301(c) and 301(g) of the Act. These statutory modifications do not apply to toxic or conventional pollutants. To apply for these modifications a discharger must be in compliance with BPT. Because this rule will make BAT equal to BPT, EPA does not expect any applications for Section 301(c) or 301(g) modifications. [See 43 FR 40895 (September 13, 1978).] NSPS are not subject to EPA's "fundamentally different factors" variance or any statutory or regulatory modifications. (See *E. I. du Pont de Nemours and Co* v. *Train*, supra.)

XII. Relationship to NPDES Permits

The BAT limitations and NSPS in this regulation will be applied to individual ore mines and mills through NPDES permits issued by EPA or approved state agencies, under Section 402 of the Act. As discussed in the preceding section of this preamble, these limitations must be applied in all Federal and State NPDES permits except to the extent that variances and modifications are expressly authorized. Other aspects of the interaction between these limitations and NPDES permits are discussed below.

One issue that warrants consideration is the effect of this regulation on the powers of NPDES permit-issuing authorities. The promulgation of this regulation does not restrict the power of any permitting authority to act in any manner consistent with law or these or any other EPA regulations, guidelines or policy. For example, even if this regulation does not control a particular pollutant, the permit-issuer may still limit such pollutant on a case-by-case basis when limitations are necessary to carry out the purposes of the Act. Where manufacturing practices or treatment circumstances warrant additional controls, such limitations may be technology-based in conformance with the legislative history of the Act. However, such limitations are subject to administrative and judicial review as part of the permit issuance process. In addition, to the extent that State water quality standards or other provisions of State or Federal law require limitation of pollutants not covered by this regulation (or require more stringent limitations on covered pollutants), such limitations must be applied by the permit-issuing authority.

A second topic that warrants discussion is the operation of EPA's NPDES enforcement program, many aspects of which were considered in developing this regulation. We emphasize that although the Clean Water Act is a strict liability statute, the initiation of enforcement proceedings by EPA is discretionary. We have exercised

and intend to exercise that discretion in a manner that recognizes and promotes good-faith compliance efforts.

XIII. Public Participation

The Agency solicited public comment on the proposed rules published in the Federal Register on June 14, 1982. (47 FR 25682). In addition, the Agency accepted public comment on the development document and economic analysis supporting the proposed rules. The Agency received over fifty comment submittals.

Individual public comments received on the proposed regulation, and our responses, are presented in a report, "Responses to Public Comments, Proposed Ore Mining and Dressing Industry Effluent Guidelines and Standards," November 1982, which is part of the public record for this regulation.

Most of the major comments and the Agency's response are discussed in Section V of this preamble, Summary of Promulgated Regulation and Changes from Proposal.

XIV. Small Business Administration (SBA) Financial Assistance

The Agency is continuing to encourage small manufacturers to use Small Business Administration (SBA) financing as needed for pollution control equipment. Three basic programs are in effect: the Guaranteed Pollution Control Program, the Section 503 Program, and the Regular Guarantee Program. All the SBA loan programs are only open to businesses with net assets less than $6 million, with an average annual after-tax income of less than $2 million and with fewer than 250 employees.

The guaranteed pollution control program authorizes the SBA to guarantee the payments on qualified contracts entered into by eligible small businesses to acquire needed pollution control facilities when the financing is provided through pollution control bonds, bank loans and debentures. Financing with SBA's guarantee of payment makes available long-term financing comparable with market rates. The program applies to projects that cost from $150,000 to $200,000.

The Section 503 Program, as amended in July 1980, allows for long-term loans to small and medium-sized businesses. These loans are made by SBA-approved local development companies, which for the first time are authorized to issue Government-backed debentures that are bought by the Federal Financing Bank, an arm of the U.S. Treasury.

Through SBA's Regular Guarantee Program, loans are made available by commercial banks and are guaranteed by the SBA. This program has interest rates equivalent to market rates.

For additional information on the Regular Guarantee and Section 503 Programs contract your district or local SBA Office. The SBA coordinator at EPA headquarters is Ms. Frances Desselle who may be reached at (202) 382-5373.

For further information and specifics on the Guaranteed Pollution Control Program contact: U.S. Small Business Administration, Office of Pollution Control Financing, 4040 North Fairfax Drive, Rosslyn, Virginia 22203, (703) 235-2902.

XV. List of Subjects in 40 CFR Part 440

Metals, Mines, Water pollution control, Waste treatment and disposal.

XVI. Availability of Technical Assistance

The justification for the proposed regulation is detailed in four major documents available from EPA. Analytical methods are discussed in *Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants*. EPA's technical conclusions are detailed in the *Development Document for Final Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category*. The economic analysis for new sources is detailed in *Economic Analysis of New Source Performance Standards for the Ore Mining and Dressing Industry*. The economic analysis for existing sources is detailed in the *Economic Impact Analysis of Promulgated BAT Effluent Limitations Guidelines for the Ore Mining and Dressing Point Source Category*. The data contained in the analysis is covered by a third party agreement between the Agency and industry members who supplied the data. These data are confidential and can not be released until cleared by a confidentiality review panel. The Agency anticipates the BAT economic analysis will be made available to the general public shortly after this rule is promulgated.

A summary of the public comments received on the proposal and EPA's responses is presented in "Summary of Comments and Responses on the June 1982 Proposed Regulations for the Ore Mining and Dressing Industry," which is part of the public record for this regulation.

XVII. OMB Review

The regulation was submitted to the Office of Management and Budget for review as required by Executive Order 12291.

In accordance with the Paperwork Reduction Act of 1980 (P.L. 96-511), the reporting or recordkeeping provisions that are included in this regulation will be submitted for approval to the Office of Management and Budget (OMB). They are not effective until OMB approval has been obtained and the public notified to that effect through a technical amendment to this regulation.

Dated: November 5, 1982.

Anne M. Gorsuch,

Administrator.

APPENDIX A

Abbreviations, Acronyms and Units Used in This Notice

Act—The Clean Water Act.

Agency—The U.S. Environmental Protection Agency.

BADT—Best available demonstrated technology under sections 304(c) and 306.

BAT—The best available technology economically achievable, under section 304(b)(2)(B) of the Act.

BCT—The best conventional pollutant control technology, under section 304(b)(4) of the Act.

BMP's—Best management practices under section 304(e) of the act.

BPT—The best practicable control technology currently available, under section 304(b)(1) of the Act.

CWA—The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq.) as amended by the Clean Water Act of 1977 (P.L. 95-217).

FWPCA—Federal Water Pollution Control Act.

MSHA—The Department of Labor, Mine Safety and Health Administration.

NPDES Permit—A National Pollutant Discharge Elimination System permit issued under section 402 of the Act.

NSPS—New source performance standards under section 306 of the Act.

POTW—Publicly owned treatment works.

RCRA— Resource Conservation and Recovery Act (PL 94-580) of 1976, Amendments to Solid Waste Disposal Act.

UNITS

gpd—gallons per day.
mgd—million gallons per day.
mg/l—milligram(s) per liter.
µg/l—microgram(s) per liter.

APPENDIX B

Toxic Organic Compounds Not Detected During Sampling

1. Acenaphthene.

2. Acrolein.
3. Acrylonitrite.
4. Benzidene.
5. Carbon Tetrachloride.
6. 1.2.4-Trichlorobenzene.
7. Hexachlorobenzene.
8. 1.2-Dichloroethane.
9. Hexachloroethane.
10. 1.1-Dichloroethane.
11. 1.1.2-Trichloroethane.
12. 1.1.2.2-Tetrachloroethane.
13. C hloroethane.
14. Bis(Chloromethyl) Ether.
15. Bis(2-Chloroethyl) Ether.
16. 2-Chloroethyl Vinyl Ether.
17. 2-Chloronaphthalene.
18. 2.4.6-Trichlorophenol.
19. Parachlorometa Cresol.
20. 2-Chlorophenol.
21. 1.2-Dichlorobenzene.
22. 1.3-Dichlorobenzene.
23. 1.4-Dichlorobenzene.
24. 3.3-Dichlorobenzidene.
25. 1.1-Dichloroethylene.
26. 2.4-Dichloro-phenol.
27. 1.2-Dichloropropane.
28. 1.3-Dichloropropylene.
29. 2.4-Dinitrotoluene.
30. 2.6-Dinitrotoluene.
31. 1.2-Diphenylhydrazine.
32. Fluoranthene.
33. 4-Chlorophenyl Phenyl Ether.
34. 4-Bromophenyl Phenyl Ether.
35. Bis(2-Chloroisopropyl) Ether.
36. Bis(2-Chloroethoxy) Methane.
37. Methyl Chloride.
38. Methyl Bromide.
39. Bromoform.
40. Dichlorodifluoromethane.
41. Chlorodibromomethane.
42. Hexachlorobutadiene.
43. Hexachlorocyclopentadien.
44. Isophorone.
45. Naphthalene.
46. Nitrobenzene.
47. 2-Nitrophenol.
48. 4-Nitrophenol.
49. 2.4-Dinitrophenol.
50. 4.6-Dinitro-O-Cresol.
51. N-Nitrosodimethylamine.
52. N-Nitrosodiphenylamine.
53. N-Nitrosodi-N-Propylamine.
54. Benzo(A)Anthracene.
55. Benzo(A)Pyrene.
56. 3.4-Benzofluoranthene.
57. Benzo(K)Fluoranthene.
58. Chrysene.
59. Acenaphthylene.
60. Anthracene.
61. Benzo(G.H.I)Perylene.
62. Phenathrene.
63. Dibenzo(A.H)Anthracene.
64. Indeno(1.2.3-C.D)Pyrene.
65. Pyrene.
66. Trichloroethylene.
67. Vinyl chloride.
68. Chlordane.
69. 4.4-DDT.
70. 4.4-DDE.
71. 4.4-DDD.
72. Endosulfan-Alpha.
73. Endosulfan-Beta.
74. Endosulfan Sulfate.
75. Endrin Aldehyde.
76. Heptachlor Epoxide.
77. γBHC(Lindane)-Gamma.
78. PCB-1242 (AROCHLOR 1242).
79. PCB-1254 (AROCHLOR 1254).
80. PCB-1221 (AROCHLOR 1221).
81. PCB-1232 (AROCHLOR 1232).
82. PCB-1248 (AROCHLOR 1248).
83. PCB-1260 (AROCHLOR 1260).
84. PCB-1016 (AROCHLOR 1016).
85. Toxaphene.
86. 2.3.7.8-Tetrachlorodibenzo-p-Dioxin.

APPENDIX C

Toxic Organic Compounds Detected at Least One Facility but Always 10 μg/l or Less

1. Chlorobenzene.
2. Dichlorobromoethane.
3. Fluorene.
4. Aldrin.
5. Dieldrin.
6. Endrin.
7. Heptachlor.
8. 1.1.1-Trichloroethane.
9. Chloroform.
10. Ethylbenzene.
11. Trichlorofluoromethane.
12. Diethyl Phthalate.
13. Tetrachloroethylene.
14. Toluene.
15. αBHC-Alpha.
16. βBHC-Beta.
17. ΔBHC-Delta.

APPENDIX D

Toxics Detected at Levels Too Small To Be Effectively Reduced by Technologies Known to the Administrator

1. Antimony.
2. Beryllium.
3. Silver.
4. Thallium.
5. Selenium.
6. Chromium.
7. Cyanide.
8. Benzene.
9. 1.2-Trans-Dichloroethylene.
10. Phenol.
11. Bis(2-Ethylhexyl) Phthalate.
12. Butyl Benzyl Phthalate.
13. Di-N-Butyl Phthalate.
14. Di-n-Octyl Phthalate.
15. Dimethyl Phthalate.
16. Methylene Chloride.
17. Pentachlorophenol.

APPENDIX E

Toxic Organic Compounds Detected From a Small Number of Sources and Uniquely Related to These Sources

2.4-dimentylphenol.

APPENDIX F

Pollutants Effectively Controlled by the Technology Upon Which Other Effluent Limitations and Guidelines Are Based

1. Asbestos.
2. Arsenic.
3. Nickel.

APPENDIX G

Pollutants Excluded by Subcategory and Subpart

Uranium Ore Subcategory—Mine Drainage

Cadmium (not detected).
Copper (present in amounts too small to treat).
Lead (present in amounts too small to treat).
Mercury (present in amounts too small to treat).

Tungsten Ore Subcategory—Mine Drainage

Lead (not detected).
Mercury (present in amounts too small to treat).

Tungsten Ore Subcategory—Mill Process Water

Mercury (not detected).

Mercury Ore Subcategory)—Mine Drainage.

Cadmium (not detected).
Copper (not detected).
Lead (not detected).
Zinc (not detected).

Titanium Ore Subcategory—Mine Drainage

Cadmium (not detected).
Copper (present in amounts too small to treat).
Lead (present in amounts too small to treat).
Mercury (not detected).
Zinc (present in amounts too small to treat).

Titanium Ore Subcategory—Mine Drainage

Cadmium (not detected).
Copper (present in amounts too small to treat).
Lead (present in amounts too small to treat).
Mercury (not detected).

Titanium Ore Subcategory—Mill with Dredges

Cadmium (present in amounts too small to treat).
Copper (present in amounts too small to treat).
Lead (present in amounts too small to treat).
Zinc (present in amounts too small to treat).

Mercury (present in amounts too small to treat).

APPENDIX H

Subcategories Excluded From Development of BAT or NSPS

Nickel Ore Subcategory.

Vanadium Ore Subcategory (Mined alone and not as a byproduct).

Antimony Ore Subcategory.

Platinum Ore Subcategory.

Uranium, Radium, and Vanadium Ores Subcategory.

Mills using the acid and alkaline leach process for the extraction of uranium.

For the purpose of clarity, the BPT effluent limitations guidelines are being published as part of today's regulation. However, the BPT limitations remain unaffected by today's regulation and are not subject to review. For the reasons discussed above, EPA is revising 40 CFR Part 440 to read as follows:

PART 440—ORE MINING AND DRESSING POINT SOURCE CATEGORY

Subpart A—Iron Ore Subcategory

Sec.

440.10 Applicability: description of the iron ore subcategory.

440.11 [Reserved]

440.12 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.13 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.14 New Source Performance Standards (NSPS).

440.15 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart B—Aluminum Ore Subcategory

440.20 Applicability: description of the aluminum ore subcategory.

440.21 [Reserved]

440.22 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.23 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.24 New Source Performance Standards (NSPS).

440.25 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart C—Uranium, Radium, and Vanadium Ores Subcategory

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440.30 Applicability: description of the uranium, radium and vanadium ores subcategory.

440.31 [Reserved]

440.32 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.33 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.34 New Source Performance Standards (NSPS).

440.35 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart D—Mercury Ore Subcategory

440.40 Applicability: description of the mercury ore subcategory.

440.41 [Reserved]

440.42 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.43 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.44 New Source Performance Standards (NSPS).

440.45 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart E—Titanium Ore Subcategory

440.50 Applicability: description of the titanium ore subcategory.

440.51 [Reserved]

440.52 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.53 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.54 New Source Performance Standards (NSPS).

440.55 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart F—Tungsten Ore Subcategory

440.60 Applicability: description of the tungsten ore subcategory.

440.61 [Reserved]

440.62 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

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440.63 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.64 New Source Performance Standards (NSPS).

440.65 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart G—Nickel Ore Subcategory

440.70 Applicability: description of the nickel ore subcategory.

440.71 [Reserved]

440.72 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.73 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

440.74 New Source Performance Standards (NSPS). [Reserved]

440.75 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart H—Vanadium Ore Subcategory (Mined Alone and Not as a Byproduct)

440.80 Applicability: description of the vanadium ore subcategory.

440.81 [Reserved]

440.82 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

440.83 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). [Reserved]

440.84 New Source Performance Standards (NSPS) [Reseved]

440.85 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart I—Antimony Ore Subcategory

440.90 Applicability: description of the antimony ore subcategory.

440.91 [Reserved]

440.92 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT). [Reserved]

440.93 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). [Reserved]

440.94 New Source Performance Standards (NSPS). [Reserved]

440.95 Effluent limitations representing the degree of effluent reduction attainable by

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the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart J—Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory

440.100 Applicability: description of the copper, lead, zinc, gold, silver, and molybdenum ores subcategory.
440.101 [Reserved]
440.102 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).
440.103 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).
440.104 New Source Performance Standards (NSPS).
440.105 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart K—Platinum Ores Subcategory

440.110 Applicability: description of the platinum ore subcategory.
440.111 [Reserved]
440.112 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT). [Reserved]
440.113 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).
440.114 New Source Performance Standards (NSPS) [Reserved]
440.115 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart L—General Provisions and Definitions

440.120 Applicability.
440.121 General Provisions.
440.122 General Definitions.

Authority: Sections 301, 304 (b) and (c), 306, and 501 of the Clean Water Act [The Federal Water Pollution Control Act Amendments of 1972, as amended by the Clean Water Act of 1977 (the Act)] as amended 33 U.S.C. 1311, 1314 (b) and (c), 1316, and 1361; 86 Stat. 816, Pub. L. 92-500; 91 Stat. 1567, Pub. L. 95-217.

Subpart A—Iron Ore Subcategory

§ 440.10 Applicability: description of the iron ore subcategory.

The provisions of this Subpart A are applicable to discharges from (a) mines operated to obtain iron ore, regardless of the type of ore or its mode of occurrence; (b) mills beneficiating iron ores by physical (magnetic and magnetic) and/or chemical separation and (c) mills beneficiating iron ores by magnetic and physical separation in the Mesabi Range.

§ 440.11 [Reserved]

§ 440.12 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable after application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines operated to obtain iron ore shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Fe (dissolved)	2.0	1.0
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(b) Except as provided in paragraph (c) of this section, the concentration of pollutants discharged from mills that employ physical (magnetic and nonmagnetic) and/or chemical methods to beneficiate iron ore shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Fe (dissolved)	2.0	1.0
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable waters from mills that employ magnetic and physical methods to beneficiate iron ore in the Mesabi Range. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equivalent to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§ 440.131 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from mines operated to obtain iron ore shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (dissolved)	2.0	1.0

(b) Except as provided in paragraph (c) of this section the concentration of pollutants discharged from mills that employ physical (magnetic and nonmagnetic) and/or chemical methods to beneficiate iron ore shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (dissolved)	2.0	1.0

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable waters from mills that employ magnetic and physical methods to

beneficiate iron ore in the Mesabi Range. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§ 440.14 New Source Performance Standards (NSPS).

Except as provided in Subpart L of this Part, any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by applying the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from mines operated to obtain iron ore shall not exceed:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (dissolved)	2.0	1.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.0.

(b) Except as provided in paragraph (c) of this section, the concentration of pollutants discharged from mills that employ physical (magnetic and nonmagnetic) and/or chemical methods to beneficiate iron ore shall not exceed:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (dissolved)	2.0	1.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.0.

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable waters from mills that employ magnetic and physical methods to beneficiate iron ore in the Mesabi Range. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§ 440.15 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart B—Aluminum Ore Subcategory

§ 440.20 Applicability: Description of the aluminum ore subcategory.

The provisions of this Subpart B are applicable to discharges from facilities engeged in the mining of bauxite as an alumimum ore.

§ 440.21 [Reserved]

§ 440.22 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT). The concentration of pollutants discharged in mine drainage from mines producing bauxite ores shall not exceed:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Fe	1.0	.5
Al	2.0	1.0
pH	(1)	(1)

[1] Within the range of 6.0 to 9.0.

§ 440.23 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). The concentration of pollutants discharged in mine drainage from mines producing bauxite ores shall not exceed:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (total)	1.0	0.5
Al	2.0	1.0

§ 440.24 New Source Performance Standards (NSPS).

Except as provided in Subpart L of this Part, any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the application of the best available demonstrated technology (BADT). The concentration of pollutants discharged in mine drainage from mines producting bauxite ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe (total)	1.0	*0.5
Al	2.0	1.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.0.

§ 440.25 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart C—Uranium, Radium and Vanadium Ores Subcategory

§ 440.30 Applicability; description of the uranium, radium and vanadium ores subcategory.

The provisions of this Subpart C are applicable to discharges from (a) mines either open-pit or underground, from which uranium, radium and vanadium ores are produced; and (b) mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction of uranium, radium and vanadium. Only vanadium byproduct production from uranium ores is covered under this subpart.

§ 440.31 [Reserved]

§ 440.32 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable after application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines, either open-pit or underground, from which uranium, radium and vanadium ores are produced excluding mines using in-situ leach methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
COD	200	100
Zn	1.0	0.5
Ra226 [1] (dissolved)	10	3
Ra226 [1] (total)	30	10
U	4	2
pH	(2)	(2)

[1] Values in picocuries per liter (pCi/l).
[2] Within the range 6.0 to 9.0.

(b) The concentrations of pollutants discharged from mills using the acid leach, alkaline leach or combined acid and alkaline leach process for the extraction of uranium, radium and vanadium including mill-mine facilities and mines using in-situ leach methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
COD		500
As	1.0	.5
Zn	1.00	.5
Ra226 [1] (dissolved)	10	3
Ra226 [1] (total)	30	10
NH3 [2]		100
pH	(2)	(2)

[1] Values in picocuries per liter (pCi/l).
[2] Within the range 6.0 to 9.0.

§ 440.33 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR §§ 125.30–125.32, any existing point source subject to this subpart must achieve the following limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from mines, either open-pit or underground, that produce uranium ore, including mines using in-situ leach methods, shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
COD	200	100
Zn	1.00	.5
Ra226 [1] (dissolved)	10.0	3.0
Ra226 [1] (total)	30.0	10.0
U	4.0	2.0

[1] Values in picocuries per liter (pCi/l).

(b) [Reserved]

§ 440.34 New Source Performance Standards (NSPS).

Except as provided in Subpart L of this Part any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the application of the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from mines, either open-pit or underground, that produce uranium ore, excluding mines using in situ leach methods, shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
COD	200	100
Zn	1.0	0.5
Ra 226 (dissolved)	10.0	3.0
Ra 226 (total)	30.0	10.0
U	4.0	2.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Values in picocuries per liter (pCi/l).
[2] Within the range 6.0 to 9.0.

(b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills using the acid leach, alkaline leach or combined acid and alkaline leach process for the extraction of uranium or from mines and mills using in situ leach methods. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has

addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equivalent to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§ 440.35 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart D—Mercury Ore Subcategory

§ 440.40 Applicability; description of the mercury ore subcategory.

The provisions of Subpart D are applicable to discharges from (a) mines, either open-pit or underground, that produce mercury ores; and (b) mills beneficiating mercury ores by gravity separation methods or by froth-flotation methods.

§ 440.41 [Reserved]

§ 440.42 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable after application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines, either open-pit or underground, operated for the production of mercury ores shall not exceed the following limitations:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Hg	.002	.001
Ni	.2	.1
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills beneficiating mercury ores by gravity separation methods or by froth flotation methods. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equivalent to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a)(1) of this section.

§ 440.43 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

(a) The concentration of pollutants discharged in mine drainage from mines, either open pit or underground, that produce mercury ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Hg	0.002	0.001

(b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills beneficiating mercury ores by gravity separation methods or by froth flotation methods. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§ 440.44 New Source Performance Standards (NSPS).

Except as provided in Subpart L of this Part any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the application of the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from mines, either open pit or underground, that produce mercury ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Hg	0.002	0.001
pH	(1)	(1)
TSS	30.6	20.8

[1] Within the range of 6.0 to 9.0.

(b)(1) Except as provided in paragraph (6) of this section, there shall be no discharge of process wastewater to navigable waters from mills beneficiating mercury ores by gravity separation methods or by froth-flotation methods. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

§440.45 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT).

[Reserved]

Subpart E—Titanium Ore Subcategory

§ 440.50 Applicability; description of the titanium ore subcategory.

The provisions of this Subpart E are applicable to discharges from (a) mines obtaining titanium ores from lode deposits; (b) mills beneficiating titanium ores by electrostatic methods, magnetic and physical methods, or flotation methods; and (c) mines engaged in the dredge mining of placer deposits of sands containing rutile, ilmenite, leucoxene, monazite, zircon, and other heavy metals, and the milling techniques employed in conjunction with the dredge mining activity (milling techniques employed include the use of wet gravity methods in conjunction with electrostatic or magnetic methods).

§ 440.51 [Reserved]

§440.52 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of is Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable after application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines obtaining titanium ores from lode deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Fe	2.0	1.0
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(b) The concentration of pollutants discharged from mills beneficiating titanium ores by electrostatic methods, magnetic and physical methods, or flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Zn	1.0	.5
Ni	.2	.1
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(c) The concentration of pollutants discharged in mine drainage from mines engaged in the dredge mining of placer deposits of sands containing rutile, ilmenite, leucoxene, monazite, zircon, or other heavy metals, and the milling techniques employed in conjunction with the dredge mining activity (milling techniques employed include the use of wet gravity methods in conjunction with electrostatic or magnetic methods) shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Fe	2	1
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

§ 440.53 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR §§ 125.30–125.32, any existing point source subject to this subpart must achieve the following limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from mines obtaining titanium ores from lode deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe	2.0	1.0

(b) The concentration of pollutants discharged from mills beneficiating titanium ores by electrostatic methods, magnetic and physical methods, or flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Zn	1.0	0.5

(c) The concentration of pollutants discharged in mine drainage from mines engaged in the dredge mining of placer deposits of sands containing rutile, ilmenite, leucoxene, monazite, or zircon and the milling techniques employed in conjunction with the dredge mining activity (milling techniques employed include the use of wet gravity methods in conjunction with electrostatic or magnetic methods) shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe	2.0	1.0

§ 440.54 New source performance standards (NSPS).

Except as provided in Subpart L of this Part any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the applications of the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from mines obtaining titanium ores from lode deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe	2.0	1.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.1.

(b) The concentration of pollutants discharged from mills beneficiating titanium ores by electrostatic methods, magnetic and physical methods, or flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Zn	1.0	0.5
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.1.

(c) The concentration of pollutants discharged in mine drainage from mines engaged in the dredge mining of placer deposits of sands containing rutile, ilmenite, leucoxene, monazite, zircon and the milling techniques employed in conjunction with the dredge mining activity (milling techniques employed include the use of wet gravity methods in conjunction wth electrostatic or magnetic methods) shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Fe	2.0	1.0
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range of 6.0 to 9.1.

§ 440.55 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart F—Tungsten Ore Subcategory

§ 440.60 Applicability; description of the tungsten ore subcategory.

The provisions of this Subpart F are applicable to discharges from (a) mines that produce tungsten ore and (b) mills that process tungsten ore by either the gravity separation or froth-flotation methods.

§ 440.61 [Reserved]

§ 440.62 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines producing 5000 metric tons (5512 short tons) or more of tungsten bearing ores per year shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.3	.15
Zn	1.0	.5
Pb	.6	.3
As	1.0	.5
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(b) The concentration of pollutants discharged in mine drainage from mines producing less than 5000 metric tons (5512 short tons) or discharged from mills processing less than 5000 metric tons (5512 short tons) of tungsten ores per year by methods other than ore leaching shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	50	30
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(c) The concentration of pollutants discharged from mills processing 5000 metric tons (5512 short tons) or more of tungsten ores per year by purely physical methods including ore crushing, washing, jigging, heavy media separation, and magnetic and electrostatic separation shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(d) The concentration of pollutants discharged from mills processing 5000 metric tons (5512 short tons) or more of tungsten ores per year by froth flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

§ 440.63 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from tungsten mines shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cd	0.10	0.05
Cu	0.30	0.15
Zn	1.0	0.5

(b) The concentration of pollutants discharged from mills shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cd	0.10	0.05
Cu	0.3	0.15
Zn	1.0	0.5

§ 440.64 New source performance standards (NSPS).

Except as provided in Subpart L of this Part any new source subject to this subpart must achieve the following NSPS representing the degree of effluent reduction attainable by the application of the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from tungsten mines shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cd	0.10	0.05
Cu	0.30	0.15
Zn	1.0	0.5
pH	(1)	(1)
TSS	30.0	20.0

(1) Within the range of 6.0 to 9.0.

(b) The concentration of pollutants discharged from mills shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cd	0.10	0.05
Cu	0.3	0.15
Zn	1.0	0.5
pH	(1)	(1)
TSS	30.0	20.0

(1) Within the range of 6.0 to 9.0.

§ 440.65 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart G—Nickel Ore Subcategory

§ 440.70 Applicability: description of the nickel ore subcategory.

The provisions of this Subpart G are applicable to discharges from (a) mines that produce nickel ore and (b) mills that process nickel ore.

§ 440.71 [Reserved]

§ 440.72 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR §§ 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines producing 5000 metric tons (5512 short tons) or more of nickel bearing ores per year shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.3	.15
Zn	1.0	.5
Pb	.6	.3
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(b) The concentration of pollutants discharged in mine drainage from mines producing less than 5,000 metric tons (5,512 short tons) or discharged from mills processing less than 5,000 metric tons (5,512 short tons) of nickel ores per year by methods other than ore leaching shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	50	30
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(c) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of nickel ores per year by purely physical methods including ore crushing, washing, jigging, heavy media separation and magnetic and electrostatic separation shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0

(d) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of nickel ore per year by froth flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

§ 440.73 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). [Reserved]

§ 440.74 New source performance standards (NSPS). [Reserved]

§ 440.75 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart H—Vanadium Ore Subcategory (Mined Alone and Not as a Byproduct)

§ 440.80 Applicability: description of the vanadium ore subcategory.

The provisions of this Subpart H are applicable to discharges from (a) mines that produce vanadium ore (recovered alone and not as a by-product of uranium mining and mills) and (b) mills that process vanadium ore (recovered alone, not as a byproduct of uranium mining and mills).

§ 440.81 [Reserved]

§ 440.82 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines producing 5,000 metric tons (5,512 short tons) or more of vanadium bearing ores per year shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.3	.16
Zn	1.0	.5
Pb	.6	.3
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(b) The concentration of pollutants discharged in mine drainage from mines producing less than 5,000 metric tons (5,512 short tons) or discharged from mills processing less than 5,000 metric tons (5,512 short tons) of vanadium ore per year by methods other than ore leaching shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	50	30
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(c) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of vanadium ores per year by purely physical methods including ore crushing, washing, jigging, heavy media separation, and magnetic and electrostatic separation shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

(d) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of vanadium ores per year by froth flotation methods shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

(1) Within the range 6.0 to 9.0.

§ 440.83 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). [Reserved]

§ 440.84 New source performance standards (NSPS). [Reserved]

§ 440.85 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart I—Antimony Ore Subcategory

§ 440.90 Applicability; description of the antimony ore subcategory.

The provisions of this Subpart I are applicable to discharges from (a) mines that produce antimony ore and (b) mills that process antimony ore.

§ 440.91 [Reserved]

§ 440.92 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT). [Reserved]

§ 440.93 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT). [Reserved]

§ 440.94 New source performance standards (NSPS). [Reserved]

§ 440.95 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart J—Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory

§ 440.100 Applicability; description of the copper, lead, zinc, gold, silver, and molybdenum ores subcategory.

(a) The provisions of this Subpart J are applicable to discharges from (1) mines that produce copper, lead, zinc, gold, silver, or molybdenum bearing ores, or any combination of these ores from open-pit or underground operations other than placer deposits; (2) mills that use the froth-flotation process alone or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores, or any combination of these ores; (3) mines and mills that use dump, heap, in-situ leach or vat-leach processes to extract copper from ores or ore waste materials; (4) mills that use the cyanidation process to extract gold or silver; and (5) mines or mines and mills that use gravity separation methods (including placer or dredge mining or concentrating operations, and hydraulic mining operations) to extract gold ores or silver ores.

(b) The provisions of this subpart shall not apply to discharges from the Quartz Hill Molybdenum Project in the Tongass National Forest, Alaska.

§ 440.101 [Reserved]

§ 440.102 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology (BPT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the

degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The concentration of pollutants discharged in mine drainage from mines operated to obtain copper bearing ores, lead bearing ores, zinc bearing ores, gold bearing ores, or silver bearing ores, or any combination of these ores open-pit or underground operations other than placer deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cu	.30	.15
Zn	1.5	.75
Pb	.6	.3
Hg	.002	.001
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(b) The concentration of pollutants discharged from mills which employ the froth flotation process alone or in conjunction with other processes, for the beneficiation of copper ores, lead ores, zinc ores, gold ores, or silver ores, or any combination of these ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cu	.30	.15
Zn	1.0	.5
Pb	.6	.3
Hg	.002	.001
Cd	.10	.05
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable water from mines and mills which employ dump, heap, in situ leach or vat leach processes for the extraction of copper from ores or ore waste materials. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equivalent to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(d)(1) Except as provided in paragraph (d) of this section, there shall be no discharge of process wastewater to navigable waters from mills which extract gold or silver by use of the cyanidation process. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equivalent to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(e) The concentration of pollutants discharged in mine drainage from mines or discharged from mine and mill complexes beneficiating gold ores or silver ores by gravity separation methods including mining of placer deposits, dredge mining and hydraulic mining operations will be proposed and promulgated at a later date.

(f) The concentration of pollutants discharged in mine drainage from mines producing 5,000 metric tons (5,512 short tons) or more of molybdenum bearing ores per year shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.3	.15
Zn	1.0	.5
Pb	.6	.3
As	1.0	.5
pH	(1)	(1)

[1] Within the range of 6.0 to 9.0

(g) The concentration of pollutants discharged in mine drainage from mines producing less than 5,000 metric tons (5,512 short tons) or discharged from mills processing less thant 5,000 metric tons (5,512 short tons) of molybdenum ores per year by methods other than ore leaching shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	50	30
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

(h) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of molybdenum ores per year by purely physical methods including ore crushing, washing, jigging, heavy media separation shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily value for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

[1] Within the range 6.0 to 9.0

(i) The concentration of pollutants discharged from mills processing 5,000 metric tons (5,512 short tons) or more of molybdenum ores per year by froth flotation methods shall not exceed:

Effluent characteristics	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
TSS	30	20
Cd	.10	.05
Cu	.30	.15
Zn	1.0	.5
As	1.0	.5
pH	(1)	(1)

[1] Within the range 6.0 to 9.0.

§ 440.103 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from mines that produce copper, lead, zinc, gold, silver, or molybdenum bearing ores or any combination of these ores from open-pit or underground operations other than placer deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cu	0.30	0.15
Zn	1.5	0.75
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05

(b) The concentration of pollutants discharged from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cu	0.30	0.15
Zn	1.0	0.5
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable waters from mine areas and mills processes and areas that use dump, heap, in situ leach or vat-leach processes to extract copper from ores or ore waste materials. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(d)(1) Except as provided in paragraph (d) of this section, there shall be no discharge of process wastewater to navigable waters from mills that use the cyanidation process to extract gold or silver. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(e) The concentration of pollutants discharged in mine drainage or discharged from mines and mills beneficiating gold or silver ores by gravity separation methods including mining of placer deposits, dredge mining and hydraulic mining operations will be proposed and promulgated at a later date.

§ 440.104 New source performance standards (NSPS).

Except as provided in Subpart L of this Part any new source subject to this subsection must achieve the following NSPS representing the degree of effluent reduction attainable by the application of the best available demonstrated technology (BADT):

(a) The concentration of pollutants discharged in mine drainage from mines that produce copper, lead, zinc, gold, silver, or molybdenum bearing ores or any combination of these ores from open-pit or underground operations other than placer deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cu	0.30	0.15
Zn	1.5	0.75
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05
pH	(1)	(1)
TSS	30.0	20.0

[1] Within the range 6.0 to 9.0.

(b)(1) Except as provided in paragraph (b) of this section, there shall be no discharge of process wastewater to navigable waters from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of copper, lead, zinc, gold, silver, or molybdenum ores or any combination of these ores. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2)(i) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(ii) In the event there is a build up of contaminants in the recycle water which significantly interferes with the ore recovery process and this interference can not be eliminated through appropriate treatment of the recycle water, the permitting authority may allow a discharge of process wastewater in an amount necessary to correct the interference problem after installation of appropriate treatment. This discharge shall be subject to the limitations of paragraph (a) of this section. The facility shall have the burden of demonstrating to the permitting authority that the

discharge is necessary to eliminate interference in the ore recovery process and that the interference could not be eliminated through appropriate treatment of the recycle water.

(c)(1) Except as provided in paragraph (c) of this section, there shall be no discharge of process wastewater to navigable waters from mine areas and mills processes and areas that use dump, heap, in-situ leach or vat-leach processes to extract copper from ores or ore waste materials. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(d)(1) Except as provided in paragraph (d) of this section, there shall be no discharge of process wastewater to navigable waters from mills that use the cyanidation process to extract gold or silver. The Agency recognizes that the elimination of the discharge of pollutants to navigable waters may result in an increase in discharges of some pollutants to other media. The Agency has considered these impacts and has addressed them in the preamble published on December 3, 1982.

(2) In the event that the annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility exceeds the annual evaporation, a volume of water equal to the difference between annual precipitation falling on the treatment facility and the drainage area contributing surface runoff to the treatment facility and annual evaporation may be discharged subject to the limitations set forth in paragraph (a) of this section.

(e) The concentration of pollutants discharged in mine drainage or discharged from mines and mills beneficiating gold or silver ores by gravity separation methods including mining of placer deposits, dredge mining and hydraulic mining operations will be proposed and promulgated at a later date.

§ 440.105 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT). [Reserved]

Subpart K—Platinum Ores Subcategory

§ 440.110 Applicability; Description of the platinum ore subcategory.

The provisions of this Subpart K are applicable to discharges from (a) mines that produce platinum ore and (b) mills that process platinum ore.

§ 440.110 [Reserved]

§ 440.112 Effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT). [Reserved]

§ 440.113 Effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT).

Except as provided in Subpart L of this Part and 40 CFR 125.30–125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best available technology economically achievable (BAT):

(a) The concentration of pollutants discharged in mine drainage from mines that produce platinum bearing ores from open-pit or underground operations other than placer deposits shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cu	0.30	0.15
Zn	1.5	0.75
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05

(b) The concentration of pollutants discharged from mills that use the froth-flotation process alone, or in conjunction with other processes, for the beneficiation of platinum ores shall not exceed:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days
	Milligrams per liter	
Cu	0.30	0.15
Zn	1.0	0.5
Pb	0.6	0.3
Hg	0.002	0.001
Cd	0.10	0.05

§ 440.114 New source performance standards (NSPS). [Reserved]

§ 440.115 Effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BTC). [Reserved]

Subpart L—General Provisions and Definitions

§ 440.130 Applicability

Abbreviations and methods of analysis set forth in 40 CFR 401 shall apply to Part 440 except as provided in these general provisions and definitions. The general provisions and definitions in this subpart apply to all subparts of Part 440 unless otherwise noted.

§ 440.131 General provisions.

(a) *Combined Waste Streams:* In the event that waste streams from various subparts or segments of subparts in Part 440 are combined for treatment and discharge, the quantity and concentration of each pollutant or pollutant property in the combined discharge that is subject to effluent limitations shall not exceed the quantity and concentration of each pollutant or pollutant property that could have been discharged had each waste stream been treated separately. In addition, the discharge flow from the combined discharge shall not exceed the volume that could have been discharged had each waste stream been treated separately.

(b) *Storm Exemption for Facilities Permitted to Discharge:* If, as a result of precipitation or snowmelt, a source with an allowable discharge under 40 CFR 440 has an overflow or excess discharge of effluent which does not meet the limitations of 40 CFR 440, the source may qualify for an exemption from such limitations with respect to such discharge if the following conditions are met:

(1) The facility is designed, constructed and maintained to contain the maximum volume of wastewater which would be generated by the facility during a 24-hour period without an increase in volume from precipitation

and the maximum volume of wastewater resulting from a 10-year, 24-hour precipitation event or treat the maximum flow associated with these volumes. In computing the maximum volume of wastewater which would result from a 10-year, 24-hour precipitation event, the facility must include the volume which would result from all areas contributing runoff to the individual treatment facility, i.e., all runoff that is not diverted from the active mining area and runoff which is not diverted from the mill area.

(2) The facility takes all reasonable steps to maintain treatment of the wastewater and minimize the amount of overflow.

(3) The facility complies with the notification requirements of § 122.60 (g) and (h). The storm exemption is designed to provide an affirmative defense to an enforcement action. Therefore, the operator has the burden of demonstrating to the appropriate authority that the above conditions have been met.

(c) *Storm Exemption for Facilities Not Permitted to Discharge:* If, as a result of precipitation (rainfall or snowmelt), a source which is not permitted to discharge under 40 CFR 440, has an overflow or discharge which violates the limitations of 40 CFR 440, the source may qualify for an exemption from such limitations with respect to such discharge if the following conditions are met:

(1) The facility is designed, constructed, and maintained to contain the maximum volume of wastewater stored and contained by the facility during normal operating conditions without an increase in volume from precipitation and the maximum volume of wastewater resulting from a 10-year, 24-hour precipitation event. In computing the maximum volume of wastewater which would result from a 10-year, 24-hour precipitation event, the facility must include the volume which would result from all areas contributing runoff to the individual treatment facility, i.e., all runoff that is not diverted from the area or process subject to zero discharge, and other runoff that is allowed to commingle with the influent to the treatment system.

(2) The facility takes all reasonable steps to minimize the overflow or excess discharge.

(3) The facility complies with the notification requirements of § 122.60(g) and (h). The storm exemption is designed to provide an affirmative defense to an enforcement action. Therefore, the operator has the burden of demonstrating to the appropriate authority that the above conditions have been met.

(d) *pH Adjustment:* (1) Where the application of neutralization and sedimentation technology to comply with relevant metal limitations results in an inability to comply with the pH range of 6 to 9, the permit issuer may allow the pH level in the final effluent to slightly exceed 9.0 so that the copper, lead, zinc, mercury, and cadmium limitations will be achieved.

(2) In the case of a discharge into natural receiving waters for which the pH, if unaltered by human activities, is or would be less than 6.0 and approved water quality standards authorize such lower pH, the pH limitations for the discharge may be adjusted downward to the pH water quality criterion for the receiving waters provided the other effluent limitations for the discharge are met. In no case shall a pH limitation below 5.0 be permitted.

(e) *Groundwater infiltration provision:* In the event a new source subject to a no discharge requirement can demonstrate that groundwater infiltration contributes a substantial amount of water to the tailing impoundment or wastewater holding facility, the permitting authority may allow the discharge of a volume of water equivalent to the amount of groundwater infiltration. This discharge shall be subject to the limitations for mine drainage applicable to the new source subcategory.

§ 440.132 General definitions.

(a) "Active mining area" is a place where work or other activity related to the extraction, removal, or recovery of metal ore is being conducted, except, with respect to surface mines, any area of land on or in which grading has been completed to return the earth to desired contour and reclamation work has begun.

(b) "Annual precipitation" and "annual evaporation" are the mean annual precipitation and mean annual lake evaporation, respectively, as established by the U.S. Department of Commerce, Environmental Science Services Administration, Environmental Data Services, or equivalent regional rainfall and evaporation data.

(c) "Appropriate treatment of the recycle water" in Subpart J, § 440.104 includes, but is not limited to pH adjustment, settling and pH adjustment, settling, and mixed media filtration.

(d) "Groundwater infiltration" in § 440.131 means that water which enters the treatment facility as a result of the interception of natural springs, aquifers, or run-off which percolates into the ground and seeps into the treatment facility's tailings pond or wastewater holding facility and that cannot be diverted by ditching or grouting the tailings pond or wastewater holding facility.

(e) "In-situ leach methods" means the processes involving the purposeful introduction of suitable leaching solutions into a uranium ore body to dissolve the valuable minerals in place and the purposeful leaching of uranium ore in a static or semistatic condition either by gravity through an open pile, or by flooding a confined ore pile. It does not include the natural dissolution of uranium by ground waters, the incidental leaching of uranium by mine drainage, nor the rehabilitation of aquifers and the monitoring of these aquifers.

(f) "Mill" is a preparation facility within which the metal ore is cleaned, concentrated, or otherwise processed before it is shipped to the customer, refiner, smelter, or manufacturer. A mill includes all ancillary operations and structures necessary to clean, concentrate, or otherwise process metal ore, such as ore and gangue storage areas and loading facilities.

(g) "Mine" is an active mining area, including all land and property placed under, or above the surface of such land, used in or resulting from the work of extracting metal ore or minerals from their natural deposits by any means or method, including secondary recovery of metal ore from refuse or other storage piles, wastes, or rock dumps and mill tailings derived from the mining, cleaning, or concentration of metal ores.

(h) "Mine drainage" means any water drained, pumped, or siphoned from a mine.

(i) "Ten (10)-year, 24-hour precipitation event" is the maximum 24-hour precipitation event with a probable recurrence interval of once in 10 years as established by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, or equivalent regional or rainfall probability information.

(j) "U" (Uranium) is measured by the procedure discussed in 40 CFR 141.25(b)(2), or an equivalent method.

[FR Doc. 82-31394 Filed 12-2-82; 8:45 am]

BILLING CODE 8560-50-M

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

January 17, 1984

File Ref: 1630 (Exxon)

Dear Librarian:

Exxon recently provided the Department with additional copies of the attached list of documents. Please place these documents with the Exxon Environmental Impact Report (EIR) material.

Eight libraries are receiving a complete set of the attached list of documents. They include: the Antigo Public Library; the Crandon Public Library; the Brown County Library in Green Bay; the City and County Library in Ladysmith; the Milwaukee Public Library; the Platteville Public Library; the Rhinelander Public Library; and the Charles M. White Public Library in Stevens Point.

Due to our shortage of copies, we cannot make a complete distribution of these documents to all of the Exxon EIR repositories. Three libraries will receive all of the documents except for document #4 on the attached list. These three libraries include: the L. E. Philips Library in Eau Claire; the Marathon Public Library in Wausau; and the Nicolet College Learning Resources Center. The Vaughn Public Library in Ashland will receive all of the documents except documents numbered 1, 4, and 14 on the attached list. The Madison Public Library will receive documents numbered 6, 7, 8, 9, 11, and 12 only. I will send these libraries the remaining documents as copies become available. Meanwhile, those libraries should contact me if they have a request for the remaining documents. Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:mgr

Enclosure

1. Mine/Mill Access Road, a Final Report for Exxon Minerals Corporation, Preliminary Engineering Contract #21615, Volumes I and II. Foth and Van Dyke, 1982.

2. Geotechnical Review, Crandon Project, Waste Disposal System, Project Report II, Volumes I, II and III. Golder Associates, 1982.

3. Addendum #1, Geotechnical Review, Crandon Project, Waste Disposal System. Golder Associates, 1982.

4. Crandon Project Wetlands Assessment Report and Maps. Normandeau and IEP, 1982.

5. Investigations of Feasibility of Dewatering and Other Alternatives for Open Pit Mine Options near Crandon, Wisconsin. Dames and Moore, 1977.

6. Results of Permeability Tests and Analysis of Water Samples from Deep Exploration Holes, Crandon Ore Body, Crandon, Wisconsin, Dames and Moore, 1978.

7. Report - Results of Geologic Geotechnical and Hydrologic Investigations of a Portion of the Proposed Exploration Ramp, Crandon Project. Dames and Moore, 1977.

8. Crandon Project, Mine Waste Disposal Facility, System 41-1148, Tailings Upon Water Clarification Pools, Exxon Mineral Company, 1983.

9. Soil Attenuation Study, Crandon Project, Appendix H, Laboratory Data, Volume I and II, Final Report. D'Appolonia, 1982.

10. Exxon Minerals Corporation, Exxon contract #21562 Preliminary Engineering Mine/Mill Railroad Spur, Crandon Project, Volumes I and II. Foth and Van Dyke, 1982.

11. Systems Developement Report, Crandon Project, Waste Disposal System, Project Report #8. Golder Associates, 1982.

12. Final Report Mine Hydrology Tests Data Analysis, Crandon Project, May 27, 1982.

13. Report on Pump Test and Analysis, Crandon Project, Waste Disposal System, Project Report #4, Golder Associates, 1981.

14. EIR Chapter #1, Crandon Project, Construction of Waste Disposal Facilities, INDECO, 1982.

4413R

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

January 6, 1984

File Ref: 1630 (Exxon)

Dear Librarian:

Please place the enclosed document in the red binder you have on file along with the rest of the Exxon Environmental Impact Report (EIR) material. This document is a copy of the Department's second letter to the firm containing review comments on the EIR. The letter includes comments made by other state agencies and the public since the Department's first review letter of May 11, 1983.

For your information, our distribution of consultant reports related to Exxon's EIR is almost complete. I will be sending you one last, large shipment of documents by mid-January. This shipment will contain most of the remaining supporting consultant reports. Future transmittals of documents will mainly consist of Departmental review comments on the EIR, and Exxon's responses to those comments.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Impact

Carol Nelson

Carol Nelson
Environmental Specialist

CN:mgr

Enclosure

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

December 29, 1983 IN REPLY REFER TO: 1630 (Exxon)

Mr. Barry Hansen
Exxon Minerals Company
P. O. Box 813
Rhinelander, WI 54501

Dear Mr. Hansen:

We have completed the second phase of our review of the Environmental Impact Report (EIR) and associated materials. The attached comments should be considered in conjunction with those provided in our May 11, 1983 letter. Our comments comprise the following categories:

1. Additional comments on Chapters I, II, and III of the EIR. These comments include the results of our analysis of public comments, additional comments from State and Federal agencies, and further comments from Department staff.

2. Comments on Chapter IV of the EIR. These represent our first review of Exxon's "impact analyses". We have confined our comments to those aspects which we believe constitute primarily numerical analyses and have not commented on the more subjective elements of the analyses in which Exxon has drawn non-numerical conclusions on impacts.

   For example, while we have asked for additional information regarding potential changes to surface water quantities and qualities, we have not commented on the analyses of the impacts on fish populations.

3. Further comments resulting from review of Exxon's response to our May 11, 1983 letter. While our staff analyses of these responses have not been completed, we are providing the available comments now in an effort to identify additional informational needs at the earliest opportunity. The remaining reviews of Exxon's responses will be provided in a subsequent letter. These comments also encompass relevant portions of the various technical reports which have been submitted in support of the EIR. Since some of these reports have only recently been provided to the Department, the attached comments do not constitute a review of all supporting documents nor do they reflect comments of other agencies or the public on these reports. In addition, several of our contractor reviews of specific technical components of the EIR such as noise and socioeconomics have not been completed. These reviews will be provided to you as soon as possible.

4. Reviews of the various reports dealing with baseline conditions and potential impacts to wetlands in the project area.

Our comments are generally restricted to issues that are outside the scope of our normal permit review functions. More specific technical comments will be transmitted through our permit application reviews and through issue-specific correspondence such as our November 14, 1983 letter regarding hydrogeological data.

Since many of the permit requirements overlap with EIR informational needs, we suggest that Exxon consider using some permit applications in lieu of corresponding EIR sections. For example, the Mine Plan could replace EIR Chapter I; the Feasibility Report and Air Permit Applications could be vehicles for providing related EIR information. We believe this approach could minimize the inherent duplication in the current EIR and permit reviews and would simplify our dialogue on issues. We would be happy to discuss this approach further if you feel it has merit.

We have attempted to limit our comments to the more substantial issues. We also have a number of less substantive concerns, which we will accommodate as necessary in our EIS. You should, therefore, be aware that our EIS will not necessarily comport with corresponding sections of the EIR.

We continue to have significant concerns regarding the potential impacts of the proposed mine. Impacts to ground and surface waters are among the key issues. More specifically, it is imperative that adequate data be provided to allow for definitive projections of: 1) maximum mine inflow rates; 2) the total zone of groundwater drawdown; 3) effects on lake levels; 4) effects on low stream flows; 5) impacts to wetlands; and 6) impacts to groundwater quality during and after operations. Additional data and analytical requirements necessary to address hydrogeological aspects of the proposal are currently being developed through ongoing discussions between our staffs.

Your responses should focus on providing the detailed information necessary to evaluate these and other central project issues. Please refer to the guidelines provided in our May 11, 1983 letter for further suggestions regarding your response.

Please contact us for further discussion or clarification of any aspect of the attached comments.

Sincerely,
Bureau of Environmental Impact

Howard S. Druckenmiller /GA

Howard S. Druckenmiller
Director

HSD:dlw/4426R
cc: Linda Bochert - ADM/5
John Brasch - Rhinelander
Jim Huntoon - ADM/5
George Meyer - ADM/5
Lyman Wible - ADM/5
James Derouin - Madison
Joan Knoebel - Madison
Kevin Lyons - Milwaukee
Raymond Huber - Wausau
Donald Zuidmulder - Green Bay
Kathy Falk - DOJ

I. Followup Comments on Exxon's Responses

The following comments address several concerns raised in our May 11, 1983 letter which require further clarification. It should be noted that these comments do not represent a comprehensive review of all responses contained in all of Exxon's September 16 and October 3, 1983 letters; several staff evaluations are currently ongoing.

The numbering system corresponds to that employed in Exxon's response letters.

CHAPTER I

Comments #30, 31, 154, 207:

1. In the May 11 letter to Exxon, there were four questions on manpower needs. The questions were aimed at clarifying peak manpower needs and identifying the skills required for the construction and operations work forces. When we know what Exxon's specific hiring needs are, they can be compared to the availability of skills of the local work force. From this comparison an estimate of local hires can then be made. All other hires are assumed to be non-local, thereby requiring worker immigration. Immigration is a key variable in determining socioeconomic impacts, including impacts on local facilities and services, schools, housing, taxes and others. Exxon's responses did not provide sufficiently detailed information (for example, mine technical, mine operation, mill technical, operation and maintenance) for us to estimate whether the jobs could be filled locally. Please provide us with explicit descriptions of the essential skills required for each type of Exxon construction and contract construction and operations workers to be hired. Each type of work position should also be identified by the appropriate 4-digit Standard Occupational Classification Code (SOC) of the U.S. Department of Commerce. This explicit description should include the skills and knowledge required for each SOC code as a prior condition for employment at the project.

2. Exxon has frequently stated they are committed to preferentially hiring local people to the extent allowable under applicable laws. To which federal and state laws does this refer and what are the implications? Are there any existing or planned agreements with local governments or Indian tribes relating to proposed hiring practices? What activities does Exxon plan in cooperation with local educational institutions to support training of local workers in order to increase local hiring? Would Exxon financially support a locally organized van or bus transportation system between outlying areas, including Indian reservation lands, and the mine site to encourage local hires?

3. At the November 18, 1983 meeting in Madison, when the Future Conditions Report was discussed by Exxon, the subject of local hiring rate was raised. Exxon stated that a skills analysis of the local study area had been performed and had been used as the basis for determining that the local hiring rate for operations workers could be as high as 60%. That figure was used for calculating impacts in the three scenarios used in the Future Conditions Report - minimum, most likely, and maximum impact scenarios. Please provide us with that skills assessment and any other data used to calculate the local hiring rate so we can verify your approximations of local hiring rates.

4. The following data are from Exxon's Forecast of Future Conditions Report (1983): Scenario I (minimum impact) identifies that in 1989 there would be 1,410 workers on site; Scenario II (most-likely impact) identifies 1680 workers on site; Scenario III (maximum impact) has 1830 workers on site. These are approximate staffing levels needed during peak hiring in the final year of construction (p. 17).

   In Exxon's response to comment number 154, a peak hiring number of slightly more than 1,400 employees would occur as the construction and operations workers overlapped. Which number of peak total workers is correct and why?

5. Exxon has indicated to the Department of Industry, Labor and Human Relations that for planning purposes for the septic system at the mill, 1,400 workers was the peak employment. If the peak employment is 1,680 workers as indicated in the Future Conditions Report's, most-likely scenario, would the septic tank and soil absorption field be adequately sized? Please explain.

6. Are there any federal requirements and regulations relating to training, mine safety, or other prerequisites for underground miners which could impact Exxon's local hiring? Are there any other barriers to local hiring? Please discuss.

Comment #45

Exxon's response indicates that an inventory of all private water wells and systems within the 1 meter potential groundwater drawdown area was undertaken. However, the appropriate drawdown area must be defined by the 0-meter contour and under a worst-case scenario analysis. These data are required so that impact to all potentially affected wells can be evaluated.

Comment #72

Please identify classes or "typical" chemicals which may be used as dewatering agents.

Comment #102:

Surface fuel storage facilities would be surrounded by dikes to contain accidental spills. Please provide details on how precipitation would be permitted to run off the site while accidental fuel spills would be contained.

Comment #104:

Our comment was erroneous. Since there will be no permanent residences the potable water supply system will be classified as a noncommunity water supply. As such, the approval for well construction and chemical treatment are governed by NR 112, Wisconsin Administrative Code.

Comment #176:

Please provide either plan elevation drawings or a schematic representation showing dust collection points and duct work to the dust collector(s).

Comment #186:

Please discuss the potential for generation of hydrogen sulfide from the concentrator.

CHAPTER II

Comment #5:

The most accurate characterization of the Department's role in air monitoring would be to state that the Department certified Exxon's air monitoring data.

Comment #9:

The equation provided for calculating the geometric mean value is incorrect, perhaps due to a typographical error. Please provide the correct equation.

Comment #16:

Please identify the locations of test wells and soil borings which have been abandoned and describe the abandonment methodology.

Comment #21:

This response does not address the potential for contamination of the samples from drilling fluids.

Comment #23:

We feel that additional testing for asbestiform materials is warranted. While the bulk analyses performed to date indicate a general absence of asbestiform minerals, even trace amounts of asbestiforms fibers can be a potential health hazard. Since

asbestiform fibers would tend to be concentrated in the tailings and the concentrate fines, it is necessary to investigate these materials using trace techniques. Similar analyses could also be conducted on waste rock and glacial till samples.

The fines fractions should be analyzed as if they were air particulates obtained by special sampling techniques. The analysis should conform with that specified in the U.S. EPA document "Electron Microscope Measurement of Airborne Asbestos Concentrations; A Provisional Methodology Manual", EPA - 600/2-77-178 (Revised June, 1978). Please consult with our Bureau of Air Management before initiating this program.

Comment #25:

This response does not provide the requested information. Please provide quality control data collected when Exxon's samples were analyzed and describe the evaluation of these data.

Comment #34:

Please provide interpretive lithologic logs for the exploration holes drilled to evaluate the mineral potential of Sites 40 and 41. Discuss the degree of bedrock fracturing, weathering, and permeability of these two sites.

Comment #33:

Please provide the results of the analyses for the 6 till samples cited in this response.

Comment #44:

Please provide noninterpretive lithologic logs which address bedrock weathering and fracturing for the deep exploration holes used in the packer tests and the data obtained from these tests. Attachment 2, submitted in support of response 18, should be amended to indicate which holes had been subjected to the packer tests.

Comment #58:

Please indicate the groundwater divides on Figure 2.3-4.

Comment #61:

Provide at least one illustrative comparison of a selected groundwater hydrograph with piezometer data or a stream hydrograph, and precipitation data to substantiate this response.

Comment #62:

Provide an illustrative demonstration of the comparability of data recorded by continuous and intermittent water level recorders.

Comment #83:

Please note that the same methodology for total sulfur analysis should be used in future analysis to insure comparability of data.

Comment #84:

This response does not address the comment. Please explain how total sulfur data can be reported to a greater number of significant figures than the sulfate data from which it is partially derived.

Comment #87:

Is the 0.01 mg/l detection limit for Cr^{+6} listed in Table 2.4-10 correct?

Comment #119

Analysis of the most recent surface water quality samples collected from Duck Lake revealed that baseline conditions have not been reestablished since the 1980 pumping test. Values for conductivity, alkalinity and pH remain elevated. Exxon must continue monitoring Duck Lake on a periodic basis until baseline conditions are reestablished.

Comment #123:

We believe that the low dissolved oxygen levels at Station Z are attributable to aquatic plant communities in that segment of the Wolf River rather than inputs of low dissolved oxygen water from Swamp, Spider, and Pickerel Creeks.

Comment #128:

Contrary to your response, there are sediment metal concentrations significantly outside the expected range of values (e.g. Cr and Pb in sediment at Station D). Please provide a discussion and explanation for these unusually high concentrations.

Comment #137:

Rather than selecting a representative species from each trophic level, it is only necessary to sample a top level predator (i.e. walleye, bass, or northern) and a bottom feeder (i.e. carp or suckers).

Comment #138:

As a point of clarification, metal analysis of bullheads and catfish should be conducted with skin-off fillets.

Comment #146:

The statement that "The fish community structure upstream and downstream of Rice Lake is similar" is inaccurate since a native brook trout fishery (Class II) exists in Swamp Creek above Rice Lake but is nonexistent downstream of Rice Lake.

CHAPTER III

Comment #2:

Please provide a discussion of the likelihood and ramifications of ore reserves significantly exceeding the current estimate.

Comment #10:

Due to the lack of an adequate buffer zone between Skunk Lake and the proposed slurry pipeline and haul road corridor, we recommend consideration of a more southern route as an alternative.

Comment #24:

Localized pumping of the overburden aquifer appears to be under active consideration by Exxon. If so, this proposal should be discussed in the appropriate sections of the EIR and mining plan with greater detail on pumping rates, mine inflow control and excess water discharge.

Comment #29:

Please discuss the alternative of installing a second tailings transport pipeline as a backup system.

Comment #33:

Will the synthetic membrane system alternative require a 6 inch bentonite liner? Also, no seepage collection systems are included for alternatives 2 and 3. If seepage collection systems are components of these alternatives, the cost estimates should be modified accordingly.

APPENDICES

Comment #A4:

Attachment number A2 does not provide data from Northern Lakes Services. Please provide these data if they are available.

II. Additional Comments, Chapters 1-3 of the EIR

1.1.2.3. Project Schedules

The EIS indicates that over 4 years are required to construct the mine and mill complex, about 3 years to reach full production, and 26 years of operation. The Future Conditions Report, however, indicated an operations life of 21 years. Please explain why the estimated operation life was shortened by 5 years. Are the other schedules accurate? Will the operating duration change result in any project construction or operation changes?

1.2.1.2.1 Main Shaft

Construction of the main shaft will require blasting of consolidated bedrock material for the proper placement of the shaft collar and headframe foundation. Discuss the potential for bedrock fracturing during blasting which could increase the rate of groundwater flow into the mine. Will grouting be capable of minimizing these inflows?

1.2.1.2.4 Stopes

Supergene weathering of the hanging wall and the Crandon formation has created a very deep weathering slot that extends as deep as 230 m. Figure 1.2-4 indicates that mining will occur between 140 m. and 230 m. Describe in greater detail the precautions that will be taken to minimize groundwater inflows and mine gallery collapse in these weathered bedrock areas.

1.1.3.6. Requirements for Governmental Service

Could sludge from sewage treatment be disposed in the tailings pond or on site as a fertilizing amendment?

1.2.1.2.14 Fuel Handling and Storage

Will the fuel handling storage facilites in the mine have a liner as well as retaining walls to contain spilled fuels? How will spilled fuels be collected and disposed/recycled? What equipment will be used and will each level with a fuel storage area have this equipment available?

1.2.2.3 Concentrating

The EIR states that "floors will drain to separate sump pumps which return the various product spills to appropriate feed points". Will there be general floor drains to remove cleanup or rain waters that enter the building? Will spilled material be recyclable without treatment?

1.2.2.10 Spill Control Facilities

What capacity will the spill control surge tank have? If multiple spills occur for different process lines can the materials be safely mixed? If recovered spills cannot be recycled where will they be stored pending disposal.

1.2.4.2 Access Road

The EIR states that the access road will be two paved lanes (12 feet each) with 8 feet shoulders. For the projected traffic load (600-780 vehicles/day) two paved lanes (11 feet each) with 6 feet shoulders should be adequate.

1.2.4.3 Parking and Gate House

Describe in greater detail the two water retention basins on the site. If basin siltation requires dredging, where will the dredged materials be dumped? Estimate the quality of the water leaving these basins. To which streams will this water flow?

1.2.4.5. Combustible Storage Building

What measures will be taken to contain, control, and clean up spills (e.g. contingency plans, liners, berms, recycling, disposal, safety equipment)?

1.3.1 Facilities Construction

Please provide a list of nonmetallic minerals needed for construction purposes. This would include gravel for all road and facility construction, the ballast for the railroad spur, and materials for road/facility surfacing. Include the processing plants associated with these activities if appropriate, and indicate quantity of materials needed, estimated cost, and likely source.

1.3.1.3. Access Road Construction

Please provide additional details on access road construction activities including topsoil stockpile areas, location and design of erosion control methods such as sediment basins, and deposition of peat removed from wetlands.

1.3.1.9 Railroad Construction

Please provide additional details for railroad construction and associated activities, including topsoil stockpile location, retention basin details, and deposition of wetland organic soils.

1.4.2.3. Ventilation and Air Heating

How will controlled amounts of clean air be withdrawn for each level?

1.4.7 Operations Traffic

This section estimates a total of 623 vehicles used to transport 782 operations workers on a daily basis, with an occupancy rate of 1.25 persons per vehicle. In section 1.3.3.4 on construction traffic, only 550 vehicles are needed to transport over 1,450 construction workers and staff in the peak year of construction. Please explain why fewer vehicles would be needed for a greater number of workers during construction than during operations.

1.5.1 Facilities Removal

The EIR states that drifts, raises, and shafts will not be backfilled. Why shouldn't they be filled with tailings and plugged with concrete or bentonite to minimize surface subsidence and maximize the amount of waste rock returned to the mine? What is the volume of mine drifts, raises and shafts that would not be backfilled? How does this compare with the volume of the stopes which will be backfilled?

2.4.1.2 Stream Flow Rates

There are a number of streams which may be impacted by lowering the groundwater potentiometric surface. However, the information presented in the EIR does not indicate the maximum extent of the groundwater drawdown or the drawdown under a worst-case scenario if mine inflow is greater than 2,000 gpm. When this information is available, we will be able to determine whether additional streams may be impacted. An example of streams which could be impacted are the five unnamed streams tributary to the north and east sides of Rolling Stone Lake. Three of these contain brook trout populations and are Class I trout streams. For these or other streams within the ultimate groundwater drawdown zone of influence, we may require water quality , low flows, and biotic data gathering as necessary to document premining conditions.

For all streams within the area potentially impacted by mine dewatering, low flows (7-day Q_{10}) must be determined. Please include information on how stream low flows are determined. Low flow information is required to adequately assess the potential drawdown impacts on these streams. The analyses of flow reductions based on average total flow or average base flow are inadequate.

2.5.2.1 Drainage Lakes and Associated Streams (Aquatic Ecology)

Page 2.5-37, - Baetis, in particular, is a very common mayfly in Swamp Creek that was not identified to species. Because of the numerical importance of this genus, species identifications should be made. As a general guideline, species identification should be made on all future Exxon benthos specimens, when possible, with the exception of biotic index samples which may not require species identification for tolerance assessment.

With regard to Table 2.5-13, the practice of "lumping" or "splitting" taxonomic groups for data presentation affects our ability to review and compare data sets. If many taxonomic groups are "lumped" as in Table 2.5-13, it makes DNR's verification of the data cumbersome and time consuming. Rather than requiring a complete remake of this and other similar tables, please send raw data and/or unpublished copies of the necessary data for review purposes.

3.5.6.1 Water Treatment Systems

Compare the expected quality of the sodium sulfate byproduct from the water treatment process with the commercially available sodium sulfate presently used in the paper making industry. If the reclaimed sodium sulfate is not of commercial quality please discuss the alternatives for purifying the sodium sulfate versus land disposal.

3.5.2 Process Alternatives

Due to the environmental hazards associated with the use of cyanide compounds please discuss the use of alternative reagents in the copper beneficiation process.

Briefly discuss the feasibility of heap leaching the tailings to enhance metal recovery.

3.5.6.3. Water Treatment Waste Disposal

This section states that water treatment wastes could potentially be sold to Kraft paper mills in Wisconsin, or transported to and disposed of in a secure landfill site. One of the tailings ponds could be used for the storage of this waste if a separately bermed area was provided. If this alternative were chosen, would it require any modifications to the size of the tailings ponds? How would sodium sulfate be handled and disposed in the tailings ponds?

III. Chapter 4, Comments on Environmental Consequences

Introduction

The following comments pertain to Exxon's EIR Chapter 4, Environmental Consequences. The first group of comments is referenced to the corresponding EIR section for your convenience. The second group of general comments has no corresponding section in Chapter 4.

These comments represent our initial review of Chapter 4. We have incorporated the appropriate concerns identified by local units of government, the general public, Indian tribes, state and federal agencies and our Department staff into these comments. As additional comments on the EIR are received, they will be transmitted to you as appropriate.

We have not provided complete comments on several sections in Chapter 4 of the EIR, especially those sections on impacts to surface waters and groundwater. Discussions on these issues between the Department and Exxon are currently underway to determine additional field data requirements and further analytical modeling needs. The Department's position on information needs was detailed in the November 14, 1983 letter to Exxon, hereby incorporated by reference. The specific data needs and analyses which must be addressed by Exxon include:

1) a worst-case analysis of the mine inflow rate;

2) the extent of the ultimate groundwater potentiometric surface drawdown which must be identified by the 0-meter contour interval;

3) acceptable low flow (7-day Q_{10}) data on streams, rather than average flows, on which to calculate flow changes due to mine dewatering.

4) quantified impacts to surface water (lake, streams, springs and wetlands) quality and quantity due to lowering the groundwater potentiometric surface and from altered surface drainage;

5) impacts to water wells from groundwater potentiometric surface drawdown;

6) potential impacts to groundwater and surface water quality due to contaminant movement out of the mine and the mine waste disposal facility after closure; and

7) mitigation strategies for potentially impacted water wells, groundwater, and surface waters.

We will continue to work with Exxon toward resolving these issues by developing a comprehensive hydrogeological program.

Specific Comments

4.0 Environmental Consequences

4.1.1.2 Ambient Air Quality

Page 4.1-2: The EIR states: "Since the estimated component air emissions rates for construction and operation sources are essentially equal, the results of the operation air quality impacts modeling are considered representative of impacts from construction." Though construction and operation emissions may be approximately equal, this does not mean the impact from these emissions will be equal. The emissions must be emitted in the same manner, over similar time intervals and from the same areas to have the same impact. However, during operation approximately 80 tons of particulate matter will be emitted from the concentrator building at heights ranging from 25 to 133 feet above the ground. Sixty of those tons will be emitted at 133 feet with an upward exit velocity of 20.8 m/s. By comparison, construction particulate emissions will be emitted near the ground. Since construction emissions will be released at ground level they will have greater impact closer to the facility than will operation emissions. Construction phase emissions may have less affect on air quality off Exxon's property. Please include a discussion of these differences.

Tables 4.1-1, 2 and 3: Emissions are not estimated in Tables 4.1-1,2,3 for several air contaminant sources described or mentioned in the project description. Please include estimates for these sources:

1. Existing gravel access roads (page 1.3-3)

2. Temporary on-site diesel power generators (page 1.3-4)

3. Burning of stumps and brush during site clearing (pages 1.3-2, 1.3-5, and others)

4. Wind erosion from MWDF stockpiles (p. 1.3-13)

5. Screening and stacking plant to produce MWDF liner and underdrain materials (p. 1.3-15)

6. Primary crusher and related ore handling facilities during construction (p. 1.2-9)

7. Ore loading, hauling and dumping (p. 1.4-3)

8. Removal of rock from shaft during underground mine construction (p. 1.3-7)

4.1.2.2 Landscape

More discussion on the landscape changes caused by the MWDF are needed.

4.1.3.1 Groundwater Hydraulics

Figure 4.1-2: Percolation rates should be converted to volume measures.

In the discussion on p. 4.1-8, it should be mentioned that wells in the area are also discharge points for local groundwater.

4.1.3.2 Groundwater Quality

The redirection of groundwater flow which would occur during mine dewatering could result in water quality changes in nearby private water supplies. These changes could occur if the redirection causes wells to be down-gradient of contamination sources, such as septic systems or recharge areas with low pH water which may contain elevated levels of iron, manganese, and possibly hydrogen sulfide. In addition, there could be induced infiltration from groundwater discharge areas due to groundwater gradient reversal. These potential impacts on groundwater quality must be discussed in the EIR for both the drawdown of the groundwater potentiometric surface and its rebound following mine closure.

4.1.4.1.1 Surface Water Quantity - Streams

Since groundwater has different chemical and physical characteristics than surface runoff, any change in the proportion of groundwater and surface water going into a stream will result in changes in stream water quality. For example, during drought conditions, a loss of groundwater flow to a stream may increase stream temperatures and cause a possible reduction in available dissolved oxygen. Reduced groundwater flow into cold water streams could adversely affect cold water fisheries. Please discuss potential impacts to streams, especially Swamp Creek, due to the mine discharge.

Increased flooding potential on the segment of Swamp Creek below the wastewater discharge should be discussed in this section.

Estimates of impacts on stream water quality due to soil erosion from the various construction activities must be provided. Activities which could increase soil erosion include construction of tailings ponds, and reclaim ponds, slurry pipeline, haul road, mine-mill complex, access road, railroad spur, discharge pipeline, and topsoil stockpiling. Please provide soil sediment loading estimates for the impacted streams.

The treatment system for the water discharge to Swamp Creek may be designed to meet WPDES permit limits; however, this does not guarantee that the system will always work as designed and that limits will always be met. Exxon must discuss potential

impacts to Swamp Creek if the treatment system malfunctions. A reasonable range of possible malfunctions should be considered, with potential impacts on Swamp Creek flow rates and water chemistry calculated.

Duration of the possible malfunctions should be identified, and a scenario based on low flow conditions should be calculated.

4.1.4.1.2 Lakes

P4.1-15: The impacts of stormwater runoff on surface water quality during both the construction and operation phases should be discussed in the EIR. Siltation could have significant impacts on aquatic habitat and water quality. Please provide quantitative estimates of siltation into lakes during construction.

4.1.4.1.4 Wetlands

Figures 4.1-13 through 4.1-19: The hydrologic connections between Wetlands F-57 and F-60, and F-64 and F-65 should be indicated. Were they disconnected because of road placement? (There are also roads between F-23 and F-25 and F-27, yet these connections were shown.) Waterflow networks of all affected wetlands should be shown.

Figure 4.1-13: The discharge pipeline crosses the drainage outlet of Wetland Z-20. The possible effects to this wetland and its outlet from the pipeline construction should be addressed.

Figure 4.1-15: The wetlands along the east 1/4 of Alternate C should also be shaded. The osprey nest location is in error. It is further south - the correct location has previously been given to Exxon.

Page 4-1-20: Standard construction methods for wetlands will be used..." What are these standard methods? In order to know what the impacts to adjacent wetlands will be, these construction activities (e.g., dredging, diversions, sediment pond construction and discharge, soil disposal, erosion potential, stockpiling, etc.) must be identified and the potential impacts to wetland hydrology specified. Even if these impacts are "short term and localized" (p. 4.1-21) they must be identified.

Tables 4.1-16 and 4.1-17: Wetland #F-23 is incorrectly numbered. In the Normandeau Study, the correct number of the wetland is F-32.

Throughout the life of this project, erosion control "catch basins" will be constructed to trap soil particles and slowly release storm waters. Will the discharge be to wetlands adjacent to local surface water bodies? The discharges could

result in physical and chemical changes within the wetlands. There needs to be further discussion on the impacts of siltation and runoff water quantity and quality on adjacent wetlands and surface waters.

4.1.5.2 Aquatic Biota. Table 4.1-14: Is the fish "brook silverside" correct or was "brook stickleback" intended? Are the capture locations known and voucher specimens available for verification?

4.1.6 Terrestrial Ecology

4.1.6.1.2 Wetland Communities

Page 4.1-33: Pipeline placements do not necessarily "remove" acreage from wetlands (such as Z-20) if the buried pipeline does not involve wetland fill, and the corridor is allowed to revegetate as proposed.

Table 4.1-19: A 200 foot corridor width was used by Exxon to calculate wetland loss; figures should be revised using a width of 100 feet. Transmission lines and pipelines, for example, while constructed through wetlands, would not result in complete loss of those wetlands.

4.1.9.1.4 Residential

Exxon should indicate the number of summer cottages purchased (Little Sand Lake and others, if any) and discuss their eventual use.

4.2 Environmental Consequences - Operation

4.2.1.1 Meteorology and Air Quality

4.2.1.1 Local Meteorology

The EIR states: "Under some conditions the mine exhaust ventilation shafts will cause water vapor plumes." Additional information is needed on when water vapor plumes will be formed, their frequency, magnitude, and likely consequences.

Page 4.2-2 (Second paragraph): The EIR states that air quality constituent concentrations are expected to be below primary and secondary federal and state ambient air quality standards at the project boundary. However, the EIR does not identify the contribution to emissions by the handling, storage, and use of processing reagents. Please include such a discussion.

Table 4.1-1: Please revise or explain the total emission figures because they are not equal to the sum of these components.

Table 4.2-2: This table should include air emissions from the burnt pebble lime facility (p. 1.4-45).

Table 4.2-4: This table should include SO_2 emissions from the SO_2 scrubber tower (Fig. 1.4-13).

Page 4.2-3 (Second paragraph): The EIR indicates that the control of 95% of dust emissions in the mine by gravity settling and the humid conditions has been documented. The reference should be provided.

4.2.3.2 Groundwater Quality

The data presented does not indicate whether the concentration gradients from the tailings ponds decrease in the future. The implication is that the concentration gradients will increase continuously such that concentration gradients at the top of the stratified drift and perhaps at the compliance boundary may exceed groundwater standards. There should be some explanation that the MWDF seepage quantity or quality will correct itself in the future.

4.2.4 Surface Water

Table 4.2-7A: The discrepancy between the reported difference in flow cfs for Rolling Stone Lake and lower portion of Pickerel Creek for Project Year 33 (reported as -0.04) versus the same value reported in Table 4.1-7 (reported as -0.35 cfs) should be explained.

Page 4.2-13 (Last Paragraph): Effects on the portion of Pickerel Creek above Rolling Stone Lake should also be summarized in this section.

4.2.4.2 Surface Water Quality

Sources other than seepage from the MWDF must be considered in evaluating impacts to surface water quality. Additional factors include chemical and physical changes in Swamp Creek due to the wastewater inputs, reduced flows, altered temperatures in streams, and increased siltation.

4.2.5 Aquatic Ecology

4.3 Environmental Consequences Post - Operation

4.3.1 Meteorology and Air Quality

The EIR should discuss fugitive dust and vehicle emissions which will occur during site decommissioning (removal of facilities), landscaping and other reclamation activities.

4.3.3 Groundwater

The EIR states that when the groundwater potentiometric surface has returned to its preconstruction level, the effects due to lowering the potentiometric surface on local users of groundwater will no longer exist. This statement discounts the potential impacts due to: 1) the possibility of dewatered aquifer subsidence; 2) the potential chemical (e.g. oxidation-reduction potentials) and physical (e.g. permeability) alteration of aquifer materials caused by the dewatering operations (28 yrs.) and time required for groundwater potentiometric surface to return to normal (total of 64 years); 3) altered bedrock-overburden flow gradients due to the abandoned underground mine; and 4) the altered surface recharge because of the mine waste disposal facility. Exxon must consider these four factors and in their groundwater analysis for the period after closure.

4.4 Environmental Consequences - Alternatives

4.4.1.7 Groundwater Discharge - The discussion of the three alternative locations for groundwater discharge of excess treated water must be expanded to include potential impacts to groundwater quality and hydrology.

4.4.2.3 Tailings Disposal Methods

The EIR does not identify the major potential impacts associated with alternative subaerial and dry tailings disposal methods. Potential impacts could occur during construction, operations and reclamation. Please provide a discussion of the major potential impacts to air quality, groundwater quality, surface waters and wetlands that the alternatives could create.

4.4.2.6 Surface Water Discharge

The data from the pump test discharge to Duck Lake indicate more impacts (such as elevated alkalinity and pH, etc.) could occur than indicated. Exxon's own data on Duck Lake raises question on this analysis "...the only incremental impacts associated with lake discharge would be a possible increase in the lake water surface elevation or discharge flow out of the lake." Although Little Sand Lake's volume is greater than Duck Lake's, the temporary nature of the Duck Lake pump test discharge vs. long-term pumping in Little Sand Lake, and comparative dilution factors need more than a cursory analysis. Exxon should provide a more detailed analysis of this problem. It is possible that lake levels will be lowered by mine dewatering, and various alternative mitigating strategies, including discharge into lakes, would be required.

From the existing discussion, there is no basis for assessing why a lake discharge is not a preferred alternative.

The alternative of a wetland discharge needs additional discussion. A brief discussion of the major impacts to wetlands hydrology, surface water and groundwater quality, vegetation must be provided.

4.4.2.7 Groundwater Discharge - For the three described alternatives (injection wells, infiltration basin, and drain field), please provide additional brief discussions of the potential impacts to groundwater hydrology and quality.

Chapter 4
General Comments on Exxon's EIR

In the EIR there is no discussion of the potential threats to the integrity of the MWDF reclamation cap. Eventual penetration by deep-rooted trees, soil creep, settling, erosion, animal burrows and frost heaving will act to slowly degrade the reclamation cap. Please provide an analysis on the integrity of the reclamation cap based on these factors.

The proposed mine-mill complex will utilize a number of process reagents, some of them toxic, others potentially hazardous, in large quantities. The reagents will require a substantial amount of transport handling and storage, before they are utilized and eventually disposed. The potential impacts of an accidental spill, railroad car or truck accident, or other release of chemicals to the environment need to be discussed. Potential impacts to air quality, groundwater, surface water, and wetlands should be addressed.

The EIR assumes that once the mine is operating, it will continue operating until the ore body has been completely mined. Exxon has addressed (comment 167) temporary shut down conditions, when the mine and facilities would be maintained in a state of readiness. Under that situation, pumping the MWDF underdrain would continue, the mine dewatering would continue, and the tailings ponds would remain ready for use, and mining/milling could begin at short notice. In addition to short-term shutdowns, there is a possibility that mining would cease for longer periods of time. If that happened, would the mine ever be allowed to flood? Would the MWDF underdrain continue to be pumped? Would the tailings and reclaim ponds be allowed to dry? What would the closing duration have to be for these events to occur? For example, please discuss the potential impacts which would result from a closure of 2-5 years. Include in the discussion potential impacts to groundwater quality, surface water quality, and implications of restarting the mine.

IV. Review of Exxon's Wetland Documents:

We have received several documents dealing with wetlands that were submitted by Exxon Minerals Company in support of their proposed mine development. In order to provide an integrated review of all reports dealing with wetlands, we have included the following documents in this review: 1) Wetlands Assessment Report (Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc.); 2) Supplemental Wetland Assessment Report (IEP, Inc.); 3) Hydrological Balance for Selected Wetlands (IEP,Inc.) and 4) Crandon Project Environmental Impact Report.

Following are our specific comments and further questions on these documents in addition to those found in our comments to Chapter 4 of the EIR, Environmental Consequences sections 4.1 and 4.3. Final acceptance of this work is contingent on the satisfactory resolution of these comments and questions.

Compliance with NR 132.06(4):

The areas proposed for development appear reasonable based on the wetland acreage minimization criterion outlined in ch. NR 132. Further discussion is needed, however, to justify wetland impacts of the preferred access road corridor, since it is not the least acreage alternative.

Effect of Mine Dewatering on Wetlands:

It is predicted that the only wetland to be affected by mine dewatering is Z17 (EIR 4.2-26), identified as the only water table wetland within the expected cone-of-depression. Yet there is some reduction in flow to certain surface waters even beyond the expected zone of influence. Since these surface waters possess associated wetlands, it would appear that some wetland impacts may also be expected. Also, the extent of groundwater connected wetland impacts may be influenced by further refinement and modification of groundwater models by Exxon and the Department. We will have to review this new information as it relates to wetlands as it becomes available.

Basis for Determination of Perched Versus Water Table Hydrologic Position of Wetlands:

Wetlands were identified as being perched or water table linked without explanation of how this was determined for each wetland. Explanation of how this condition was determined for each wetland inventoried within the expected zone of influence of mine dewatering is necessary to evaluate impacts to these wetlands. In your explanation please refer to the presence of spring seeps in the vicinity of wetlands that have been classified as perched (Figure 2.3 -17 of the EIR).

Difficulty in Reproducing Model Results:

In testing the consultants' wetland evaluation models on a sample of wetlands, both with our own field data as well as theirs, we had difficulty in achieving the same results. While the size of the differences are not substantial, the number of differences are. The number of differences can affect the relative rankings and the model means which are used in the impact analysis. This problem needs to be reconciled.

Normalization Difficulties:

We have not been able to normalize the wetland scores to achieve the same results as the consultant. We understand, from an inquiry by the Department (R. Read) to the consultant, that the normalization process described in Appendix L of the Wetland Assessment Report was not used. Instead a scaling process was utilized. However, we have still not been able

to achieve the same "normalized" results that are presented in Table 6.2-2 of the Assessment Report and Table 5.2-2 of the Supplemental Assessment Report. This problem needs to be reconciled.

Misidentification of Species:

Based on the known geographical distribution of the following species, we believe that they may have been misidentified by the consultants. Examination of vouchers by the consultants should be made to determine the correct identification. Should they prove to be correctly identified, the presence of these species in studied wetlands would indicate special biotic values.

Picea rubens (Red Spruce) -- Not recognized as a native Wisconsin species.

Kalmia angustifolia (Sheep Laurel) -- An eastern species not yet recognized as a native Wiscionsin species.

Vaccinium corymbosum (Highbush Blueberry) -- An exceedingly uncommon species in Wisconsin, not known to occur in northeastern Wisconsin.

Quercus muenlenbergii (Chinquapin Oak) -- Quercus muehlenbergii occurs in Wisconsin on dry prairie sites in southwestern Wisconsin.

Scirpus atrocinctus (Bulrush) -- Considered synonymous with S. cyperinus (Wool-grass), which is also listed as occurring in the same wetland (Z1) (plus cf. 3.1 - 2, Supplemental Assessment Report).

Fraxinus pennsylvania var, subintegerrima and Fraxinus nigra -- Our field investigations found that F. nigra was by far the most prevalent ash species in wetlands, while the consultants found green ash to be most common. We think black ash is the common wetland ash species.

Determination of Wetland Bank Surficial Material:

We would like to know how the element describing the surficial geologic material of the wetland bank (Storm and Flood Water Storage Function Model) was distinguished from "surficial material of watershed" element for the same model. There is no place on the field data collection sheet for recording of "wetland bank surficial material."

Qualitative Elements:

Table 6.1-1 in the Assessment Report, and Table 5.1-1 in the Supplemental Report, summarize the major elements used to describe and evaluate the wetlands. These are qualitative descriptors, and are not explained in the text. It is not clear how they were derived from the field data sheets. The derivation of most of these elements can be surmised, such as: "Water Storage" in the tables apparently summarizes "Dominant Hydrologic Type" on the field inventory sheets. A discussion of what these descriptive elements are, and how they achieved, would be useful. For example, what exactly is meant by "Living Filter Capacity"?

Inconsistencies Within The Report:

The following comments refer more to the report format than to substantive problems with the wetlands assessment.

Inventory Report Format: The dominant class listings on the field data sheets do not conform to the six classes described in the text. Deciduous and coniferous swamps are lumped together on the front page of the inventory, yet are distinquished elsewhere in the report. Conversely, though "Wet Meadow" and "Shallow Marsh" are considered identical in the report, they are presented as two distinct categories on the cover page of the inventory report form.

Dominant Wetland Class Determinations: Throughout the Assessment Report there are disagreements about the dominant wetland class of various wetlands. We have used the field data sheets as the final word on any questions about wetland type, but the high number of these presumably typographic errors needs to be pointed out. There are numerous discrepancies among the inventory reports, Table 3.5-1, Table 6.1-1, and Appendix G. For example:

Wetland	Inventory Report	Table 3.5-1	Table 6.1-1	Appendix G
D3	D.S.	D.S.	D.S.	C.S.
D8	D.S.	D.S.	D.S.	C.S.
F60	C.S.	D.S.	C.S.	C.S.
B4	C.S.	C.S.	C.S.	C.S.

D.S. = Decidous Swamp
C.S. = Coniferous Swamp

When the field data sheets are used to correct these discrepancies, summary tables, such as Table 6.3-1 in the Assessment Report, are significantly changed (seven wetlands out of forty-six are shifted into different categories in Table 6.3-1.

Comments on Specific Wetlands:

The following specific comments apply to wetlands in the vicinity of the proposed mine which were identified in the Supplemental Wetlands Assessment Report (SWAR) and Wetland Assessment Report (WAR). The comments are listed here as examples of differences between Department and Exxon's consultant's observation of wetland classification and function. While some of these differences may not be significant in terms of wetland evaluation or impacts to them, others may be significant. Please review the following comments and address those which could be significant in altering wetland scoring or facility placement, or significantly alter projections of impacts.

1. Wetland Z-2 - There is an open water area located along this wetland's southern edge not identified in the SWAR. Also, separate from this wetland is a small pond. The pond appears to discharge to Z-2 during high water periods.

2. Wetland Z-5 - The field inspection and the vegetation list provided in the SWAR indicate this wetland should be classified a "shallow marsh" rather than a "shrub swamp".

3. Wetland Z-6 -

   This wetland does not have an inlet from Wetland Z-10, as indicated in the SWAR (see direction on Wetland Z-10 for details).

4. Wetland Z-7 and Wetland Z-9 - These wetlands are the headwaters of streams 24-14 and 24-15 T35N R12E. Department surveys have determined both of these streams pass through Wetland W-2 before reaching Swamp Creek. The original "Wetlands Assessment Report" indicates Wetland W-2's outlet is located "off site". Wetland W-2's inventory report should be completed now that it is included in the wetland study area.

5. Wetland Z-9 - The SWAR does not indicate that this wetland receives surface water flow from Wetland Z-10 (see Wetland Z-10 discussion for details).

6. Wetland Z-10 - This wetland discharges to Wetland Z-9 via a culvert under the logging road that separates the two wetlands. Creek 24-4, T35N, R12E, originates in Wetland Z-10. A channel approximately two feet wide is present immediately downstream from the culvert. There was a flow of approximately one-half cfs during a July 26, 1983, field inspection. Wetland Z-10's outlet is incorrectly identified as flowing to Wetland Z-6 in the SWAR.

7. Wetland Z-15 - Though not indicated in the SWAR, water from this wetland appears to follow its historical route to Z-11 during high water periods passing over the town road that separates the two wetlands. No culvert could be found connecting the two wetlands.

8. Wetland Z-16 - The SWAR lists this wetland as having no outlet. However, a District field inspection determined the wetland intermittently drains to the south through a culvert under Keith Siding Road to Wetland T-4. The open water portion of the wetland identified in the SWAR is listed in "Surface Waters of Forest County" as Lake 17-16, T35N, R13E.

9. Wetland Z-18 - The SWAR does not recognize that this wetland complex is listed as Hoffman Spring in the "Surface Waters of Forest County".

10. Wetland Z-20 - Our inspection of this wetland determined the forested portion has primarily "conifer" rather than "deciduous" tree species as listed in the SWAR.

11. Wetland Z-21 - This wetland discharges to Z-20 during periods of high water, contrary to being listed as having no outlet in SWAR. Wetlands Z-20 and Z-21 appears to be contiguous on their north ends during high water periods.

12. Wetland Z-22 - This wetland drains south through a culvert under Little Sand Lake Road to Wetland Z-20 during high water periods. This is contrary to the "absent" outlet listing in the SWAR. The open water area portion of the wetland identified in the SWAR listed as Lake 25-11, T35N, R12E, in the "Surface Waters of Forest County".

13. Wetland Z-23 - The drainage characteristics of this wetland have not yet been determined. However, recent information indicates that the wetland discharges to both Rolling Stone and Mole Lakes rather than having Mole Lake as its outlet. Our inspection of this wetland determined the primary tree species are black spruce and tamaracak. Black spruce is listed in the SWAR as only an "occasional" species and tamarack is not listed at all.

Wetland F-10 - While this wetland is for the most part contiguous with Little Sand Lake, it is doubtful if waterflow is perennial as listed in WAR.

Wetland F-15 - The WAR did not identify the ephemeral surface water discharge in this wetland's southwest corner. In addition, the WAR does not identify the large portion of Wet Meadow within this wetland.

Wetland F-17 - This wetland's ephemeral surface water discharge to Wetland F-16 was not identified in the WAR.

Wetland F-19 - Water depth in the portion of this wetland adjacent to Deep Hole Lake would be sufficient to require a classification of Deep Marsh. This was not recognized in the WAR.

Wetland F-33 - The WAR did not identify this wetland's ephemeral surface water discharge to the north during high water conditions. It is not an isolated wetland and could be included in the water balance study.

Wetland F-60 - The WAR lists this wetland's inlet as originating in F-68. There is no F-68 wetland.

Wetland F-62 - This wetland is listed as a zero summer discharge, however, it has been observed flowing during and after rainy periods.

Wetland F-70 - Our investigation of this wetland resulted in a classification of Shallow Marsh. The WAR classified the wetland as Wooded Swamp.

Wetland F-72 - The WAR did not identify this wetland's ephermal surface water discharge to Wetland F-60.

Wetland F-81 - This small pond intermittently drains south across the road via a steel pipe. This surface discharge was not identified in the WAR.

Wetland F-114 - The WAR did not identify this wetland's ephemeral surface water discharge to the southwest.

Wetland F-119 - We identified a portion of this wetland as Shallow Marsh in addition to the WAR classification of Wooded Swamp.

Wetland H-1 - The WAR did not identify this wetland's ephemeral surface water discharge to the east.

Wetland K-4 - We classified this wetland as Shallow Marsh, while the WAR made the classification of Shrub Swamp.

Wetland K-5 - The WAR did not identify this wetland's ephemeral surface water discharge to the northeast.

Wetland M-4 - The WAR did not identify this wetland's ephemeral surface water discharge to the north.

Wetland R-7 - The WAR did not identify this wetland's ephemeral surface water inlet across the road to the north from Wetland R-7A.

Wetland R-8 - THE WAR did not identify this wetland's ephemeral surface water outlet to Wetland R-7A.

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EXXON MINERALS COMPANY

POST OFFICE BOX 813 • RHINELANDER, WISCONSIN 54501

November 11, 1983

Responses to DNR Comments on
the Mining Permit Application

Mr. Gordon H. Reinke
Chief, Mine Reclamation Section
Wisconsin Department of Natural Resources
GEF II
P.O. Box 7921
Madison, WI 53707

Dear Mr. Reinke:

Enclosed are responses to DNR Comments contained in your letter dated October 10, 1983, on the Mining Permit Application. These responses also address the general comments on this permit application that were included in your letter of September 19, 1983. This submittal includes 44 copies of the responses and 24 copies of the attachments. Some of the attachments are the same as those included in our responses to DNR comments on Chapter 1.0 of the EIR; however, rather than reference these we have duplicated them in order to maintain a complete separate response package.

Pertinent information contained in these responses will be integrated into the revised Mining Permit Application following review and approval by the DNR on these responses. In some of our responses we have indicated that further discussion with the DNR will be necessary before reaching final resolution on the specific point in question. We will be making arrangements with you to discuss our responses to these particular comments in the near future.

By way of this letter, I am transmitting one copy of these responses and attachments to Mr. Terry McKnight, Environmental Impact Coordinator, North Central District Office of the DNR in Rhinelander.

If you have questions regarding this submittal, please contact me.

Very truly yours,

EXXON MINERALS COMPANY

B J Hansen

Barry J. Hansen
Permitting Manager

BJH:HSL:sjq

Attachments

xc: w/attachments
Mr. T. C. McKnight

Comment No. 1

Section A, Item 7 - This description of the mining site is inadequate. A breakdown of the site in a manner similar to that in Table A-8 would be more appropriate. What is the actual acreage to be covered by the mining permit?

Response:

The legal description of the mine site will be revised into a tabular summary (attached) similar to Table A-8. The actual area covered by the mining permit is 1607 ha (3971 acres) as defined in Chapter 1, subsection 1.1.2 of the EIR.

Comment No. 2

Section A, Item 8 - The description and table regarding land ownership should identify the State of Wisconsin as the owner of the lake beds in the area. Table A-8 states that a portion of Section 20, T35N, R13E is owned by Everett Rudlof but Figure A-8 shows Ernest Rudlof as the owner. Also, the table shows Gerald Solpers as an owner in Section 33, T35N, R13E, but the map shows Gerald Solper.

Response:

The tabluation of property ownership within the boundary of the Crandon Project has been revised to reflect the State of Wisconsin as owner of the lake beds (see attached Table A-8).

The land in Section 20, T35N, R13E, is owned by Everette E. Rudloff as shown in Table A-8. Figure A-8 will be revised to reflect the correct spelling.

The map will also be revised to show the correct spelling as "Gerald Solpers."

Comment No. 3

Table A-8, Page 5 of 5 - As of February 23, 1982, all pipeline easements were not yet recorded at the Forest County Register of Deeds Office. Please indicate which easements have not been finalized and/or recorded.

Response:

As of October 20, 1983, all pipeline easements have been recorded with the Forest County Register of Deeds.

Comment No. 4

Section A, Item 9 - Table A-9 should be amended pursuant to the comments made regarding Table 1.1-2 of Exxon's EIR. Also, Table A-9 indicates that an operating license for the MWDF is required prior to construction. In actuality, this license will not be issued until after the facility has been constructed.

(TABLE FOR RESPONSE TO COMMENT NO. 1)

PROPERTIES OWNED, UNDER OPTION, OR LEASED BY EXXON MINERALS COMPANY WITHIN THE CRANDON PROJECT BOUNDARY

Location	Description	Purpose
T35N-R13E:		
Town of Lincoln:		
Section 19:	Portion of NW NW	Access Road ROW
	Portion of SW NW	Access Road ROW
	Westerly 600 feet of SW 1/4	Access Road ROW
Section 20:	Portion of NE NE	Railroad ROW
	Portion of E 1/2 NW NE	Railroad ROW
	Portion of W 1/2 NW NE, NE NW	Railroad ROW
	Portion of W 1/2 SW NW, SE NW	Railroad ROW
	E 1/2 W 1/2 SW - 100 feet Easement	Railroad ROW
Section 28:	SW SW	Tailings/Buffer Zone
Section 29:	Entire Section	Tailings/Buffer Zone

(TABLE FOR RESPONSE TO COMMENT NO. 1 CONTINUED)

Location	Description	Purpose
T35N-R13E:		
Town of Lincoln:		
Section 30:	NE, NE NW	Mine and Mill Complex/ Buffer Zone
	NW NW, S 1/2 NW, S 1/2	Mine and Mill Complex/ Buffer Zone
Town of Nashville:		
Section 31:	N 1/2 N 1/2	Mine and Mill Complex/ Buffer Zone
	SE NE, E 1/2 SE	Tailings/Buffer Zone
Town of Lincoln:		
Section 32:	Entire Section	Tailings/Buffer Zone
Section 33:	NW NW	Tailings/Buffer Zone
	SW NW, NW SW	Tailings/Buffer Zone
	SW SW	Tailings/Buffer Zone
	SE SW	Tailings/Buffer Zone
T35N-R12E:		
Town of Nashville:		
Section 23:	Portion of NE 1/4	Access Road ROW

(TABLE FOR RESPONSE TO COMMENT NO. 1 CONTINUED)

Location	Description	Purpose
T35N-R12E:		
Town of Nashville:		
Section 24:	NE NE, W 1/2 NE, NW, NE SW, SE	Access Road ROW
	Portion of SE NE	Access Road ROW
Section 25:	E 1/2 NE, SE	Mine and Mill Complex/ Buffer Zone
Section 36:	NE 1/4, less tract owned by Adeline Vollmar R. 1, Crandon, WI 54520, and lakelot properties, NW 1/4, E 1/2 SW 1/4	Mine and Mill Complex/ Buffer Zone
T34N-R13E:		
Town of Nashville:		
Section 4:	NW 1/4	Tailings/Buffer Zone
Section 5:	Entire Section	Tailings/Buffer Zone
Additionally	All Town Roads in the Town of Nashville in the following sections are covered by a Mining Lease: T35N-R13E: Section 31 T35N-R12E: Sections 25 and 36 T34N-R13E: Sections 4 and 5	

Location	Description	Purpose
Pipeline Easements:		
T35N-R12E:		
Town of Nashville:		
Section 25:	Portion of NE SE, SE SE, SW SE, (also included in Project boundary description)	Water Pipeline Easement, 50 foot
Section 36:	Portion of N 1/2 NE (also included in Project boundary description)	Water Pipeline Easement, 50 foot
Section 36:	Portion of N 1/2 NW (also included in Project boundary description)	Water Pipeline Easement, 50 foot
Section 35:	Portion of NE NE	Water Pipeline Easement, 50 foot
	Portions of SE NE and SE NW	Water Pipeline Easement, 50 foot
	Portion of NE SW	Water Pipeline Easement, 50 foot
	Portion of NW SE	Water Pipeline Easement, 75 foot
Section 34:	Portion of NE NE	Water Pipeline Easement, 75 foot
	Portions of S 1/2 NE, NW NE,	Water Pipeline Easement, 75 foot
	Portions of Government Lot 4,	Water Pipeline Easement, 10-50 foot
	Portion of SW NW	Water Pipeline Easement, 25 foot

Location	Description	Purpose
Pipeline Easements:		
T35N-R12E:		
Town of Nashville:		
Section 33:	Portion of S 1/2 NE	Water Pipeline Easement, 25 foot
	Portion of SE NW	Water Pipeline Easement, 50 foot
	Portion of N 1/2 SW	Water Pipeline Easement, 50 foot
Section 32:	Portion of NE SE	Water Pipeline Easement, 50 foot
	Portions of NW SE, NE SW, SE NW Portions of E 1/2 NW	Water Pipeline Easement, 50 foot

(TABLE FOR RESPONSE TO COMMENT NO. 2)

TABLE A-8

PROPERTIES OWNED, UNDER OPTION, OR LEASED BY EXXON MINERALS COMPANY WITHIN THE CRANDON PROJECT BOUNDARY

Location	Description	Owner
T35N-R13E:		
Town of Lincoln:		
Section 19:	Portion of NW NW - Optioned for 200 feet Roadway ROW	S. N. Moe, et ux 1129 Primrose Court Neenah, WI 54956
	Portion of SW NW - Optioned for 200 feet Roadway ROW	Adah S. Paul Lake Shore Drive Crandon, WI 54520
	Westerly 600 feet of SW 1/4 - Optioned for 200 feet Roadway ROW	John B. Hess RFD 1 Laona, WI 54541
Section 20:	Portion of NE NE - Optioned for Railroad ROW	Leo Zelechowski, et ux R. R. 1, Box 175 Crandon, WI 54520
	Portion of E 1/2 NW NE - Optioned for Railroad ROW	Delmar Pennington, et ux R. R. 3, Box 309 Elkhorn, WI 53121
	Portion of W 1/2 NW NE, NE NW - Optioned for Railroad ROW	Everette Rudloff, et ux R. R. 1 Crandon, WI 54520
	Portion of W 1/2 SW NW, SE NW - Optioned for Railroad ROW	Wallace C. Bradley, et al 204 W. Grant St. Crandon, WI 54520
	E 1/2 W 1/2 SW - 100 feet Easement - Location to be selected	American Can Co P.O. Box 790 Green Bay, WI 54305
Section 28:	SW SW - Option for Purchase	Forest County c/o Forest County Clerk, Court House Crandon, WI 54520
Section 29:	Entire Section	Forest County Crandon, WI 54520

Location	Description	Owner
T35N-R13E:		
Town of Lincoln:		
Section 30:	NE, NE NW - As SW SW of 28	Forest County Crandon, WI 54520
	NW NW, S 1/2 NW, S 1/2	Exxon Corporation 1251 Avenue of the Americas New York, N.Y. 10020
Town of Nashville:		
Section 31:	N 1/2 N 1/2	Exxon Corporation New York, N.Y. 10020
	SE NE, E 1/2 SE - Option to Purchase	Virgil W. Moore 4 Patricia Lane Prospect Heights, Illinois 60070
Town of Lincoln:		
Section 32:	Entire Section	Exxon Corporation New York, N.Y. 10020
Section 33:	NW NW - Option to Purchase	Virgil Richter 450 Lincoln Drive Apt. 120 Twin Lakes, WI 53181
	SW NW, NW SW - Mining Lease	Gerald K. Solpers 1427 Polier Street Green Bay, WI 54301
	SW SW - Option to Purchase	J. Smits 818 Virginia Dr. DePere, WI 54115
	SE SW - Option to Purchase	Eugene Baeten R. 2 Green Bay, WI 54301
T35N-R12E:		
Town of Nashville:		
Section 23:	Portion of NE 1/4 - Optioned for 200 feet Road ROW	Thomas A. Mihalko, et ux R. 1 Crandon, WI 54520

Location	Description	Owner
T35N-R12E:		
Town of Nashville:		
Section 24:	NE NE, W 1/2 NE, NW, NE SW, SE - Optioned for 200 feet Road ROW	Mihalko Land and Logging Co., Inc. R. 1 Crandon, WI 54520
	Portion of SE NE - Optioned for 200 feet Road ROW	S. N. Moe, et ux 1129 Primrose Court Neenah, WI 54956
Section 25:	E 1/2 NE, SE	Exxon Corporation New York, N.Y. 10020
Section 36:	NE 1/4, less tract owned by Adeline Vollmar R. 1, Crandon, WI 54520, and lakelot properties, NW 1/4, E 1/2 SW 1/4	Exxon Corporation New York, N.Y. 10020
T34N-R13E:		
Town of Nashville:		
Section 4:	NW 1/4 - Mining Lease	Connor Forest Industries P.O. Box 847 Wausau, WI 54401
Section 5:	Entire Section - Land Exchange Option	Owens-Illinois, Inc. P.O. Box 1035 Toledo, OH 43666
Additionally	All Town Roads in the Town of Nashville in the following sections are covered by a Mining Lease: T35N-R13E: Section 31 T35N-R12E: Sections 25 and 36 T34N-R13E: Sections 4 and 5	

Location	Description	Owner
Pipeline Easements:		
T35N-R12E:		
Town of Nashville:		
Section 25:	Portion of NE SE, SE SE, SW SE, owned for 50 foot Pipeline ROW (also included in Project boundary description)	Exxon Corporation 1251 Avenue of the Americas New York, N.Y. 10020
Section 36:	Portion of N 1/2 NE owned for 50 foot Pipeline ROW (also included in Project boundary description)	Exxon Corporation New York, N.Y. 10020
Section 36:	Portion of N 1/2 NW, owned for 50 foot Pipeline ROW (also included in Project boundary description)	Exxon Corporation New York, N.Y. 10020
Section 35:	Portion of NE NE, owned for 50 foot Pipelne ROW	Exxon Corporation New York, N.Y. 10020
	Portions of SE NE and SE NW, 50 foot Water Pipeline Easement	Mihalko Land and Logging Co. R.F.D. 1 Crandon, WI 54520
	Portion of NE SW, 50 foot Water Pipeline Easement	Tom and Arlene Tambellini R.F.D. 6 Rhinelander, WI 54501
	Portion of NW SE, 75 foot Water Pipeline Easement	Patrick and Susie Phalen, Jr. 3059 Hwy. CC Slinger, WI 53086
Section 34:	Portion of NE NE, 75 foot Water Pipeline Easement	Patrick and Susie Phalen, Jr. Slinger, WI 53086
	Portions of S 1/2 NE, NW NE, 75 foot Water Pipeline Easement	Patrick and Lillian Phalen R.F.D. 1 Crandon, WI 54520
	Portions of Government Lot 4, 10-50 foot Water Pipeline Easement	Hobert R. and Faye M. LeMaster 1711 54 Street Court Moline, IL 61265
	Portion of SW NW, 25 foot Water Pipeline Easement	Robert and Helen Jacobsen R.F.D. 1 Crandon, WI 54520

Location	Description	Owner
Pipeline Easements:		
T35N-R12E:		
Town of Nashville:		
Section 33:	Portion of S 1/2 NE, 25 foot Water Pipeline Easement Portion of SE NW, 50 foot Water Pipeline Easement	Robert and Helen Jacobsen R.F.D. 1 Crandon, WI 54520
	Portion of N 1/2 SW, 50 foot Water Pipeline Easement	David J. and Edward F. Bula R. 1, Box 698 Crandon, WI 54520
Section 32:	Portion of NE SE, 50 foot Water Pipeline Easement	David J. and Edward F. Bula R. 1, Box 698 Crandon, WI 54520
	Portions of NW SE, NE SW, SE NW, Water Pipeline Easement. Portions of E 1/2 NW	John Schallock Flossie Schallock Neil Schallock Alpha Schallock Crandon, WI 54520
Lake Bed Ownership Within Project Area:		
T35N-R13E:		
Town of Lincoln:		
Section 30:	Portion of E 1/2 SE; that portion underlying Skunk Lake	State of Wisconsin
Section 32:	Portion of W 1/2 SW: that portion underlying Duck Lake	State of Wisconsin
Town of Nashville:		
Section 31:	Portion of E 1/2 SE; that portion underlying Duck Lake	State of Wisconsin

Response:

Table A-9 (attached) has been amended pursuant to the DNR's comments on Table 1.1-2 of the EIR. This table contains a supplemental list of potential federal permits required to begin construction. Also, actions by the Wisconsin Department of Industry, Labor and Human Relations are included.

Many federal programs that would otherwise be applicable are administered by the state. It is assumed that the state will remain or become qualified to administer the following federal programs: National Pollution Discharge Elimination System; Resource Conservation and Recovery Act Solid Waste Disposal programs; Clean Air Act - non-PSD aspects; and Safe Drinking Water Act.

We acknowledge the comment that an operating license for the MWDF is not required prior to construction and that this license would not be issued until after the facility has been constructed. Table A-9 has been revised accordingly.

Comment No. 5

Section A, Item 12 - Unless Exxon can definitively demonstrate an alternate use for the access road, reclamation costs for the road should be included. The reclamation costs presented in Table A-12 must be further itemized and broken down to unit costs. If these are not available, a discussion of how the costs were derived should be included.

Response:

Some of the land agreements associated with the access road right-of-way allow the adjacent landowner the use of the access road. Undoubtedly, over the Project life, some use of the access road will have been established by an adjacent landowner, thereby precluding reclamation of the access road by Exxon Minerals Company.

However, for completeness in presenting total potential reclamation costs the access road has been included. For this estimate the reclamation planned for the access road includes removing the pavement and stone base, performing minor regrading, and establishing vegetation in the disturbed areas. Removal of the Swamp Creek crossing structure is also included.

The following data reflect total estimated Project reclamation costs with the access road included. The attached table and supporting cost data for the reclamation of the various facilities or facility groups include the breakdown used in estimating the total cost.

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
FEDERAL			
33 U.S.C. 1344	U.S. Army Corps of Engineers	Dredge or fill permits for activities in or impacting navigable streams or wetlands	Permit issuance
30 U.S.C. 801 et seq	Dept. of Labor-Mine Safety & Health Administration	File legal identity report	
42 U.S.C. 300 h et seq	EPA	Possible well injection of ground water, placement of backfill sands below ground water aquifer.	Issue Class V permit
33 U.S.C. 1321	EPA	Spill prevention control counter measure plan (40 CFR 112.7)	Have plan on file and before operations begin
49 U.S.C. 1348	FAA	Registration with FAA of a structure that will exceed 200 feet above ground level	Determine that head-frame is not an air navigational obstruction
16 U.S.C. 470F	Advisory Counsel on Historic Preservation	Monitors actions of federal government which may involve sites having buildings, structures, or objects eligible for inclusion in the National Register	Coordinate with U.S. Army Corps of Engineers

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
18 U.S.C. 843	Bureau of Alcohol, Tobacco and Firearms	Explosives user permit	Permit issuance

Many federal programs that would otherwise be applicable are administered by the state. It is assumed that the state will remain or become qualified to administer the following federal programs: National Pollution Discharge Elimination System; Resource Conservation and Recovery Act Solid Waste Disposal programs; Clean Air Act -- non-PSD aspects; and Safe Drinking Water Act.

STATE

Wis. Stat. 23.11	DNR	EIR submittal	Determine adequacy
Wis. Stat. 30.12	DNR	Placement of structures	Permit issuance
Wis. Stat. 30.12	DNR	Placement of riprap	Permit issuance
Wis. Stat. 144.855(2)	DNR	Diversion of surface water	Permit issuance
Wis. Stat. 30.19(1)(c)	DNR	Grading of banks	Permit issuance
Wis. Stat. 30.20 (1)	DNR	Dredging	Permit issuance
Wis. Stat. 31.23	DNR	Bridges	Permit issuance
Wis. Stat. 86.07	Dept. of Transportation	Permit to connect mine access road to State Highway 55 and to run water discharge pipeline underneath Highway 55	Permit issuance

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
Wis. Stat. 28.11(11)	DNR - Forest County	Withdrawal of land within project site boundary from County forest status	Approval of withdrawal application filed on December 2, 1980 with DNR
Wis. Stat. 101.15	DILHR	Mine shaft sinking, hoisting and ventilation of underground workings	Review mining activities and issue all applicable permits (see letters dated May 3, 1983 and August 30, 1983 between DILHR and Exxon for a more specific listing of required approvals
Wis. Stat. 101.12	DILHR	Surface building plans, blasting procedures	Review and approve applicable construction procedures and building plans and issue applicable permits
Wis. Stat. 145.02	DILHR	Plumbing and fire protection	Review and approve plans and issue applicable permits
Wis. Stat. 145.025(2)(e)	DNR	High capacity wells	Permit issuance
Wis. Stat. 144.04	DNR	Waste water treatment system	Plan approval

PERMITS REQUIRED TO BEGIN CONSTRUCTION OF THE CRANDON PROJECT

Statutory Obligation	Administering Agency	Activity	Action
Wis. Stat. 145.19, 145.20, 147.02	DILHR, Forest County, and DNR	Private sewage system	Permit issuance (county) and review and approve final plans (DILHR, DNR)
Wis. Stat. 144.392, 144.391	DNR	Air emission	Permit issuance
Wis. Stat. 144.44, 144.46	DNR	Mine Waste Feasibility Report, Plan of Operation	Approval
Wis. Stat. 144.85	DNR	Mining	Permit issuance
Wis. Stat. 59.971	Forest County, DNR	Placement of mining structures in shoreland/ wetland zoning districts	Adopt Shoreland zoning ordinances in accordance with NR115; approve the placement of such structures in the zoning districts
Wis. Stat. Chap. 147	DNR	Water discharge	Permit issuance
Wis. Stat. Chap. 162	DNR	Potable water supply	Review and approve final plans

LOCAL

The Town of Lincoln has a zoning ordinance. It is expected that the Town of Nashville will have an ordinance relating to mining.

(TABLE FOR RESPONSE TO COMMENT NO. 5)

TOTAL ESTIMATED RECLAMATION COSTS FOR THE CRANDON PROJECT
IN 1982 DOLLARS

Facility or Facility Group	Reclamation Year(s)*	Cost (K$)
Access Road	37	$350
Railroad Spur	37	500
Haul Road and Tailings Transport Corridor	35	100
Mine/Mill Site Area	33-37	8,000
Mine Waste Disposal Facility		
Tailings Pond T1	11	4,000
Tailings Pond T2 (Partial)	16	2,000
Tailings Pond T3	25	5,000
Tailings Pond T4 and T2	33-35	10,000
Reclaim Ponds R1 and R2	33-35	1,000
Excess Water Discharge System	35	10
Mine	33	300
TOTAL PROJECT RECLAMATION COST		$31,260

*Start of Project construction in year 1.

(SUPPORTING DATA FOR RESPONSE TO COMMENT NO. 5)

Access Road	Cost (K$)
Remove bituminous concrete pavement 45,000 yd^2 @ $2/$yd^2$	$90
Remove crushed aggregate base course 35,000 yd^3 @ $2/$yd^3$	70
Regrading 100,000 yd^2 @ $0.5/$yd^2$	50
Vegetation (seed and fertilizer) 100,000 yd^2 @ $0.5/$yd^2$	50
Remove Swamp Creek Crossing Structure	50
Contingency	40
TOTAL ESTIMATED RECLAMATION COST	$350

RECLAMATION COSTS

Railroad Spur

(Salvage value not included)

Remove track and ties 28,000 ft @ $10/ft	$280
Remove ballast and subballast 50,000 yd^3 @ $2/$yd^3$	100
Regrading 80,000 yd^2 @ $0.5/$yd^2$	40
Vegetation (seed and fertilizer) 80,000 yd^2 @ $0.5/$yd^2$	40
Remove Swamp Creek Crossing Structure	10
Contingency	30
TOTAL ESTIMATED RECLAMATION COST (with no salvage value included)	$500

RECLAMATION COSTS	Cost(k$)
Rock Haul Road and Tailings Transport Corridor	
Buried Pipe Removal	
Excavation - 5,000 yd^3 @ \$2/yd^3	10
Pipe Removal - 10,000 ft @ \$2/ft	20
Backfill and Cover with 0.5 Foot Soil	
10,000 yd^3 @ \$3/yd^3	30
Regrading	
30,000 yd^2 @ \$0.5/yd^2	15
Vegetation (seed and fertilizer)	
30,000 yd^2 @ \$0.5/yd^2	15
Contingency	10
TOTAL ESTIMATED RECLAMATION COST	\$100

(SUPPORTING DATA FOR RESPONSE TO COMMENT NO. 5 CONTINUED)

RECLAMATION COSTS	Cost (K$)
Mine/Mill Site Area	
Building Demolition	
25,000,000 ft^3 @ \$0.10/ft^3	\$2,500.0
Pavement Removal (asphalt and concrete)	
100,000 yd^2 @ \$5.00/yd^2	500.0
Foundations/Slabs Removal	
25,000 yd^3 @ \$60/yd^3	1,500.0
Pipe Removal	
40,000 ft @ \$5.00/ft	200.0
Railroad Track and Tie Removal	
10,000 ft @ \$10.00/ft	100.0
Site Regrading and Topsoil Replacement	
280,000 yd^3 @ \$3.00/yd^3	840.0
Turf Establishment	
100 acres @ \$2000/acre	200.0
Contingency	2,160.0
TOTAL ESTIMATED RECLAMATION COST	\$ 8,000.0

RECLAMATION COSTS

Mine Waste Disposal Facility

Tailings Pond T1 (Construction Phase 3)	Cost (K$)
Grading Cover	
714,000 m^3 @ \$1.38/m^3	\$ 984.3
Bentonite Cap	
50,000 m^3 @ \$20.69/m^3	1034.4
Overdrain	
66,000 m^3 @ \$10.29/m^3	679.4
Cover Layer	
304,000 m^3 @ \$1.76/m^3	534.0
Turf Establishment	
53 ha @ \$2900/ha	153.7
Contingency	614.2
Subtotal	\$4000.0

Tailings Pond T2 (Partial Reclamation) (Construction Phase 4)	
Grading Cover	
1,132,000 m^3 @ \$1.42/m^3	\$1601.9
Turf Establishment (Partial)	
15 ha @ \$2900/ha	43.5
Contingency	354.6
Subtotal	\$2000.0

Tailings Pond T3 (Construction Phase 5)	Cost (K$)
Grading Cover	
928,000 m^3 @ \$1.53/m^3	\$1424.1
Bentonite Cap	
59,000 m^3 @ \$21.43/m^3	1264.4
Overdrain	
79,000 m^3 @ \$10.20/m^3	805.6
Cover Layer	
360,000 m^3 @ \$1.84/m^3	662.0
Turf Establishment	
55.5 ha @ \$2900/ha	161.9
Contingency	682.0
Subtotal	\$5000.0

Tailings Pond T2 and remaining T2 reclamation (Construction Phase 6)	
Grading Cover	
1,071,000 m^3 @ \$1.55/m^3	\$1655.3
Bentonite Cap	
173,000 m^3 @ \$20.09/m^3	3475.8
Overdrain	
230,000 m^3 @ \$10.24/m^3	2354.2
Cover Layer	
1,053,000 m^3 @ \$1.50/m^3	1584.0
Turf Establishment (Partial)	
141.5 ha @ \$2900/ha	410.4
Contingency	520.3
Subtotal	\$10,000.0

Reclaim Ponds R1 and R2	Cost (K$)
Regrading	
402,000 m^3 @ \$1.29/m^3	518.2
Turf Establishment	
30.0 ha @ \$2900/ha	87.0
Contingency	394.8
Sub Total	\$ 1,000.0
TOTAL ESTIMATED MWDF AND RECLAIM POND RECLAMATION COST	\$22,000.0

Reclamation Costs

Excess Water Discharge System

Concrete plugs at pipe ends, remove discharge structure and riprap, regrade disturbed areas Turf establishment as necessary	
TOTAL ESTIMATED RECLAMATION COST	\$ 10.0

Reclamation Costs

Mine

Concrete plugs for the four shafts at overburden/bedrock interface, backfill to surface	
TOTAL ESTIMATED RECLAMATION COST	\$ 300.0
GRAND TOTAL ESTIMATED RECLAMATION COST	\$31,260.0

Comment No. 6

Section A, Item 13 - Table A-13 states that one of the owners in Section 33, T35N, R13E is John Campshure but Figure A-8 shows John Campshire.

Response:

The correct spelling of the landowner in Section 33, T35N, R13E, is John Campshure. Figure A-8 will be revised to the correct spelling.

Comment No. 7

Section A, Item 14 - Are the Wetlands Assessment Report and Inventory considered part of this permit application? If not, maps should be provided to show the proposed site and the potentially affected wetlands. If the reports are part of the application, they should be attached.

Response:

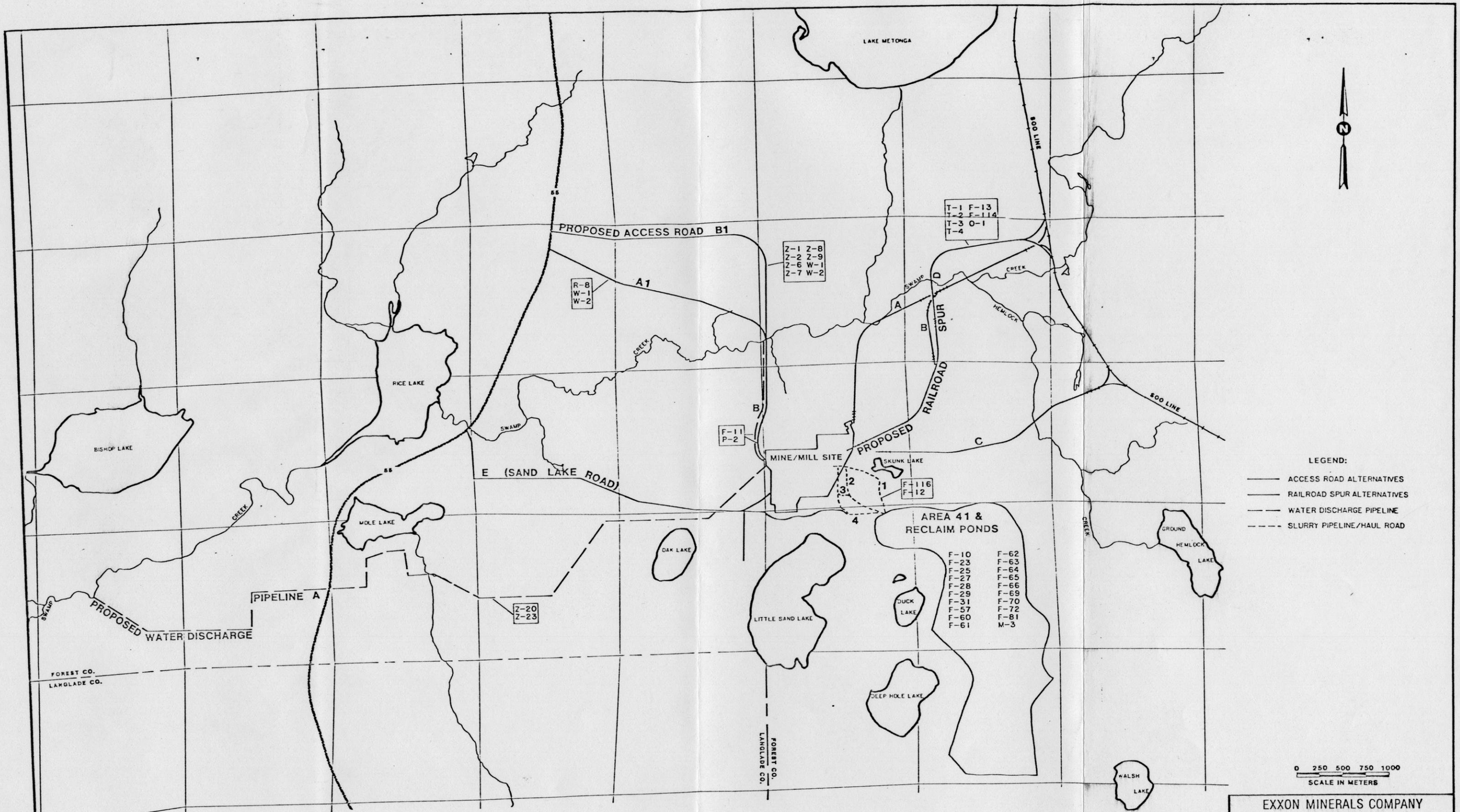
The Wetland Assessment Reports dated August 1982 and August 1983 are not considered part of the Mining Permit Application. Figures 1 through 8 (attached) will be included in the revised Section A, Item 14 of the Mining Permit Application to show wetlands that could potentially be affected by proposed or alternative Project facilities.

Comment No. 8

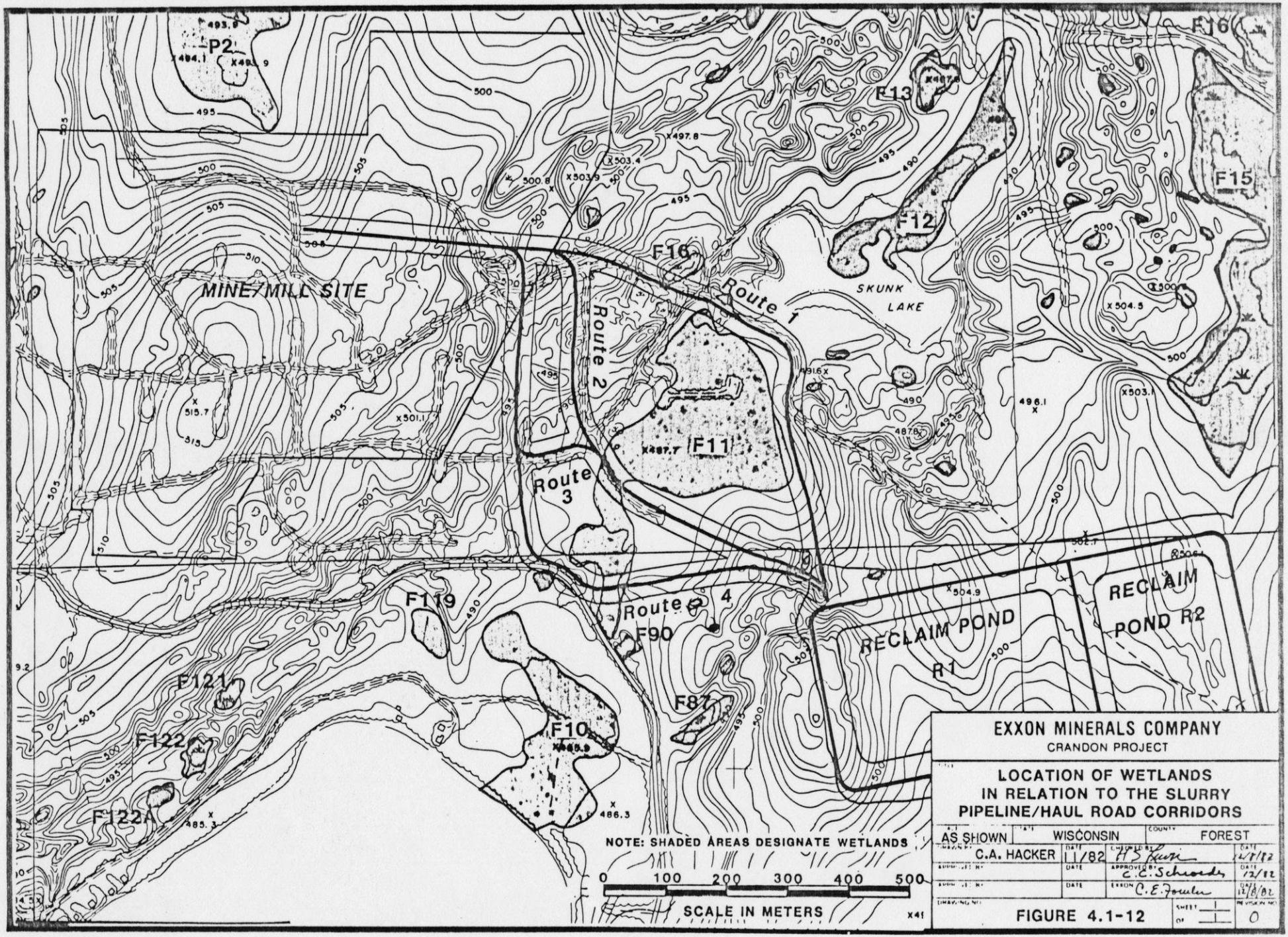
Contrary to what is stated in the application, since area 41 is hydrologically upgradient of area 40, then area 41 has to have as much, if not more, downgradient domestic use of groundwater.

Response:

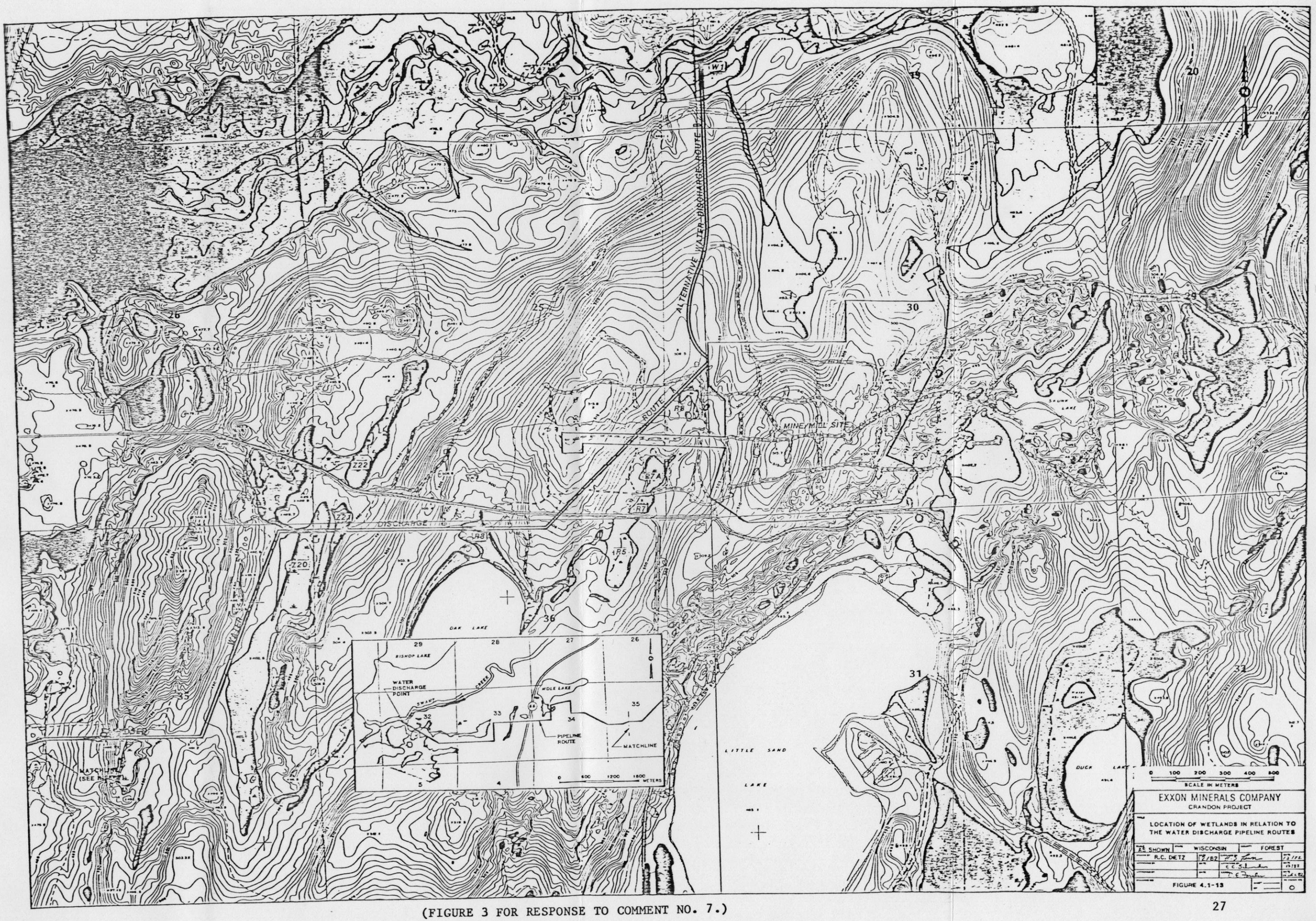
The Mine Permit Application is correct as stated. Area 41 is a recharge area with ground water flow both to the southwest and to the eastern section of the site (i.e., northeast and southeast). Approximately half of this ground water flow is in a direction (i.e., easterly) where there is no major domestic use of ground water. Additionally, a large portion of this area is county or private forest land, and therefore, is not currently available for major domestic use of ground water. Area 40 has its total ground water flow to the south-southwest of the site, so that all of the ground water which goes through this area is available for domestic use. These gradients can be seen in EIR Section 2.3, Figure 2.3-4.



(FIGURE 1 FOR RESPONSE TO COMMENT NO. 7.)



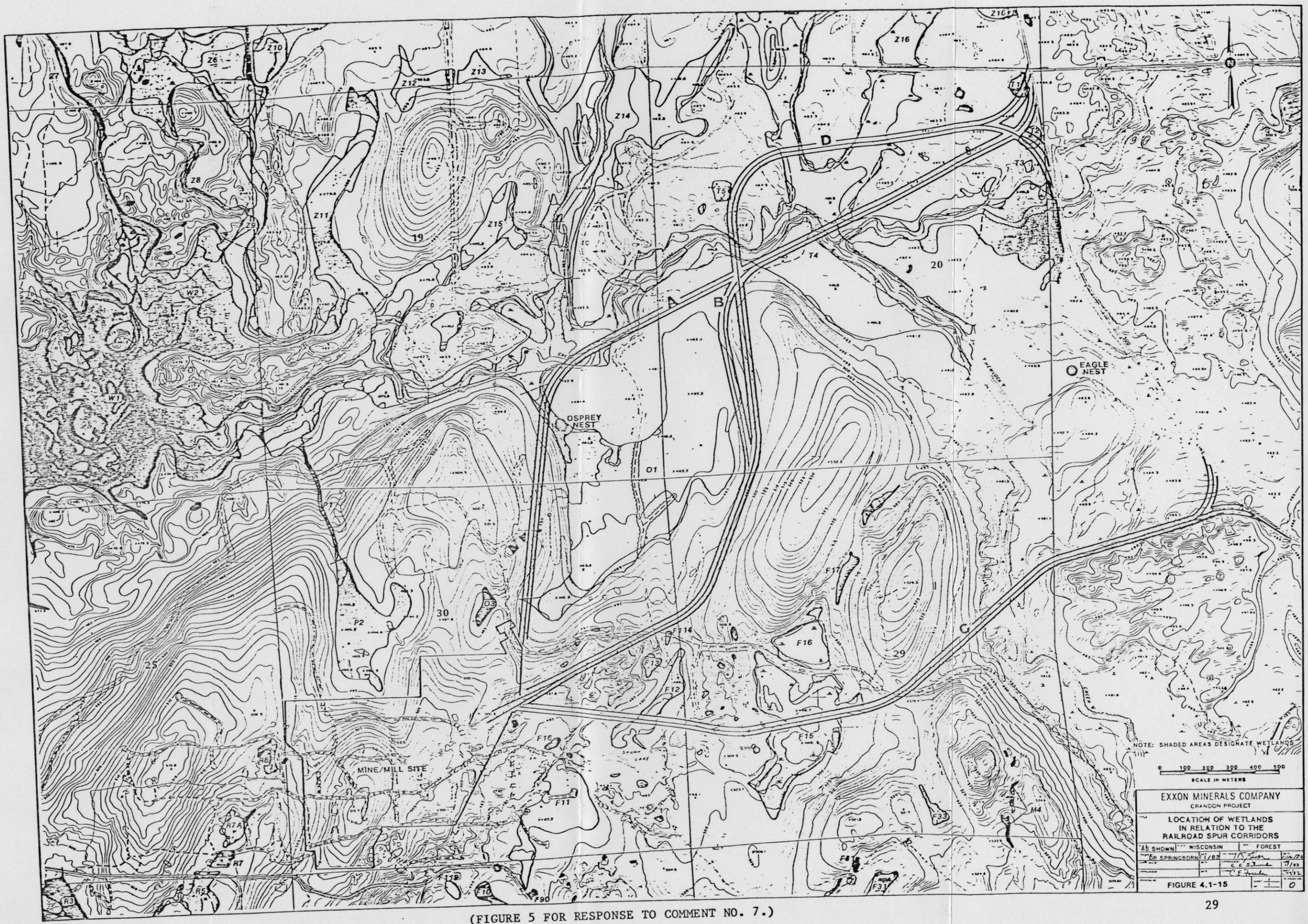
(FIGURE 2 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 3 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 4 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 5 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 6 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 7 FOR RESPONSE TO COMMENT NO. 7.)



(FIGURE 8 FOR RESPONSE TO COMMENT NO. 7.)

SECTION A, ITEM 15

Comment No. 9

Groundwater - The monitoring requirements related specifically to the MWDF will be finalized through the Feasibility Report review and the Plan of Operation approval. These requirements will have to be included in the mining permit application once they have been established. Following are some preliminary comments pertaining to the proposed groundwater monitoring program.

Response:

Comment acknowledged and the monitoring requirements for the MWDF will be included in the revised Mining Permit Application when they have been finalized through the DNR's Feasibility Report review and Plan of Operation approval.

Comment No. 10

The proposed background and operational groundwater monitoring program as shown in Figure 1 is inadequate. More wells north of the mine/mill site and also around Little Sand Lake should be included. Also, more wells will be needed around the mine waste disposal facility in all directions and at variable depths.

Response

The details of the ground water monitoring program will be resolved through discussions with appropriate DNR staff. This resultant monitoring program will be included in the Monitoring and Quality Assurance Plan as part of the Mining Permit Application when it is finalized.

Comment No. 11

Pursuant to s. NR 182.075(1)(d)5, the parameters to be analyzed in the background ground water monitoring program for the MWDF must include all parameters with a primary or secondary drinking water standard. The list of parameters indicated on Table 1 does not include all of the secondary parameters.

Response:

NR 182.075(1)(d)5 is related to the ground water standards and the need to collect monitoring data "for at least 12 consecutive months prior to disposing of waste at the site to determine baseline water quality." The Monitoring and Quality Assurance Plan was submitted to fulfill the requirements of NR 132.06(3)(d) of the mine permit which requests submittal of a "...proposed monitoring...plan..." consistent with NR 182 and that this proposed plan would be considered at the s.144.836, Stats., hearing. NR 182.08(2)(e) 8 requires submittal of a monitoring program "...developed for...determining whether the proposed facilities meet all environmental standards." Further, the monitoring "Program design...should be based on ... quality and quantity of waste materials...".

Therefore, the proposed Monitoring and Quality Assurance Plan was designed to evaluate the MWDF's performance related to meeting the ground water standards. Several of the primary and secondary drinking water standards have no relation to the MWDF contents. For example, the MWDF will not contain organic chemicals such as endrin, lindane, and 2,4,5-TP Silvex. Similarly, foaming agents, color and odor are more directly applicable to wells and monitoring programs for community or public water supplies. Therefore, these parameters were not proposed for monitoring.

To estimate any organic compounds which might be found in the ground water from whatever source, total organic carbon (TOC) was proposed for the program. If for some unknown reason TOC concentrations measured are indicative of organic chemicals, more specific determinations could be completed from analyses at that time. Corrosivity is calculated from the Langelier Index. All parameters used to calculate this index are included in the monitoring program.

Comment No. 12

A monitoring plan should also include the backfill storage area.

Response:

A reappraisal of the mine plan and the stope development sequence has indicated that there is no longer a need to provide large volume surge storage capacity for backfill sands. As a result, this facility has been eliminated and all backfill material handling will be totally within the confines of the concentrator building.

It is now the intention to utilize the area previously designated for storage of backfill sands as an area for storage of preproduction ore. Prior to mill start-up, a maximum of 1,000,000 t (1,120,000 short tons) of uncrushed ore will be accumulated in the storage area. This material will be fully consumed during the early years of mill operation.

Comment No. 13

Oak Lake should be added to the list of surface waters to be sampled quarterly. The parameters to be analyzed in Oak Lake should correspond to the list in Footnote 3, Table 3.

Response:

The monitoring plan was based on potentially identified effects as warranted by the analyses in Chapter 4, Impacts. As a result, the predictions indicate no effect or impacts to Oak Lake, and the need for monitoring is not believed to be justified.

Comment No. 14

The parameters monitored on Swamp Creek at the proposed discharge location should correspond to the list of pollutants found in Exxon's effluent.

Response:

The parameters monitored in the effluent will be a condition of the WPDES Permit. Parameters monitored as part of the Swamp Creek sampling programs at the proposed discharge location will reflect the list of pollutants identified in the WPDES permit.

Comment No. 15

Suspended solids should be added to the monitoring list in Footnote 3, Table 3.

Response:

Comment acknowledged. Table 3 in the Monitoring and Quality Assurance Plan will be revised accordingly to include suspended solids in the list of parameters to be monitored.

Comment No. 16

Continuous stream flow recording should occur at Hemlock Creek (Station H) and Swamp Creek (Station S -- above Rice Lake). One additional station on Swamp Creek below Rice Lake (either at CTH "M" or in the vicinity of the proposed discharge) should be monitored continuously for stream flow. Quarterly flow monitoring, as proposed by Exxon, at Stations H, S and the proposed discharge location is simply inadequate to address the impacts of mine dewatering on surface water flows.

Response:

Table 3 will be revised to include continuous stream flow monitoring in Hemlock Creek (Station H) and in Swamp Creek at Station S. In addition to these locations, the USGS maintains continuous stream monitoring gages in Swamp Creek at County Trunk Highway M (i.e., downstream of Rice Lake) and at State Highway 55 as part of their statewide stream gaging program. The flow data collected at these locations will be used as part of the monitoring program.

Comment No. 17

Pickerel Creek, Creek 11-4 and Creek 12-9, which are tributaries to Rolling Stone Lake, may be adversely affected by mine dewatering especially during low flow periods. Therefore, these streams should be monitored for flows on a monthly basis from November through May and biweekly from June through October when flows are generally lower.

Response:

Projections developed for the EIR (see Appendix X) indicate that Pickerel Creek, Creek 11-4 and Creek 12-9 are outside the limit of the ground water drawdown zone of influence. Only Creek 12-9 has a small portion at its upper stream section which is within the projected 1 m drawdown contour. This upper stream section has less than 100 m potentially affected. Further, the projected drawdown of 1 m is within the historical ground water level changes for the area. These historical decreases in the ground water

levels have not been identified as having an effect on these creeks and the modeling results support this. Therefore, surface water flow rate monitoring of these creeks is not proposed in the Monitoring and Quality Assurance Plan.

Comment No. 18

Table 3 lists the sampling frequency as quarterly for some parameters and annually for others for sampling locations on Swamp and Hemlock Creeks. How was the sampling interval determined for each of the parameters? Quarterly sampling for all the parameters is recommended.

Response:

The rationale for annual measurement of certain parameters was based on the low probability of those parameters being affected by the Project. We would agree to quarterly analyses of those parameters initially during the Project, with the idea that if we can prove over the first several years of operation that they are not affected, then the monitoring will be reduced to annual.

Comment No. 19

Will Exxon analyze the parameters under footnote 2 on a quarterly basis and those under footnote 3 on an annual basis?

Response:

See response to comment No. 18.

Comment No. 20

Table 3 lists Skunk Lake as a sampling location. However, the site for Skunk Lake is not included in Figure 4. Please clarify.

Response:

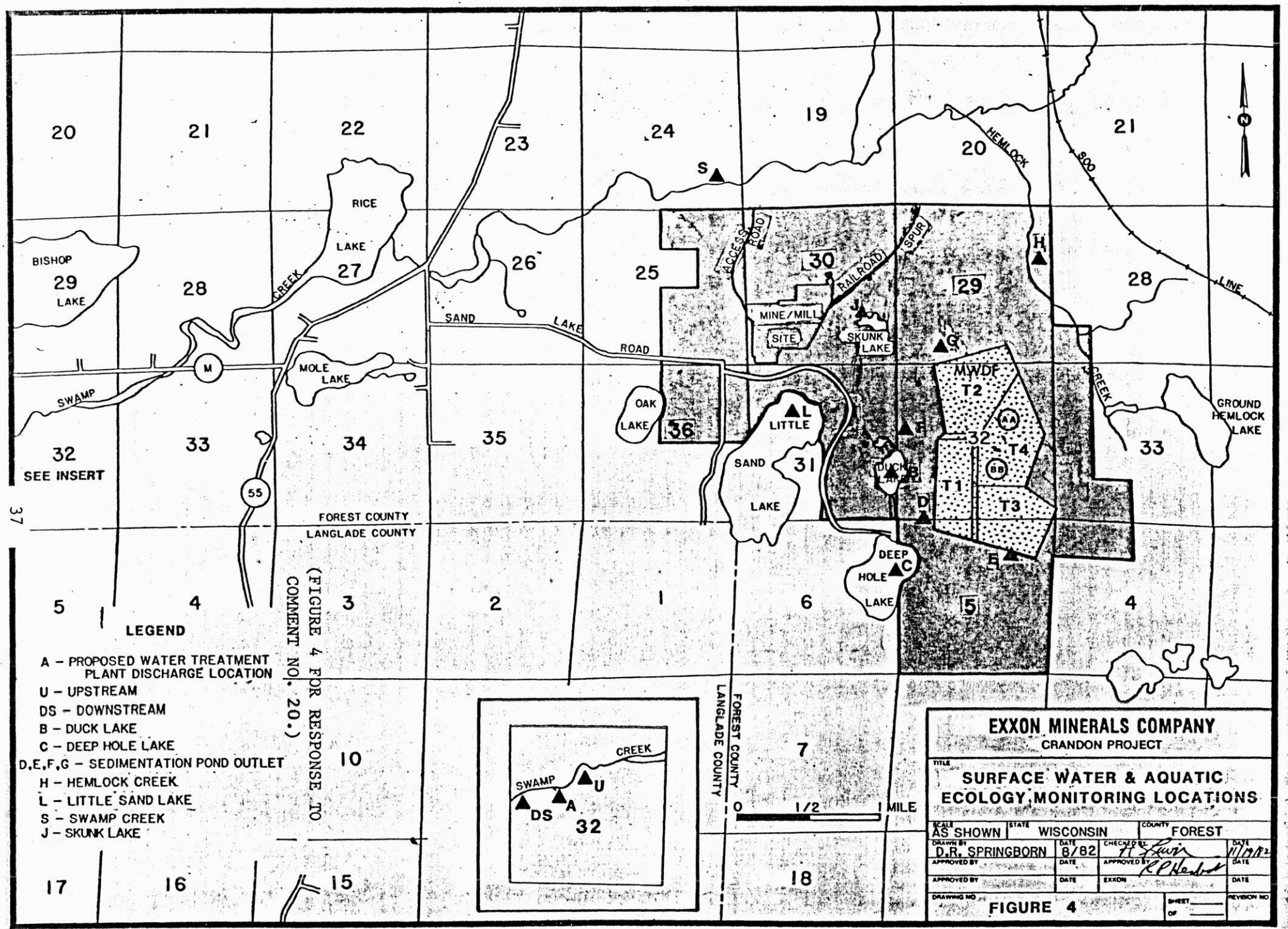
Figure 4 (attached) has been revised to include the location where monitoring will occur in Skunk Lake.

Comment No. 21

Hoffman Springs should be included in the surface water monitoring program.

Response:

Section 3.0, including Figure 4 and Table 3, in the Monitoring and Quality Assurance Plan will be revised to include Hoffman Springs in the surface water monitoring program. Hoffman Springs is located on the perimeter of the 1 m (3.3 feet) drawdown area; however, because it supports a brook trout population downstream in Hoffman Creek, it is considered a more sensitive water body than others in the immediate area. Also, the main source of water for the springs and Hoffman Creek is ground water.



LEGEND

- A – PROPOSED WATER TREATMENT PLANT DISCHARGE LOCATION
- U – UPSTREAM
- DS – DOWNSTREAM
- B – DUCK LAKE
- C – DEEP HOLE LAKE
- D,E,F,G – SEDIMENTATION POND OUTLET
- H – HEMLOCK CREEK
- L – LITTLE SAND LAKE
- S – SWAMP CREEK
- J – SKUNK LAKE

(FIGURE 4 FOR RESPONSE TO COMMENT NO. 20.)

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
SURFACE WATER & AQUATIC ECOLOGY MONITORING LOCATIONS

SCALE	STATE	COUNTY
AS SHOWN	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
D.R. SPRINGBORN	8/82	H.S. Levin	11/10/82
APPROVED BY	DATE	APPROVED BY	DATE
		R.C. Henderson	
APPROVED BY	DATE	EXXON	DATE

DRAWING NO. **FIGURE 4** SHEET ___ OF ___ REVISION NO.

Comment No. 22

Parameter lists do not include suspended solids. This should be monitored especially during the construction period.

Response:

Table 3 will be revised to include suspended solids in the list of parameters to be monitored. Also, see response to comment No. 15.

Comment No. 23

In general, a discussion section summarizing potential problem areas and reasons for selecting sites to monitor the problem areas is needed. More specifically, the following questions and comments should be considered for inclusion in a discussion section covering monitoring rationale:

Response:

A brief rationale for the proposed monitoring program was provided as part of the introductory paragraphs for each major section (i.e., air quality, surface water) of the Monitoring and Quality Assurance Plan. Further discussion is presented below to correspond with specific comments of the DNR.

Comment No. 23a

Why were the particular sites on Swamp and Hemlock Creeks selected for study?

Response:

The particular sampling sites on Swamp and Hemlock creeks were selected because of their location related to baseline data collection, the major input sources of their water (see Figure 4 of the Monitoring and Quality Assurance Plan), and the location of any potentially projected effects of the Project. For example, proposed monitoring location H (i.e., Hemlock Creek) is below its major source of water which is Ground Hemlock Lake. It is also below the projected area along Hemlock Creek where Project facilities (i.e., MWDF) might have an effect. Therefore, this monitoring location will aid in determining what, if any, flow rate variations in Hemlock Creek occur at this location. When compared with historical information (i.e., literature and baseline data collections [see EIR Figures 2.4-1 and 2.4-2]), differences measured can be evaluated to determine what effect, if any, they may have.

A similar rationale was used for establishing monitoring location S (i.e., Swamp Creek) below its major tributaries (Outlet and Hemlock creeks) and the Project proposed access road and railroad spur. In addition, monitoring location S is above a USGS flow rate measuring gage at State Highway 55 which provides a long-term data base for comparative purposes.

Comment No. 23b

Why were only four lakes selected for study? Do these four lakes have the greatest potential for ecological impacts from the mine operation? If not, why weren't other lakes included for study?

Response:

In general these four lakes were selected for the monitoring program because of the potential projected effects of Project facilities. Although none of these lakes are projected to have ecological impacts from the mine operation, they are the closest surface water ecosystems to other Project facilities (i.e., railroad spur, MWDF) which may have a potential effect for which to monitor. That is the reason no other lakes were proposed for monitoring.

In addition, the parameters selected for monitoring measurements were chosen with the intent of determining any changes which occur, as soon as possible. Therefore, the designed monitoring program parameters emphasized physical-chemical parameters, many of which can give instantaneous indications of change (i.e., pH, specific conductance, copper). Biological parameters, such as chlorophyll-a, often provide data which are difficult to interpret and require a longer time-frame for analysis and evaluation (i.e., seasonal, yearly). Further, the biological community has inherent response mechanisms which are contradictory. For example, some populations have development patterns (i.e., spring "blooms") which may be totally unrelated to any short-term environmental change. In other cases, biological populations or communities may require decades to exhibit detectable differences related to environmental change. Therefore, biological parameters were considered secondary to physical-chemical parameters for monitoring changes related to Project activities. Biological parameters for monitoring can be selected after a physical-chemical parameter indicates such a need.

Comment No. 23c

Are the lakes to be sampled at different depths?

Response:

Yes, depending upon the parameter and sampling frequency. For example, quarterly sampling for such parameters as pH, temperature and specific conductance would be completed at different depths (i.e., through a "water column" from the surface to the basin). However, sampled parameters such as arsenic, cadmium, copper and selenium would be completed from a composite sample of different depths. Where lakes are sampled with a shallow basin (i.e., Skunk Lake), a single sample would be collected from mid-depth or 1 m (3.3 feet), whichever is deeper from the water surface.

Comment No. 23d

Productivity indicators like chlorophyll-a, total-P and secchi disc should be included in the lake sampling parameter list.

Response:

Productivity indicators such as chlorophyll-a were not included in the monitoring program because physical-chemical parameters are a more immediate and reliable indicator of water quality changes. For example, parameters such as specific conductance, temperature, pH, and copper concentrations would indicate a short- or long-term water quality change which might affect biological populations sooner than aquatic community changes. Further, aquatic community changes such as seasonal blooms are most often related to internal cycling mechanisms in ecosystems. Therefore, measured parameters such as chlorophyll-a concentrations can be unreliable and difficult to evaluate, especially for water quality changes.

Comment No. 23e

Sedimentation pond monitoring should be event-related (sample collection just after significant rainfall and snowmelt events).

Response:

Comment acknowledged and the Monitoring and Quality Assurance Plan will be revised accordingly.

Comment No. 23f

Sedimentation pond should also be sampled for metals, suspended solids and oil and grease.

Response:

Comment acknowledged and the Monitoring and Quality Assurance Plan will be revised accordingly.

Comment No. 23g

Any surface receiving waters of sedimentation pond discharges should be monitored for water quality impacts.

Response:

The Monitoring and Quality Assurance Plan included this consideration in selection of the monitoring locations. There are no unidentified surface waters which will ultimately receive sedimentation pond discharges that are not monitored. The proposed water quality measurements at these locations (i.e., sedimentation ponds and receiving water bodies) will enable an evaluation of any water quality impacts from the sedimentation pond discharges.

Comment No. 23h

Will the annual creek water chemistry samples be limited to metals and nitrate analysis, or will they also include the general quarterly parameter coverage?

Response:

See the response to comment No. 18.

Comment No. 24

Discharge monitoring from the water treatment plant will be required and specified in the WPDES permit. Daily, weekly and monthly monitoring may be required for various pollutants dependent on the toxicity of the pollutant and possibly the volume of discharge.

Response:

Comment acknowledged.

Comment No. 25

Sampling of the runoff from the sedimentation ponds will again be dictated by the WPDES permit. The frequency will depend on the projected contaminants. The parameters which at a minimum will be required include total suspended solids, pH, alkalinity and oil and grease where appropriate. Limitations may be imposed for any or all of these parameters.

Response:

Comment acknowledged.

AQUATIC ECOLOGY

Comment No. 26

This section states that biological parameters will only be examined at the three locations on Swamp Creek in the vicinity of the discharge. It is essential to monitor the aquatic ecology of all of the surface waters where potential impacts could occur from construction activities, dewatering and the discharge.

Response:

The rationale for selection of surface water monitoring locations is presented in the response to comment No. 23. The rationale for the aquatic biology sampling locations is also included in the response to comment No. 23.

Comment No. 27

In general, much more detail is needed for describing the aquatic ecology study plan.

a. Periphyton or aquatic macrophyte populations are scheduled for study. Which components will actually be studied and on what schedule?

b. What collection methods will be used for fish, invertebrates, periphyton and/or macrophytes?

c. There is no mention of data analysis for macrophytes. Which benthos taxa will be saved for tissue analysis? What analyses will be conducted on the tissue? There is no mention of Biotic Index (BI) analysis of benthos samples (BI analysis is being performed on Swamp Creek baseline samples). What is "total numbers" analysis of benthos data - per unit area, per station, or what? Will any qualitative benthos data be collected? From what habitat types will benthos be collected?

Response:

A preliminary sampling schedule for the Aquatic Ecology Monitoring Program is presented in the attached table. The parameters that will be sampled during each phase of Project development (preconstruction, construction and operation) are included in this table.

a. Aquatic macrophyte populations will be sampled as part of the Aquatic Ecology Monitoring Program (see attached table). Swamp Creek will be sampled in alternate years during the summer season at three locations.

Sampling of these populations for species composition and relative abundance and for tissue analysis will be initiated one year prior to construction and will continue through the construction phase and through the third year of operation. The results of the monitoring program will be evaluated at the end of the third year of operation and will serve as the basis for determining the scope of any future monitoring.

b. The methods for sampling macroinvertebrate and fish populations in Swamp Creek will be comparable to those described in the August 1983 report by Ecological Analysts, Inc. entitled "Aquatic Biology of Swamp Creek for the Crandon Project." The following sampling methods will be used:

Macroinvertebrates

Two replicate Ponar grab samples will be collected from each major substrate type (sand, silt and gravel - if present) at each of the three locations during spring, summer and autumn. To ensure complete representation by all taxa present at each location and to provide specimens for tissue analysis, organisms associated with all available habitats (e.g., aquatic vegetation [nearshore and midstream], low and high current velocity areas, underwater structures [branches and logs]) will be sampled by qualitative hand-picking, dip netting and kick-sampling. To maintain comparability between locations, qualitative sampling will consist of 30 man-minutes of collection effort at each location. Also, separate qualitative samples will be collected at each of the three locations in order to calculate Hilsenhoff's biotic index. Sampling to determine biotic index will be performed in accordance with the procedures utilized by the DNR.

(TABLE FOR THE RESPONSE TO COMMENT NO. 27)

AQUATIC ECOLOGY MONITORING PROGRAM FOR THE CRANDON PROJECT

Water Body/ Biological Component	Year	Pre-Construction 1	Construction 1	2	3	4	Operation 1	2	3
Swamp Creek									
Aquatic Macrophytes		X	X		X		X		X
Macroinvertebrates		X	X		X		X		X
Fish		X	X		X		X		X
Tissue Chemistry									
Aquatic Macrophytes		X	X		X		X		X
Macroinvertebrates		X	X		X		X		X
Fish		X	X		X		X		X

Fish

Fish populations will be sampled at each of the three locations during spring and autumn. Electrofishing will be conducted at each location over a 305 m (1000 feet) long stretch of stream. Seining also will be conducted at each of the three locations. Upstream and downstream seining will be conducted depending on stream depth and current speed. The number of seine hauls per location may vary according to the number of habitats available and the number of species in the resident fish community. Fish specimens for tissue analysis will be collected by electroshocking and/or seining.

A qualitative survey of aquatic macrophytes will be conducted at each of the three sampling locations to determine species composition and relative abundance. Both stream banks and the channel area will be visually inspected over a minimum 305 m (1000 feet) stretch of the stream to record the species present. The relative abundance of each species will be based on the frequency of occurrence of a given species over the area surveyed at each location.

One or more aquatic macrophyte species that are common to each of the three locations will be selected for tissue analysis. To the extent possible, the aquatic macrophytes will be collected within randomly located quadrats at each of the locations. Samples will be collected from a sufficient number of quadrats (size to be determined by contractor) until an adequate sample size is obtained. Duplicate samples will be analyzed at each location.

c. As indicated under item b above, aquatic macrophytes will be analyzed in the field for species composition and relative abundance. In the laboratory, the samples will be analyzed for metal (i.e., arsenic, cadmium, copper, lead, mercury, zinc) concentrations.

The macroinvertebrate taxa collected for tissue analysis may include crayfish (Orconectes spp.), clams (Fusconaia sp. and Lampsilis spp.) and snails (Campeloma sp.).

All tissues (aquatic macrophytes, macroinvertebrates and fish) will be analyzed for metal concentrations (as indicated above).

As indicated under item b above, qualitative macroinvertebrate samples will be collected for biotic index analysis. These samples will be collected in accordance with procedures utilized by the DNR to ensure compatibility.

Macroinvertebrate density per unit area will be determined from the samples collected with the Ponar dredge. Macroinvertebrates taxa collected by qualitative sampling will be counted (up to a maximum of 25 organisms) and assigned a relative abundance based on the number of each species in the sample.

As indicated under item b above, qualitative macroinvertebrate samples will be collected at each of the three locations. The qualitative samples will be collected by hand-picking, dip netting and kick sampling all available habitats. Also, qualitative samples will be collected for biotic index analysis.

Quantitative samples (Ponar dredge) of macroinvertebrates will be collected in each major habitat (sand, silt and gravel-if present) at each of the three locations. Organisms associated with all other habitats (e.g., aquatic vegetation [nearshore and midstream], low and high current velocity areas, underwater structures [branches and logs]) will also be collected by qualitative sampling.

AIR QUALITY

Comment No. 28

The location of monitor A makes it an upwind rather than a downwind monitor since wind directions recorded at the project site are predominantly from the south through west and northwest while winds from the east and northeast are rare (see Figure 2.1-2 through 2.1-9 in the EIR). A more in-depth analysis of wind data would be necessary to determine the best monitor locations, but it is suggested that monitor A would be better located if it were north of the mine waste disposal facility since winds from the south were recorded quite frequently at the project site. Better justification for the locations of the proposed monitors should be provided.

Response:

The location of air quality monitoring stations will be established as part of the Air Permit.

Comment No. 29

Page 15, Second Paragraph - It is stated that TSP (total suspended particulate) will be monitored at all sampling locations and that the samplers used will be able to distinguish particles larger and smaller than 10 microns in diameter. Does this mean that each TSP sample will actually be collected as two separate samples, one with particles greater than 10 microns in diameter and one with particles less than 10 microns in diameter? A more detailed explanation is in order here.

Response:

The monitoring program for TSP was discussed with the DNR's Bureau of Air Management. The TSP sampler will be a dichotomous sampler currently available on the market.

Comment No. 30

The dust from the MWDF could contain high levels of sulfides. The total particulates should be analyzed for sulfur to determine possible acid generation in adjacent surface waters, i.e., Duck, Deep Hole, and Little Sand Lakes.

Response:

Comment acknowledged.

TERRESTRIAL ECOLOGY

Comment No. 31

How will wildlife activity be monitored in the vicinity of the mining site?

Response:

The results of established wildlife monitoring programs conducted by the Wisconsin DNR, Bureau of Research and Bureau of Wildlife Management will be used to monitor wildlife populations. Any additional monitoring will be determined jointly with the DNR.

SECTION B, ITEM 2

Comment No. 32

Neither self-bonding nor a demonstration of net worth are acceptable methods of satisfying the financial responsibility requirements of the applicable law or code. Section 144.86(1), Stats., specifies a bond furnished by a surety company licensed to do business in Wisconsin, cash deposit, certificate of deposit or government securities as the acceptable methods of meeting the financial responsibility provisions. Does Exxon plan on submitting a bond to cover reclamation of the entire site or will the bond be updated annually according to the amount of surface disturbance? If the latter method is preferred a detailed schedule showing the disturbance which will take place every year over the life of the project is required.

Response:

Under the provisions of NR 182.17 the financial responsibility requirements of NR 132 and NR 182 are to be coordinated in such a manner that "a demonstration of financial responsibility by whatever means shall not be required twice for the same obligation regardless of whether the same is set forth in more than one chapter of the administrative code."

Accordingly, Exxon Minerals Company will use the "net worth test" method (proposed NR 182.17[3][f]) of providing proof of financial responsibility for all facilities covered by NR 182. At this time it is envisioned that the financial responsibility for the remaining mining facilities will be provided by a bond. The bond will be updated as the amount of surface disturbance changes.

SECTION C

Comment No. 33

For the record it should be noted that the fee ($10,000) will be adjusted to reflect the actual cost of evaluation.

Response:

Comment acknowledged.

SECTION D - MINE PLAN

Comment No. 34

General - Exxon refers to a number of state and federal regulations which must be complied with during the course of the project. However, Exxon does not reference the specific Administrative Code or federal rule which must be complied with. Examples of this occur in the following locations in the mining plan:

page 2-11 - sec. 2.1.2.1.2
page 2-12 - par. 1 and 2
page 2-33 - sec. 2.4.5
page 2-34 - sec. 2.4.8
page 2-35 - sec. 2.4.9
page 2-40 - last par.
page 3-8 - first par.

These and any other vague references to compliance with codes or rules should be made more specific.

Response:

The table attached to the response to comment No. 4 should serve as further assistance to more accurately identify the agencies and programs within the agency that will have jurisdiction over the Crandon Project.

Specific references to administrative codes were omitted since these code references frequently change over time. The commitment is to be in compliance with all applicable codes at the time the activity is undertaken.

Comment No. 35

Section 2, (general) - The approximate dimensions and physical appearance of all surface facilities mentioned in this section or shown on the diagrams (Figures 2.1-5, 2.2-5 and 2.4-1) should be presented. No mention is made of the reclamation material storage area, solid waste storage area or the means of limiting access to the site.

Response:

The approximate dimensions of Project surface facilities are shown in the attached table. These data will be included in the revised Mine Plan. Building siding will consist of metal paneling. Roofing will consist of metal ribbed panels. Colors have not yet been selected.

The only reclamation materials to be stored at the Project site will be the topsoil and chipped wood waste to be located on the eastern edge of the mine/mill area.

Necessary fill material required to develop final reclamation grades in the mine/mill area will be obtained from stockpile materials maintained in the MWDF area.

(TABLE FOR RESPONSE TO COMMENT NO. 35)

APPROXIMATE DIMENSIONS OF SURFACE FACILITIES

FACILITY	APPROXIMATE PLAN DIMENSIONS m (feet)	APPROXIMATE MAXIMUM HEIGHT m (feet)
Headframe	15 x 18 (49.2 x 59.0)	78 (256)
Collar House	18.4 x 18.8 (60.4 x 61.7)	9.2 (30)
Coarse Ore Storage	25.8 x 91.8 (84.6 x 301.2)	14.8 (48.6)
Crusher/Concentrator[a]	122 x 182 (400 x 597)	36.7 (120)
Mine/Mill Services Building	73.0 x 70.0 (239.5 x 229.7)	9.8 (32)
Bulk Reagent Storage	17.0 x 54.0 (55.8 x 177.2)	----
Main Substation	40.0 x 45.0 (131.2 x 147.6)	----
Substation Building	24.0 x 34.0 (78.7 x 111.6)	9.0 (30)
Lubricant Storage	13.0 x 17.0 (42.6 x 55.8)	4.0 (13)
Bulk Fuel Storage[b]	10.0 x 15.0 (32.8 x 49.2)	4.4 (14.4)
Core Storage Building	51.7 x 22.2 (169.6 x 72.8)	4.8 (15.7)
Cold Storage Building	19.0 x 27.0 (62.3 x 88.6)	4.0 (13)
Covered Storage Building	19.0 x 30.0 (62.3 x 98.4)	8.0 (26.2)
Water Treatment Building	30 x 76 (100 x 250)	11.3 (37)
Pump House	13.0 x 52.0 (42.6 x 170.6)	6.5 (21.3)
Bentonite Storage	15.0 x 30.3 (49.2 x 98.4)	
Gate House	10.0 x 12.0 (32.8 x 39.4)	5.5 (18)
Parking	121 x 145 (397 x 476)	----
Sedimentation Basin No. 1	64 x 62 (210 x 203)	----
Sedimentation Basin No. 2	100 x 98 (328 x 322)	----
Tailing Thickener[c]	60 m diameter (200 feet diameter)	----

[a]Irregular shaped building; dimensions are widest point in crushing area, longest length through crusher and concentrator including loadout, and maximum height in crushing area.

[b]Includes handrails on top of tanks.

[c]Exclusive of associated pump house.

Solid wastes will be removed for disposal off-site at an approved landfill. However, during the construction period, we do anticipate applying for a one-time disposal permit(s) for burning of some suitable construction wastes. Tree stumps and wood shipping crates would be primary examples of materials considered suitable for one-time on-site disposal by burning.

The entire mine/mill area will be enclosed with security fencing which will be installed as part of the initial site construction work.

Comment No. 36

Section 2.0, Description of Facilities - How much area included in the permitted mining site will actually be disturbed?

Response:

The following estimates of disturbed areas for the facilities comprising the Project site will be included in Section 2.0 of the Mine Plan:

Facility	Disturbed Area ha	acres
Access Road	15	37
Railroad Spur	18	45
Haul Road/Tailings Transport	4	10
Mine/Mill Site	36	89
MWDF and Reclaim Ponds	249	615
Water Discharge Line	6	15

Comment No. 37

Section 2.1.1, Mine Surface Facilities - The surface facilities associated with the air compressors, mine air heaters and the mine vent exhaust fans should be discussed more thoroughly.

Response:

Compressed air for mine use will be supplied from the surface compressor house located just north of the main shaft headframe (Attachment No. 1, drawing No. 051-1-G-001). The compressor plant, as currently planned, will contain six water-cooled rotary screw or turbine type mine/plant service air units. Each will be powered by a 597 kw (800 hp) motor, and will be rated to deliver 1.65 m^3/s (3500 cubic feet per minute) of air at a line pressure of 7.73 kg/cm^2 (110 pounds per square inch) gauge.

The peak mine demand for compressed air will be approximately 5.66 m^3/s (12,000 cubic feet per minute) or about 60 percent of the compressor plant's design rated capacity of 9.91 m^3/s (21,000 cubic feet per minute). Air will be delivered for underground distribution through a pipeline routed from the compressor house through the coarse ore conveyor gallery to the main shaft headframe, and then down the main shaft pipeway compartment.

During rated capacity mine operations fresh ventilating air requirements will be approximately 590 m^3/s (1,250,000 cubic feet per minute). Air will enter the mine under negative pressure through both the main production and intake air shafts. The proportion of total airflow in either shaft will vary throughout the mine life, contingent upon local underground ventilation requirements at any given time.

Each shaft will be equipped with an air intake structure designed to minimize entry shock losses. Each shaft will also have facilities for heating mine air during the winter months (Attachment No. 1, drawings No. B-MM-0190 and B-MM-0191). Ambient intake air must be warmed to a minimum temperature of 2°C (35°F) to preclude formation of ice in the shafts.

When required, a portion of the intake air at each shaft (up to 113 m^3/s [239,000 cubic feet per minute]) will be drawn into the heating ducts by a pair of double entry centrifugal fans. This split of air will pass through the direct fired natural gas heaters (27-38 million BTU/h, each) in the ducts. The heated air will exit into the primary air intake structure at a rate and temperature controlled such that the combined air streams remain above the minimum 2°C (35°F) intake air temperature.

An exhaust type, or negative pressure, ventilation system is planned for the Crandon Mine. The main mine fans will be located on the surface atop the east and west orebody extremity exhaust raises (Mine Plan Figure 2.1-8, Longitudinal Section). At their exit to surface these raises will be 6.1 m (20 feet) in diameter.

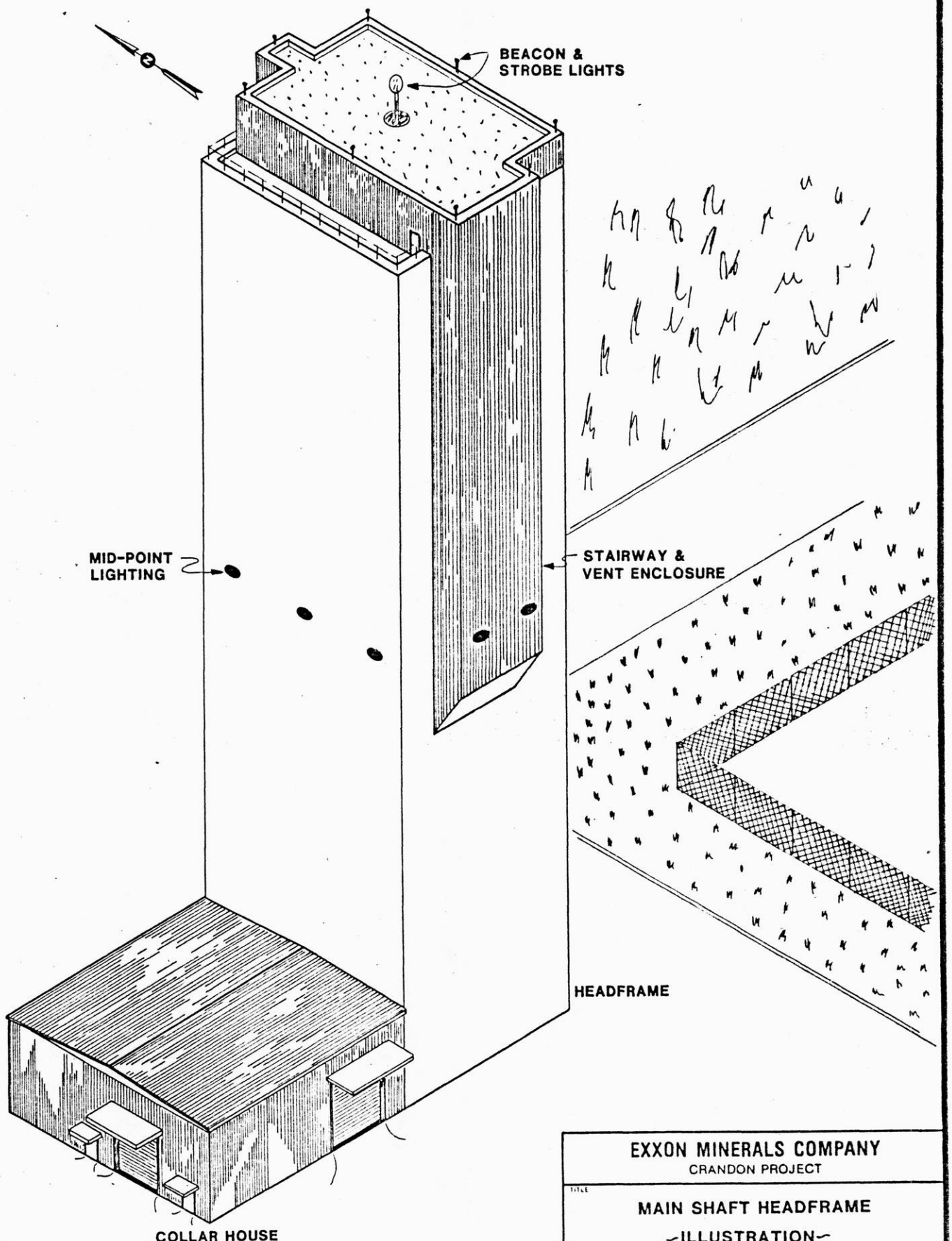
A closed collector hood with two horizontal duct exits will be installed over each exhaust raise collar. Each exit duct will contain a 2.7 m (9 feet) diameter axivane fan driven by a 522 kw (700 hp) motor. Air will exit to the atmosphere through a silenced vertical diffuser. Each of the four main fans, two at each exhaust raise, will be reversible and will feature simultaneously adjustable pitch blades. The pairs of fans will normally operate in parallel at each raise, but will be equipped with shut-off doors to allow single fan operation as required. Fan condition and performance will be remotely monitored and alarmed.

Comment No. 38

Section 2.1.1.1, Headframe - The external appearance of the headframe should be more thoroughly discussed.

Response:

The Crandon mine main production and service shaft headframe will basically be a slip-formed rectangular concrete tower 78 m (258 feet) high. The only appurtenances will be the metal siding enclosures for tower access and ventilation. These include a ventilation penthouse, return air and stairway enclosures on the upper half of the tower's north and south exterior walls and the shaft collar house at ground level. An artist's conception of the headframe is presented in the attached figure.



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
MAIN SHAFT HEADFRAME
-ILLUSTRATION-

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DR SPRINGBORN	1/83		
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE
DRAWING NO.		SHEET ___ OF ___	REVISION NO.

(FIGURE FOR RESPONSE TO COMMENT NO. 38.)

Subsection 4.2.9.2 of the Crandon Project EIR describes the aesthetics of the headframe's simple line and form. The visual impact of the tower structure's projection above the horizon will be mitigated by use of headframe exterior materials of a color selected to be compatible with the surrounding background. Headframe exterior surfaces will also be rough textured to minimize structure reflectivity.

Due to the proximity of the Crandon airport, the Wisconsin Aeronautics Administration requires installation of 360 degree unlimited distance visibility lighting on the headframe. The planned air traffic safety lighting will include white strobe lights (60 flashes/minute) atop the headframe for daylight hours, and a 300 mm (11.8 inches) flashing red beacon atop the headframe combined with red non-flashing structure mid-point lights at night.

Comment No. 39

Section 2.1.2.1, Main Shaft - Paragraph 2 discusses pumping construction mine water to the surface. The last sentence should not be left open ended. Where on the "surface" will that water go?

Response:

Subsection 2.1.2.1 presents a physical description of the main shaft and does not discuss the handling of "construction" mine water. During normal operations, contaminated water from the mine will be pumped to the water treatment plant feed tank. Uncontaminated mine water will be pumped to the uncontaminated mine water tank prior to discharge. Refer to the response to comments No. 95 and 131 for details of handling mine water during construction.

Comment No. 40

Section 2.1.2.2, Ventilation Shafts - Describe the shaft surface discharge structures, fan size, noise suppression, and air quality controls.

Response:

Fans will be located on the surface of the east and west exhaust shafts. Preliminary design includes a 90° elbow at the shaft collar, with a horizontally mounted fan or fans attached to another 90° elbow, which is directly coupled to a vertical evase for ultimate discharge to the atmosphere. Physical dimensions of the discharge evases can be found in Table C-1 of the "Air Permit Application Appendices." Fan sizes were addressed in subsection 3.5.2.3, Ventilation and Mine Air Heating of the Mine Plan. Present design indicates that each discharge shaft fan installation will convey approximately 290 m^3/s (.63 million cubic feet per minute) of air. Also, see the response to comment No. 37 for additional system detail.

Noise suppression at each of these installations was determined unnecessary by modeling (see EIR Section 4.2). However, to mitigate any undesirable noise emanations and possible resultant impacts, the discharges will be directed vertically to achieve maximum dampening and dispersion.

Description of air quality controls are presented in the Air Permit Application, subsectio 2.2.1, Mine-Construction and Operation.

Comment No. 41

Section 2.1.2.3, Drifts - Describe in detail the mining plan as it relates to the control of surface subsidence.

Response:

The mining methods and stope sequences planned for extraction of the Crandon orebody were selected to control mine area rock mass stability and preclude surface subsidence. A permanent bridge or "crown pillar" of bedrock directly beneath the glacial overburden will be purposely excluded from mining activity. This bedrock barrier will maintain surface stability and prevent piping of overburden materials into active mine workings.

Beneath the orebody crown pillar, stoping methods and sequences will be arranged to maintain local rock mass integrity and avoid disturbance of the crown pillar. All mining methods planned (refer to Mine Plan subsection 3.5.2.1) provide for backfilling of stopes immediately following ore extraction. Depletion of reserves will generally proceed from depth and the orebody extremities toward the surface, with mining directly below the permanent crown pillar planned for the final third of the mine life. These practices, combined with the fact that approximately 8 percent of the mineable ore will be left in place as pillars throughout the mine, will assure perpetual stability of the mine area bedrock surface and glacial overburden.

Comment No. 42

Section 2.1.2.10, Ore Transport Facilities - The dust control system on the primary crusher and related ore handling facilities is not adequately described. Where will the ducts and dust collection hoods duct to?

Response:

The dust collection system consists of ducting from the throat of the gyratory crusher, from the discharge of the vibratory feeder, from the discharge of the picking belt conveyor, and from the discharge of the crusher delivery conveyor to a multiple installation of bag type dust collectors, as shown schematically in a J. S. Redpath drawing No. 050.2.113.M.051 contained in Attachment No. 2. The system is powered by a 50 hp exhaust fan moving 7.27 m^3/s (15,400 cubic feet per minute) at 12 1/2 inches WG. This fan will discharge air into the exhaust air system of the mine. Dust from the collectors will be transported by a screw conveyor to a closed container, which can then be transported to the top of a backfill stope for disposal or, alternatively, emptied into the loading pocket. Drawings No. 050.2.111.S.007, 008 and 009 in Attachment No. 2 show the equipment in detail.

Water mists at each of the feeders above the crusher, above the crusher throat, at the discharge of the feeder below the crusher, at the discharge

of the picking belt conveyor, and at the discharge of the crusher delivery conveyor will suppress potentially fugitive dust at these points. This system, together with a conveyor belt fire suppression system, is shown schematically on drawing No. 050.2.113.M.050 in Attachment No. 2.

Comment No. 43

Section 2.1.2.12, Sanitation Facilities - Describe waste preservation chemicals and discuss the compatibility of chemically treated waste with the surface septic system.

Response:

Sanitation units will be serviced as demanded by local use frequency. Containerized waste will be transported to the surface in the mine cage for disposal in the plant septic system. The formaldehyde and perfume used in the chemical toilet control solutions will be in dilute concentrations compatible with the septic treatment system.

Comment No. 44

Section 2.1.2.14, Fuel Handling and Storage - Will the floors of the fuel spill retention areas be made up of bedrock or a prepared material such as concrete or asphalt?

Response:

The floors of the fuel spill retention areas will consist of bedrock.

Comment No. 45

Section 2.1.2.16, Mine Drainage - Describe in detail the physical aspects of the Case I and Case II mine drainage scenarios. How will the interceptor system water be protected from contamination? Could the interceptor system water be directly discharged with little or no treatment?

Response:

The Crandon site geohydrologic regime is relatively simple, predictable, and easily monitored. Saturated glacial overburden with definitive surface water discharge boundaries constitutes the aquifer, exclusively recharged by infiltrating precipitation. In the absence of pumping stress, the bedrock is functionally excluded from the ground water system. Development of the mine will, however, induce flow from the overburden aquifer through weathered bedrock courses not throttled by impermeable materials at the orebody subcrop.

The site geohydrologic conditions will limit the flow of ground water into the Crandon mine to a steady state rate of approximately 0.118 m^3/s (1870 gallons per minute) as documented in the Prickett Associates' report entitled "Ground Water Inflow Model for the Proposed Crandon Mine," December 1982 (previously provided to the DNR). A layer of relatively impermeable glacial till and/or clay-rich weathered bedrock retards ground water entry over much of the mine area. The inflows forecast to occur will be localized

and primarily in areas where overburden aquifer sands are in contact with porous weathered rock at the orebody subcrop. The intensity and lateral extent of the bedrock weathering diminishes with depth. Initial mine production has been planned for the 230 to 350 m stope horizon, a position that is below the majority of the weathered zones. Thus, ground water inflows to mine workings during the early years of the mine life are expected to be very localized.

Ground water inflow to the proposed Crandon Mine will be collected in two separate systems. First, an uncontaminated ground water interceptor system will be installed on the uppermost active mine levels. Exploratory diamond drilling techniques will be employed to identify active water courses prior to advance of the mine face. Flows encountered on the uppermost mine level will be captured in interceptor drill holes and contained to avoid contamination by the mining processes at levels below. Mine water control drifts will be developed ahead of production entry in the upper mine areas to maintain the ability to intercept ground water prior to contamination. Ultimately the ground water interceptor system would function as shown on the conceptual Mine Inflow Control cross-section (see attached Figure 1). Cement rock grouting may be used for local inflow control or diversion.

Actual ground water collection will be from exploration or interception drill holes developed from the access and mine water control drifts. These holes will be typically arranged in a conical fan above the drifts, increasing the effective radius of the adit as a line sink drain. As is common mine practice, each water producing hole collar will be sealed and equipped with a pipe manifold.

Ground water collected from exploration drilling, or other drill holes placed specifically for inflow interception, will be piped directly to a clean water sump and pump station near the main shaft on the 230 m mine level (Figure 2 attached). With the exception of ground water inflow diverted for mine utility water use, discharge from this segregated ground water system will be pumped to the surface uncontaminated water holding tank through a separate pipe column in the main shaft. Interceptor system ground water will be monitored prior to surface discharge.

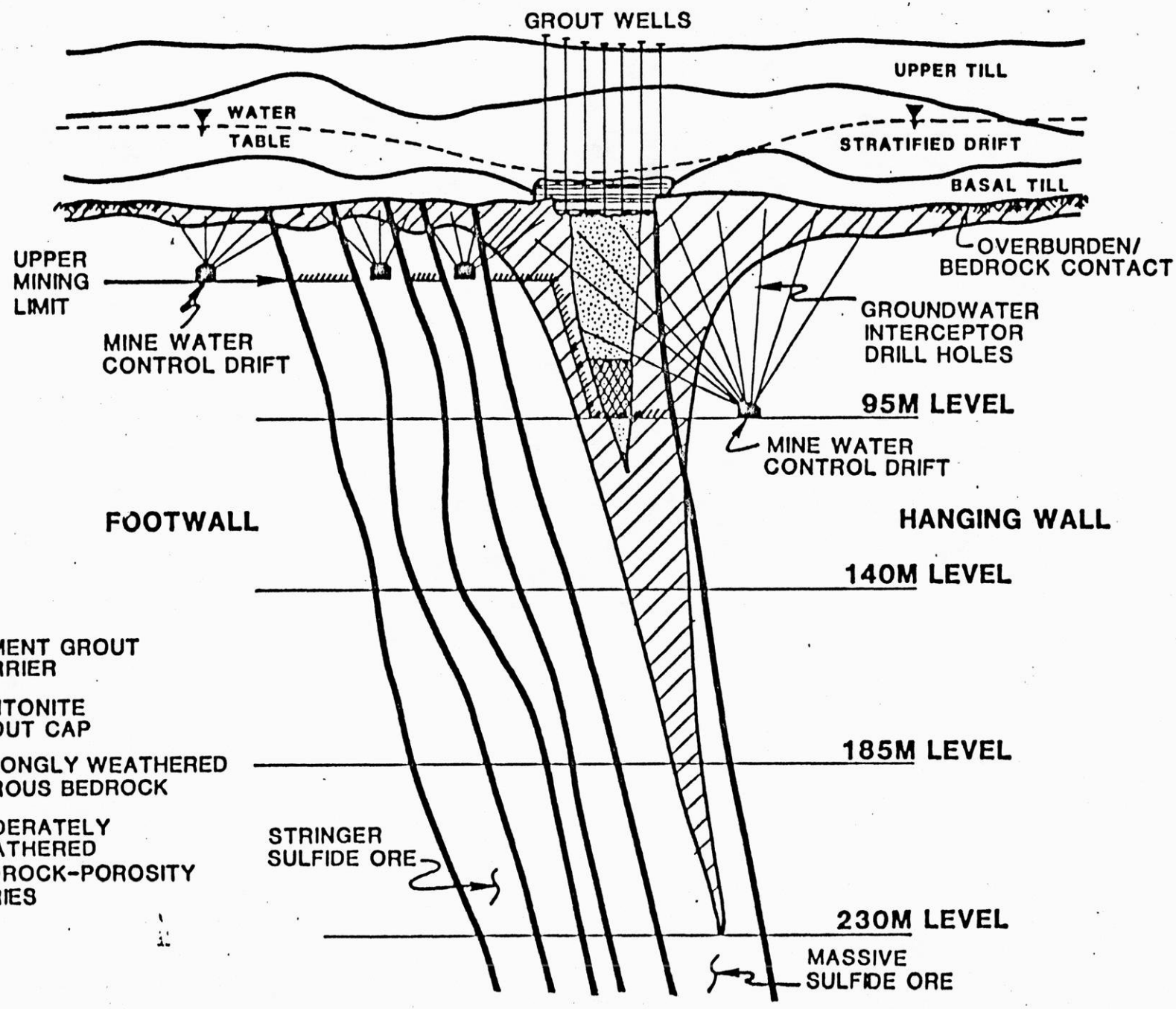
Mine inflow intercepted, contained, and discharged by this system is expected to remain near ambient ground water quality, except for possible transient effects during orebody storage depletion and initial flushing pore volumes. In the steady state, partially saturated flow conditions will exist in the weathered bedrock water courses. Some oxygen may then be introduced to this previously anaerobic environment, but its effects are expected to be minor. The oxidation and leaching potential of the water courses is already limited by the extensive pre-glaciation weathering, and the residence time for further ground water flow will be of a duration which can be measured in hours or days. Ground water intercepted under steady state conditions will likely display aquifer source quality.

Ground water seepage that is not contained by the interceptor system will infiltrate the mine workings and ultimately be recovered in the normal mine local level drainage system sumps and piped or drained to the main mine water sumps. These main mine water sumps and pump stations will be located near the main shaft on the 350 m and 780 m levels, and will also receive backfill seepage and used mine utility water.

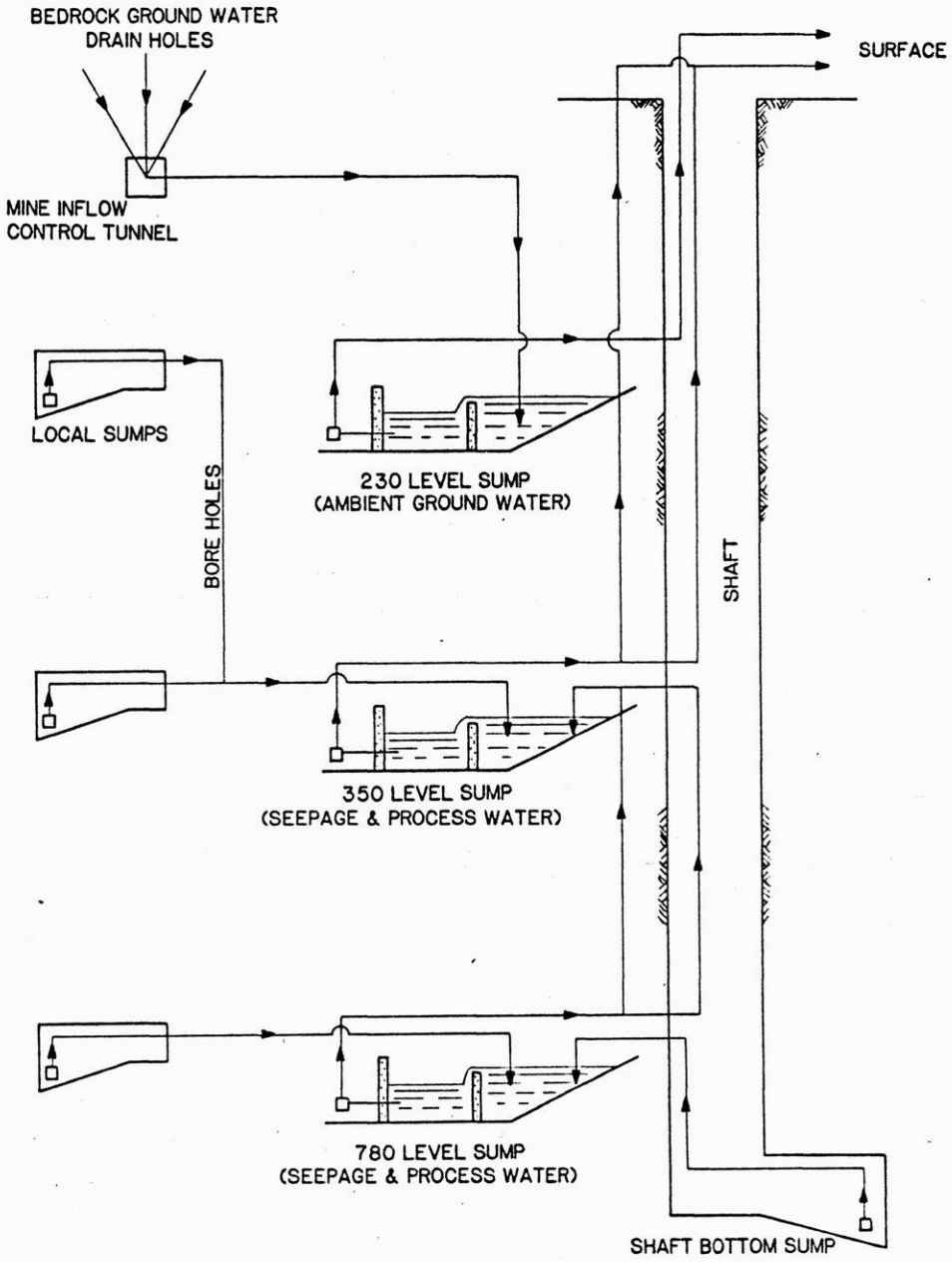
EXXON MINERALS CO.
CRANDON PROJECT

MINE INFLOW CONTROL METHODS

(CONCEPTUAL X-SECTION)



(FIGURE 1 FOR RESPONSE TO COMMENT NO. 45.)



MINE WATER DRAINAGE SYSTEM

EXXON MINERALS COMPANY CRANDON PROJECT	
TITLE: SUMPING SYSTEM SCHEMATIC	
SCALE: NONE	STATE: WISCONSIN — COUNTY: FOREST
DRAWN: DR SPRINGBORN	DATE: 10/83 — CHECKED BY / DATE
APPROVED BY / DATE	APPROVED BY / DATE
APPROVED BY / DATE	EXXON / DATE
DRAWING NO: EXHIBIT 13, FIG. A	SHEET ___ OF ___ — REVISION NO.

(FIGURE 2 FOR RESPONSE TO COMMENT NO. 45.)

Normal mine drainage collection will begin on each mine level where flows will be directed to small local sumps excavated in the drift wall. Decant water from the local mine level sumps will be piped or drained through boreholes to the main 350 m or 780 m level sumps. The main sumps will consist of downgrade excavations in the wallrock adjacent to the pump stations. A bulkhead containing the pump station suction pipes will be constructed at the sump outlet.

Since the normal local level mine drainage system pumps will be specified for "dirty" water, the main level sumps will function primarily as pumping reservoirs. However, some settling of solids is expected in the local level and main mine drainage sumps. For this reason, pairs of sumps with front-end loader access will be provided at each mine level transfer point and at the main mine drainage facilities. One sump at each location will then be operated while the other is cleaned. Sump solids will be transported to mined stopes and combined with regular stope backfill.

In the event that additional settling capability is required, a segment of the mine area adjacent to each normal local level mine drainage pump room will be reserved for excavation of a vertical cone settler. Solids discharged from the base of the conical settler would be transported to depleted stopes as backfill.

Discharge from the totally segregated ground water interceptor and mine operations drainage systems will exit the mine in separate main shaft pump columns. The contaminated ground water will be directed to a surface storage tank prior to discharge or, if needed, used as mill process make-up water. Mine drainage effluent will be routed to the water treatment plant feed tank for treatment prior to discharge.

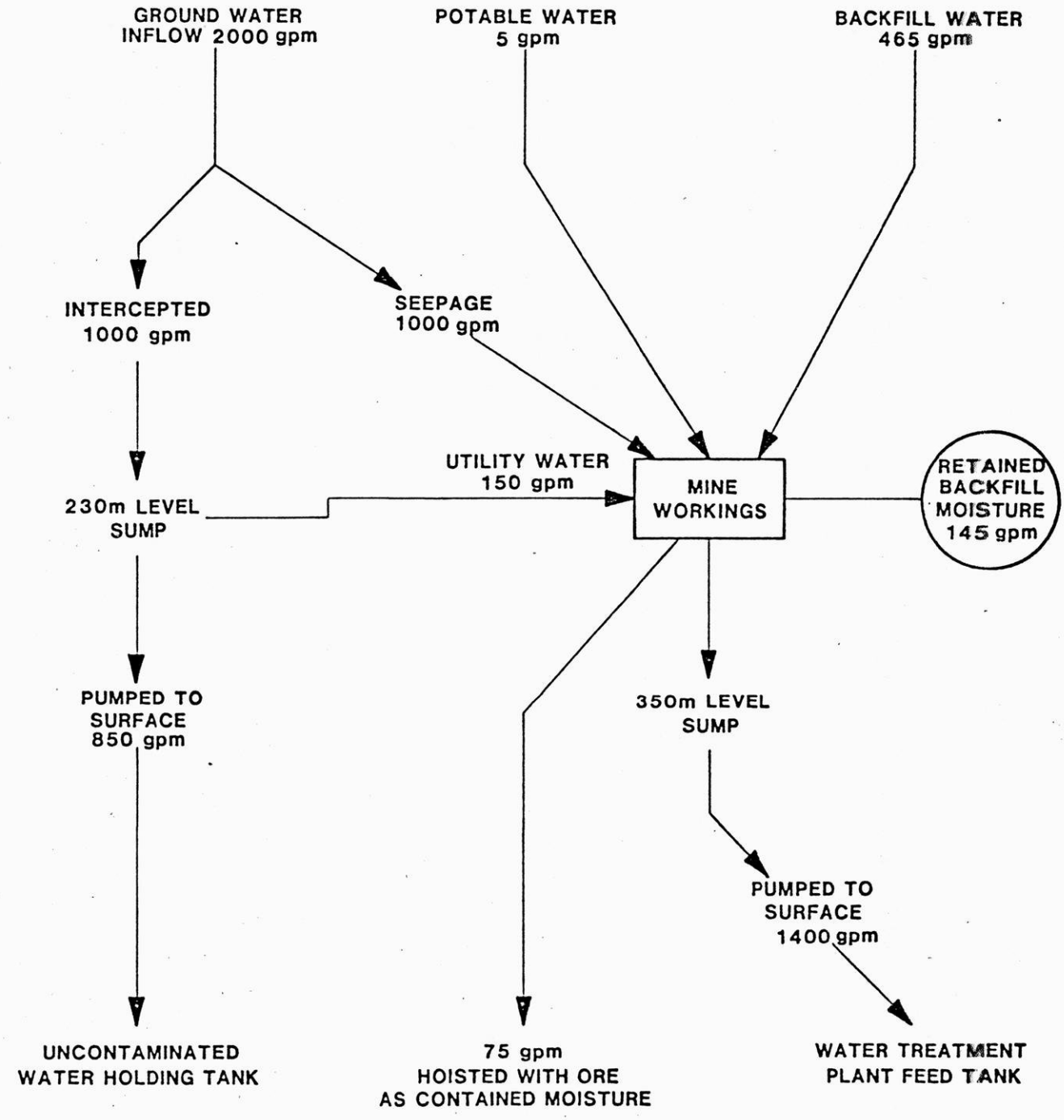
Figure 3 (attached) displays the specific Case II, or nominal 0.126 m^3/s (2000 gallons per minute), ground water inflow/mine drainage balance. Mine pumping systems will be installed for the indicated capacities. Stand-by pumps and a spare main shaft pump discharge column are planned.

It is possible that the rate of ground water flow into the mine can be controlled. With the simple source - throttle - receptor type of geohydrologic regime in mind, two basic inflow control strategies were evaluated by Klohn Leonoff:

1) Reduction of source ground water over the mine area.

2) Alteration of mine inflow path permeability.

Ground water source-reduction techniques studied included surface well field overburden dewatering, underground drainage gallery overburden dewatering, and aquifer flow restriction methods like slurry trenching and vertical grout curtains. The overburden dewatering methods would require removal of more than twice as much ground water to achieve a marginal reduction of the mine inflow, and were therefore rejected on the basis of increased environmental effects. Aquifer flow restriction methods are impractical at the Crandon site due to the extensive overburden depth. Method details and cost estimates are presented in the Klohn Leonoff report.



MINE WATER DRAINAGE SYSTEM

EXXON MINERALS COMPANY
CRANDON PROJECT

MINE DRAINAGE SCHEMATIC

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DR SPRINGBORN	9/83		
	DATE	APPROVED BY	DATE
	DATE	EXXON	DATE

EXHIBIT 13, FIG. B

(FIGURE 3 FOR RESPONSE TO COMMENT NO. 45.)

Mine inflow path permeability reduction methods evaluated included primarily cement and bentonite grouting techniques. Chemical grouting was eliminated as environmentally unsound, and long-term freezing of the saturated overburden was shown uneconomical. Of the grouting methods described by Klohn Leonoff, the plan to place bentonite grout in the high inflow areas of the orebody subcrop was most practical and potentially effective. In essence, this plan artificially creates flow resistant material similar to that which occurs over most of the mine area. Preliminary engineering plans and a cost estimate for this subcrop grouting plan are presented in the Klohn Leonoff report.

During mine final engineering, further site tests can be conducted to confirm active steady state mine inflow courses and verify the proposed bentonite grouting technique. The extent of any inflow control program instituted will be determined by the potential for lessened environmental effects in balance with reduced mine drainage and water treatment and discharge costs.

Mine inflow control grouting and uncontaminated ground water interception methods will be employed to the limit of technical achievability and economic feasibility. The practical limits may approach 50 percent for inflow control, and a 50 percent interception rate in the absence of inflow control. Theoretically, inflow control by grouting could be 100 percent effective with application of unlimited resources, and similarly ground water interception success could be greater than projected.

Given the geotechnical uncertainties which will remain until mine development begins, a non-numerical statement of intent may be best. There is environmental and economic motivation to reduce the inflow of ground water to the mine, and to avoid mine contamination of as much of the uncontrolled mine inflow as possible.

The measurable effectiveness of one system may very well depend upon the success of the other. Reduced mine inflow by grouting might, for example, eliminate flow in a water course amenable to interception. Environmental protection and mine operability will be best served by a practical combination of these proposed techniques.

Case I with its nominal ground water inflow of 0.063 m^3/s (1000 gallons per minute) represents an estimate of the potential success of applied inflow control and interception technology. Physical pumping and drainage systems, designed and installed for the higher Case II inflows, would then simply operate at reduced rates if the rate of ground water seepage can be mitigated.

Comment No. 46

Provide additional details or diagrams to illustrate the groundwater interception system to verify why water intercepted within the bedrock, even though at a shallow depth in the bedrock, can be considered to be clean. Also, some minimum detail should be included on groundwater collection sumps within the mine and disposition of the settled solids removed from the sumps.

Response:

See the response to comment No. 45.

Comment No. 47

Paragraphs 1 and 2 discuss mitigative actions to be taken to reduce ground water flow into the mine. One measure discussed in paragraph 1 is to grout through surface drill holes. Is the 1,000 gpm of reduced flow into the mine referenced in the last sentence of this paragraph attributable to just these grouting measures or will part of this 1000 gpm reduction occur as a result of the interceptor system discussed in paragraph 2? Our understanding of the system was that approximately 1,000 gpm of ground water flow into the mine could be reduced by both grouting and the interceptor system. To cite 1,000 gpm for each mitigative action leaves the reader with the impression that 2,000 gpm of ground water inflow will be prevented from entering the mine. Which is it?

Response:

The mine ground water interceptor system will not reduce the inflow of ground water to the mine. The system's only function is to collect ambient aquifer quality water seeping through the weathered bedrock before it reaches the active mine workings. Any ground water escaping interceptor system collection and segregated pumping will be contaminated as it joins the mine process water streams throughout the workings.

The mine site geohydrologic regime can be most simply described as a source - throttle - receptor system. The water source is the saturated glacial sand overburden. Low permeability glacial tills, clays, and bedrock weathering products, function as the flow throttle at the bedrock subcrop. Zones of oxidation and leaching which penetrate the bedrock to limited depths form the inflow paths to the mine, which together constitute the receptor.

Site geotechnical studies, hydrologic test programs, and inflow computer modeling have confirmed these regime concepts. Evaluation of the results indicates that ground water inflow to the mine will occur where the source and receptor can communicate (i.e., where saturated sands are in contact with porous weathered bedrock and no low permeability throttling materials are present).

There are environmental and economic motivations for attempting to reduce the predicted mine inflow of 0.126 m^3/s (2000 gallons per minute). A variety of ground water source and/or inflow path permeability reduction techniques were, therefore, investigated. Two methods with potential technical and economic feasibility emerged.

First, it may be possible to control areas of source/receptor communication by creating a low permeability throttle material. A layer of aquifer sand in contact with the bedrock could be injected from the surface with bentonite grout to form an artificial till. Success with this type program requires definitive subcrop water course identification, but could be successful over small areas of concentrated inflow.

A second possibly viable method would be source reduction by overburden aquifer pumping. With this method surface wells would be used to reduce the aquifer head over areas of high subcrop inflow potential. The ground water displaced could be reinjected down gradient, discharged to surface water, or used in other ways to mitigate hydrologic impacts.

During mine final engineering, further site tests can be conducted to confirm active steady state mine inflow courses and verify the proposed bentonite grouting technique. The extent of any inflow control program instituted will be determined by the potential for lessened environmental effects in balance with reduced mine drainage and water treatment and discharge costs.

Mine inflow control grouting and uncontaminated ground water interception methods will be employed to the limit of technical achievability and economic feasibility. The practical limits may approach 50 percent for inflow control, and a 50 percent interception rate in the absence of inflow control. Theoretically, inflow control by grouting could be 100 percent effective with application of unlimited resources, and similarly ground water interception success could be greater than projected.

Given the geotechnical uncertainties which will remain until mine development begins, a non-numerical statement of intent may be best. There is environmental and economic motivation to reduce the inflow of ground water to the mine, and to avoid mine contamination of as much of the uncontrolled mine inflow as possible.

The measureable effectiveness of one system may very well depend upon success of the other. Reduced mine inflow by grouting might, for example, eliminate flow in a water course amenable to interception. Environmental protection and mine operability will be best served by a practical combination of these proposed techniques. The nominal ground water inflow of 0.063 m^3/s (1000 gallons per minute) represents only an estimate of the potential success of applied inflow control and interception technology.

Comment No. 48

Exxon should indicate where the water from the interceptor system and the contaminated mine drainage will be routed.

Response:

Paragraph 4 in subsection 2.1.2.16, Mine Drainage, includes a statement that the mine drainage water, meaning the contaminated mine drainage, will be pumped to the water treatment plant. This will be accomplished by pumping the water to the water treatment plant feed tank located north of the headframe. The uncontaminated water, or intercepted ground water, will be pumped to the uncontaminated mine water tank prior to discharge.

Comment No. 49

Section 2.2.1, Ore Handling - Will there be any need for exterior ore surge piles in the event of system failure? Will there be any surface storage of low grade ores other than at the mine waste disposal facility?

Response:

Study of alternatives for preproduction ore storage has continued since submittal of the Mining Permit Application. While the original Mine Plan proposed preproduction ore storage in the MWDF, the current plan proposes storage at the north edge of the mine/mill site. Additional planning of the management of the mine backfill sands has eliminated the need for a temporary backfill sands storage facility allowing the preproduction ore storage area to be located in its place. This ore storage facility will be lined and drainage will be collected and transported to the plant water treatment system. The liner will be protected with a separate waste rock cover. Recovery of ore will be managed to leave this protective cover in place throughout the life of the facility.

While this storage facility is planned only for temporary storage of the preproduction ore, it could also be maintained (or reactivated) and used as an ore surge storage area if needed.

Comment No. 50

Are the wastewaters generated in the ore handling facility and the contaminated runoff generated on the preproduction ore and regular ore storage areas accounted for in the water balance? What will be the volume of runoff generated in a 10 year, 24 hour storm event? Show calculations.

Response:

These wastewater volumes are included in the water balance. The entire ore handling facility from the mine headframe through coarse ore storage, crushing, fine ore storage, and grinding is completely covered. All conveyor galleries are covered. There will be no contaminated water runoff from the ore handling facility. Any drainage water collected in the coarse ore storage facility will be collected in sumps and pumped to the grinding circuits.

The preproduction ore storage area is now planned for the 3.2-ha (8-acre) area just north of the rail tracks (previous backfill storage area). Surface water runoff from this ore storage area will be collected in a 5600-m^3 (1,479,520-gallon) sump designed to accommmodate the precipitation volume in the area from a 25-year, 24-hour storm event. Water that accumulates in this sump will be pumped to the water treatment plant feed tank.

A 15.6-ha (38.6-acre) area will be allocated in the MWDF area to hold waste rock. A sump will be provided to collect runoff from this area; it will be sized to accommodate a 10-year, 24-hour storm event in addition to a one year average net precipitation gain. If necessary, water from this sump will be pumped to reclaim pond R1. The sump will be designed for a capacity of 40,000 m^3 (10.6 million gallons).

Calculations

a) Preproduction Ore Storage; 8-acre; 25-year, 24-hour storm event; 4.2 inches (0.35 ft) of rain

$$8\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.35\ ft \times \frac{7.48\ gal}{ft^3} = 912{,}321\ gal$$

Therefore, the sump near the preproduction ore pile will be sized for 5600-m^3 (1,479,520-gallon) capacity which is more than adequate. This water could be pumped to the treatment plant over a 2-week period at a rate of 10.3 m^3/h (45 gallons per minute).

b) Waste Rock Storage; 38.6-acre; 10-year, 24-hour storm event, 3.6 inches (0.30 ft) of rain

$$38.6\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.30\ ft \times \frac{7.48\ gal}{ft^3} = 3{,}773{,}098\ gal$$

Allowance for 1-year of average net gain in precipitation over evaporation (7.41 inches or 0.62 ft)

$$38.6\text{-acre} \times \frac{43{,}560\ ft^2}{acre} \times 0.62\ ft \times \frac{7.48\ gal}{ft^3} = 7{,}797{,}735\ gal$$

Total requirement of 11.6 million gallons.

The sump near the waste rock storage area will be sized for approximately 40,000 m^3 (10.6 million gallon) capacity which is close to the total calculated requirement of 43,800 m^3 (11.6 million gallons). This water will be pumped, as necessary, to reclaim pond R1 which has a design volume of 898,938 m^3 (237,500,000 gallons), including 308,856 m^3 (81,600,000 gallons) of freeboard volume.

Comment No. 51

Figure 2.2-1 - What is the shaded facility located just east of the water treatment plant? Also, the structures located on either side of this facility and the structure between the tailings thickeners are not identified on this figure or figures 2.1-5 or 2.4-1.

Response:

The shaded facility just east of the water treatment plant was originally intended to be the waste rock crushing facility and the unshaded structures on either side of the crushing area were conveyor transfer towers. These facilities are no longer needed and do not appear on revised plot plans (see Attachment No. 1, drawing No. 051-1-G-001). The structure between the two tailings thickeners is the pump chamber for the tailings thickener underflow and overflow products. Although present plans now call for a single larger thickener, the pump chamber will remain.

Comment No. 52

Section 2.2.5, Reagent Storage and Mixing - Provide detailed plans and specifications for this facility and its equipment with emphasis and spill control, containment, and emission control. Describe the segregation of noncompatible reactive reagents, dusts, vapors, and gases.

Response:

Detailed design of the reagent storage and mixing facilities will be completed during final engineering. Preliminary drawings of these facilities are presented in Attachment No. 3, drawings No. 051-6-G-008 and 051-6-G-009. These facilities are described as follows:

Reagent Facilities Description

The reagents are received by either truck or railcar; there are three modes for receiving reagents:

1) Lime, soda ash, and sulfuric acid will be received on the inside plant track immediately north of the filter area shown on drawing No. 051-6-G-009, which will also be used intermittently to handle lead concentrate cars. These reagents are used in the water treatment plant. The track and storage tanks for lime and soda ash are shown on drawing No. 051-6-G-008.

2) Sulfur dioxide, frothers, and sodium dichromate will be received on a railroad spur entering the center of the mill building (drawing No. 051-6-G-009). Sulfur dioxide is used directly in the process and there is no intermediate storage. The frothers and sodium dichromate storage tanks are contained in a bermed area with blind sumps which will be used to return spillage to the respective tank by pump. The frothers and sodium dichromate are pumped from the storage tanks to intermediate mix tanks in the reagent preparation building (drawing No. 051-6-G-009). From the mix tanks, these reagents and most others are pumped to the day tanks above the control room. The reagent preparation tanks are isolated by berms and blind sumps. Overflows and the floor drains for the day tanks drain to the reagent preparation area blind sumps.

3) Drums, bags, and returnable bins will be delivered by truck at a loading dock at the front of the reagent storage building. These bagged and drummed reagents will be mixed to make solutions in the reagent preparation area using the mix tanks. The solutions will then be pumped to the respective day tank.

The berms that are shown in the reagent storage, mixing, and day tank areas are provided to contain any spills and to isolate noncompatible or dissimilar reagents. Similar reagents such as all xanthates will be contained together since they are chemically and functionally compatible. Noncompatible reagents will be isolated spatially as well as with berms. Sodium cyanide will not be unloaded or stored near acids nor will acids be

stored near strong caustics. The berms will be designed to contain a total spill from a single tank of similar reagents. The blind sumps will be used to return spilled reagents to their respective tank.

Dusts will be minimal in the reagent preparation building. Personal breathing protection will be provided as needed for workers in these areas. The reagent dusts encountered will primarily be in the lime and soda ash unloading, slaking and mixing areas. Drawing No. 051-6-G--008 shows this area and indicates the dust collectors used. There is an insertable dust collector provided with the unloading and storage silos in both cases.

Gases will be removed from the enclosed reagent preparation area by a ventilation system. The reagent preparation area and the day tank area will be equipped with alarms for hydrogen sulfide and hydrogen cyanide.

The reagents which are particularly noncompatible include sulfur dioxide, sodium cyanide and sodium sulfide. To avoid the mixing of sulfurous acid (results when SO_2 contacts water) with these or other reagents, SO_2 will be stored outside the concentrator building in two tanks. The liquid SO_2 will then be piped directly into the SO_2 distribution system.

Frother compounds that have fairly high vapor pressure (e.g., MIBC) will be stored in a tank outside and pumped in as needed for mixing.

Special Criteria

The attached table shows storage capacities, shipping mode, and other reagent receiving and storage data. The following criteria will be included in the reagent area design.

1) Adequate ventilation.

2) Sodium cyanide will be received in 1362 kg (3000 pound) Flo-Bins™ which are returnable.

3) Storage and mixing requirements for each reagent have been determined. Where feasible, the preferred system will be a mixing tank and a day tank. The day tanks merely store mixed reagents for distribution to the flotation circuit. Capacity of the day tank is 32 hours of operation.

4) Maximum storage for xanthate solutions is 4 days. All xanthate mixing and storage tanks will have sloping bottoms with drains for cleaning at the low point. Solution removal for process use will be at a height of 15.2 cm (6 inches) above the point where the sloping bottom begins.

5) Xanthate tanks will have a forced air exhaust to remove any carbon disulfide.

(Table for response to comment No. 52.)

REAGENT RECEIVING AND STORAGE DATA

Chemical	Receive By	Monthly Consumption (Pounds)	Shipment Size	Unit Size	Form	Storage Capacity
Sulfur Dioxide SO_2	Tank car	205,000	60,000 or 100,000 lb	30 ton	Liquid	150,000 lb
Copper Sulfate $CuSO_4 \cdot 5H_2O$	Railcar	216,300	100,000 lb minimum	100 lb bag	Granular	300,000 lb
Sodium Cyanide NaCN	Truck	13,200	36,000 lb	3,000 lb	Briquette	36,000 lb
Dowfroth 250	Truck	18,100	40,000 lb	Truck	Liquid	50,000 lb
Sodium Sulfide $Na_2S \cdot 9H_2O$	Railcar	150,200	80,000 lb minimum	400 lb drum	60% Flake	230,000 lb
Xanthates	Truck	42,100	40,000 lb	300 lb drum	Pellet	63,000 lb
Zinc Sulfate $ZnSO_4 \cdot 7H_2O$	Truck	36,000	24,000 lb minimum	50 lb bag	Granular	54,000 lb
CMC-7LT	Truck	16,900	25,200 lb minimum	50 lb bag	Powder	30,000 lb
Sodium Dichromate $Na_2Cr_2O_7 \cdot H_2O$	Truck	30,100	78,000 lb minimum	8000 gal	Liquid	12,000 gal
	Tank car	(8000 gal)				

Note: Ton in this table is short ton (2000 lb).

(Table for response to comment No. 52 [continued].)

Chemical	Receive By	Monthly Consumption (Pounds)	Shipment Size	Unit Size	Form	Storage Capacity
Sodium Silicate Na_2SiO_3	Tank car	90,100	117,000 lb (10,000 gal)	10,000 gal	Liquid	15,000 gal (175,500 lb)
Carbon	Railcar	48,100	24,000 lb minimum	50 lb bag	Powder	75,000 lb
MIBX	Tank car	24,100	40,000 lb minimum 6,000 gal	6000 gal	Liquid	12,000 gal
Lime CaO	Rail	1,100,000	190,000 lb minimum	Railcar	Pebble	2,640,000 lb
Soda Ash Na_2CO_3	Railcar	523,000	200,000 lb minimum	Railcar	Powder	750,000 lb
Sulfuric Acid H_2SO_4	Truck	76,300	45,000 lb	Tanker	Liquid	67,500 lb
HMP	Truck	6.500	No minimum	100 lb bag	Granular	7,000 lb
Flocculant	Truck	31,200	34,000 lb minimum	Tanker	Liquid	40,000 lb

Note: Ton in this table is short ton (2000 lb).

6) All reagents received in solid form will have mixing and storage tanks designed like xanthate tanks.

7) Explosion-proof motors, light fixtures and conduit will be used.

8) Emergency eye wash, shower facilities, and other necessary first aid equipment will be included in the reagent area design.

9) Special consideration will be given to materials selection for each reagent system to guard against corrosion.

10) Sodium dichromate will be received by tank truck in a saturated aqueous solution (69 percent sodium dichromate by weight). Adequate inline heating will be provided to prevent freezing in winter conditions. Sodium dichromate could also be received in solid form if necessary.

Comment No. 53

Table 2.2-2 - This table describes "typical" reagents. A complete listing of all potentially utilized reagents should be provided.

Response:

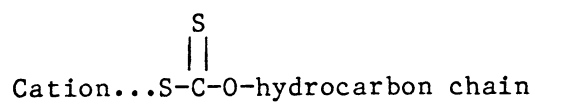
The reagents shown in Tables 2.2-2 and 2.2-3 of the Mine Plan are essentially the reagents that have been used in the process development testing for the Crandon Project. These reagents are "typical" in the sense that they are commonly used in the treatment of ores of this type. At the present time, there are no plans to use reagents other than those listed in the tables. If pilot plant and actual plant testing shows other reagents to be more beneficial or cost effective, they might be incorporated into the process. Any changes in the list of reagents will be documented in an amended Mining Plan which is reviewed annually by the DNR after the date of mining permit issuance.

Comment No. 54

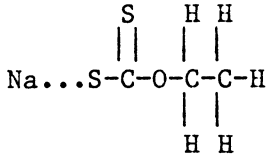
Tables 2.2-2 and 2.2-3 - Some of the reagents listed in these tables are not adequately described chemically so we do not know what they really are. In Table 2.2-2 these are xanthates and flocculants. In Table 2.2-3 they are flocculants, dewatering aid, and "other xanthates."

Response:

The xanthates are a group of flotation collectors which have the following general chemical structure:



For example, sodium ethyl xanthate is one of the xanthates used for treating Crandon ore:



Xanthates with different hydrocarbon chains that will be used include potassium amyl xanthate and sodium isopropyl xanthate. "Other xanthates" which have commonly been used in treating similar ores might be tested in the pilot plant and ultimately used in the flotation process.

Flocculants are generally organic polymers which are commonly used to flocculate fine suspended ore particles so that they settle faster in thickeners and enhance clarity in the thickener overflow. They are generally used in extremely low dosages, typically 15 to 50 g/t (0.03 to 0.1 pound per short ton of ore). Although a particular type and brand of polymer has not been identified for use at Crandon, the polymer used would be one of the flocculants in general use by mining and other industries. A typical polymer is a polyacrylamide.

Dewatering aids are chemicals used to lower the surface tension of water and/or flocculate mineral particles so that they can be filtered more easily. The mining industry uses these chemicals to aid in filtration of concentrates. They are generally similar chemically to those reagents used by car washes during rinse cycles to prevent hard water spots. A particular dewatering agent has not been identified for Crandon, nor has the absolute need for a dewatering aid been established.

Comment No. 55

Section 2.2.6, Concentrator Control Room - All remote environmental monitoring equipment should be described here or under other appropriate sections.

Response:

The concentrator control room will not have any connections to remote environmental monitoring equipment. Any such equipment will be monitored in the environmental laboratory in the concentrator building. The specifics of any such design will be related to the Monitoring and Quality Assurance Plan and completed with final design engineering.

Comment No. 56

Section 2.2.8, Tailing Thickening - More detail and diagrams should be included to describe the equipment, overflow rates, separation efficiencies of sands and fines, and other items having to do with the thickening of the tailings.

Response:

Thickeners are simple sedimentation or settling devices. A dilute slurry is continuously fed at the center feed well of a large circular vessel. The solids settle towards the bottom while clear water overflows along the periphery of the vessel. The settled solids are continuously withdrawn from the bottom of the vessel as a thick slurry. The feed rate, diameter of the vessel, and flocculants, if used, are factors that affect the performance of the thickener. Thickeners are easy to operate and are not mechanically complex and are comonly used in process industries.

For the Crandon Project, we estimate the feed stream will contain an average of 3667 t/d (4043 short tons per day) of solids with a total pulp volume of 1993 m^3/h (8777 gallons per minute). The solids content in the feed slurry will be 7.3 percent by weight. After settling, we estimate the thickener underflow to contain 55 percent solids by weight at a flow rate of 172 m^3/h (756 gallons per minute). The thickener underflow flows to a sump and will be transported by pipeline to the MWDF.

The thickener overflow at 1822 m^3/h (8022 gallons per minute) contains a small amount of solids, approximately 100-1000 ppm by weight. A portion of this water is recycled to the backfill cyclone process directly (as make-up water) and the remainder is recycled via the reclaim ponds.

Sands will not be fed to the tailing thickener but will be used as backfill in the mine. Only the fine fraction of the tailings as overflow from the backfill cyclones will be fed to the tailing thickener.

Comment No. 57

Section 2.2.9, Concentrate Handling and Loadout - Provide more details regarding the design of the covered rail cars and/or trucks to be used for concentrate shipping. This section specifies two day's production storage capacity while page 3-40 states that 10 days storage will be available. Please clarify this apparent discrepancy.

Response:

The railcars to be used to transport concentrate are open top, rectangular cars commonly called gondola cars. They have a steel bed and sides which will completely contain the concentrate without spillage. After loading, the cars will be covered with a plastic cover made especially for this application. These covers are commonly used for this application. Trucks will not normally be used; however, if they are required, they probably would be 18.1-t (20-short ton) semi-trailer type dump trucks covered with plastic similar to that mentioned above.

The correct storage capacities are 2 days for copper and zinc and 10 days for lead concentrate; the Mine Plan will be revised accordingly. Earlier plans called for a total of 10 days storage with 2 days in bins and 8 days on the floor beneath the bins.

Discussions with officials from the Soo Line Railroad indicate that the history of rail service in the area has been extremely reliable. Therefore, the probability of an extended transportation problem occurring is low. The

2-days storage capacity available for copper and zinc concentrates along with storage capacity in available railcars should be adequate to prevent shutdown of the plant during the day or two that the railroad cannot supply cars due to a weather-related problem. Currently, there is an oversupply of gondola cars and this situation is not expected to change in the near future.

Severe market problems would likely force a temporary shutdown of the Project regardless of the amount of storage capacity available.

If railcar availability was to become a problem and the planned concentrate storage capacity was inadequate, more covered storage area would be planned and a permit application for the Project site would be made.

Comment No. 58

Section 2.2.11, Backfill Preparation Facility - Under what circumstances will crushed waste rock be utilized as backfill? The location of the waste rock crusher is not shown on Figure 2.2-1 as indicated in the text. The facilities for metering and mixing coarse tailings, waste rock and cement should be discussed more thoroughly.

Response:

As described in the response to comment No. 117, shortfalls of classified tailings backfill material could result from unanticipated mine/mill operational events. In such cases it may be necessary to supplement normal backfill production with make-up materials such as glacial sand or crushed waste rock. The backfill preparation plant will be designed with provisions for possible future addition of make-up materials handling equipment. Although these conditions are probably remote, should fine (nominal 25 mm [1 inch]) crushed waste rock be required, it could be produced by a portable crushing plant placed adjacent to the surface waste rock stockpile at the west side of the coarse ore storage building (Attachment No. 1, drawing No. 051-1-G-001). Cleaned glacial sands would likely be delivered from the MWDF storage materials and/or an off-site licensed gravel contractor.

The process flow diagram No. DBM-6-L-009 in Attachment No. 4 illustrates the method of storing and handling cycloned sands for mine backfill. The following is a brief description of the process. The cycloned sands are pumped from the desliming ;yclones directly to a "repulping tank." Any sand or fine crushed rock make-up materials required will also be introduced to the circuit by controlled rate addition to the repulping tank feed. The system described here for repulping from the tanks is similar to that used successfully at other operating mining properties.

The lower part of the repulping tank is shaped to a cone and fitted with a nozzle and jet system to permit repulping to the highest percent solids consistent with pumpability. At other operations this has been approximately 70 percent. To deliver backfill product to the mine, the

nozzle/jet system is activated and the repulping tank discharge valve is opened. A density controller in the discharge line maintains the required percent solids.

Cement is added to the system by injection of cement slurry directly into the tailings slurry feed line to the mine. The variable speed drive of the rotary feeder at the discharge of the cement bin is controlled by mass flow control in the sand slurry line, thus assuring the correct cement/sands ratio (normally 6 percent by weight).

Limited surge storage of cycloned tailings sands is provided in horizontal concrete storage bunkers. A total of six such bunkers provides sufficient capacity for the storage of approximately 18,000 t (20,000 short tons) of cycloned tailings sands (approximately 4 days production). These bunkers are located inside the concentrator adjacent to the fine ore crushing area.

Stored coarse tailings sands are reclaimed from the bunker using monitor jets to wash the material into a collecting launder and sump. A sand reclaim pump delivers the sand slurry at 30 to 60 percent solids to a second repulping tank for density adjustment prior to delivery pumping.

High quality backfill mixtures are assured by the precise density and sands/cement ratio control which can be achieved with the system proposed.

Comment No. 59

Section 2.2.12, Backfill, Transport, Storage, and Reclaim - Provide detailed plans and specifications for the backfill pond, including the bottom liner, water decant system, ancillary facilities, and backfill recovery equipment.

Response:

It was originally the intention to store a total of approximately 150,000 t (168,000 short tons) of cycloned tailings sands on a pad located immediately north of the mine/mill site. Cyclone sandfill material would be routed to this storage area when the mine is unable to accept backfill for any reason. Sands would be reclaimed from the storage area as stopes become available for backfilling.

A reappraisal of the mine plan and the stope development sequence has indicated that there is no longer a need to provide large volume surge storage capacity for backfill sands. As a result, this facility has been eliminated and all backfill material handling will be totally within the confines of the concentrator building.

Under the present concept, cycloned tailing sands produced continuously during the milling operation will be mixed with a cement slurry and pumped directly into the mine. Storage capacity for a total of approximately 18,000 t (20,000 short tons) of backfill sands will be provided in concrete storage bunkers. Reclaim from the bunkers will be by monitor jets which will wash the sands into a pump sump. A pump will transfer the sand-slurry

to a repulping tank for settling, adjustment of percent solids, and direct transfer to the mine. Decant water from the repulping tanks will be pumped to the monitor jets providing a totally closed no-loss system.

It is now the intention to utilize the area previously designated for storage of backfill sands as an area for storage of preproduction ore. During the 18-month period prior to mill start-up, a maximum of 1,000,000 t (1,120,000 short tons) of uncrushed ore will be accumulated in the storage area. This material will be fully consumed during the early years of mill operation.

The storage area will be cleared and grubbed and then rough graded to provide drainage toward the northwest. The area will be lined with a bentonite-modified soil mixture protected by a layer of crushed waste rock.

A ditch will be provided to collect rainwater runoff from the stockpile and to conduct the water to a concrete sump. The ditch and sump will be sized to provide sufficient storage capacity to retain the full storm runoff, based upon a one in 25-year storm developing 106.7 mm (4.2 inches) of rainfall in 24 hours. A pump will return the runoff water to the plant process water system or to the water treatment plant as appropriate.

Comment No. 60

Will the pipeline between the backfill preparation plant and the backfill storage area be underground? The specifications and route for this pipeline should be presented.

Response:

The backfill storage area has been deleted and, therefore, the reference pipeline will not be installed.

Comment No. 61

Section 2.2.13, Concrete Batch Plant - Describe plans for concrete preparation prior to completion of the permanent concrete batch plant. Further describe the quantity of aggregate needed during various construction and operation phases. Discuss the availability of suitable aggregate on site and off site. Will the batch plant include aggregate crushing, screening, and washing facilities? If so, describe the disposal of aggregate wash water.

Response:

Preliminary studies have indicated that concrete requirements during the construction phase will probably be obtained through a local supplier who would erect a temporary batch plant within the confines of the mine/mill site. Aggregate supply for the concrete would be the responsibility of the concrete supplier. Based on the quantities of aggregate required, the supplier would probably set up a gravel plant as close to the mine/mill site as he could arrange.

During the construction phase a total of approximately 38,000 m^3 (50,000 cubic yards) of concrete will be placed. This volume of concrete will require an almost similar quantity of aggregates. A peak daily rate of approximately 600 m^3/d (783 cubic yards per day) is estimated for a limited period in 1987.

During operations the requirements for concrete decrease to approximately 1700 m^3/y (2,200 cubic yards per year) and a maximum daily requirement of approximately 23 m^3/d (30 cubic yards per day). It is now anticipated that no permanent batch plant will be required and concrete will be trucked from an off-site supplier.

Comment No. 62

The concrete batch plant, liner batch plant, and soil processing plant are not adequately described anywhere in the application. Drawings of these plants and descriptions of the processes involved will be needed.

Response:

The construction methods study and planning by INDECO included a review of material processing requirements. Basic process descriptions and equipment requirements are included in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR). During the course of INDECO's study, various equipment manufacturers were contacted to provide assurance that proposed processes could be efficiently accomplished. The attached process flowsheets (Attachment No. 5) from Universal Engineering Corporation depict an equipment set capable of providing all required soil materials by processing of the glacial till. Equivalent systems could be provided by other manufacturers.

In Universal Engineering Corporation's system, flowsheets No. 1 and No. 2 are dry processes to prepare liner material and cushion material. The only water used is in flowsheet No. 3 showing the process to prepare the underdrain material. Brief process descriptions are included with the flowsheets.

Water requirements in flowsheet No. 3, for the underdrain material preparation are primarily related to the volume rate of material handled and its fines content. The necessary rate of material handled depends on the scheduled need for facilities. The total water requirement is expected to be in the 0.25-0.38 m^3/s (4000-6000 gallons per minute) range. Actual makeup water is only in the range of 0.03-0.04 m^3/s (400-600 gallons per minute) to account for water loss with the materials removed from the process. There would be a settling pond associated with the process; however, small high capacity clarifiers would be used first to keep the pond size to a minimum. The clarifiers and settling pond would remove the finest material (-200 mesh size), with the clarifier underflow pumped to the pond. After completion of a construction phase the fines would be removed from the pond and used in the liner mix or another appropriate use. The first phase of construction (preparing the waste rock storage area and reclaim pond R1) will determine much of the system sizing requirements because there will be less opportunity to spread out the material processing during that phase.

Based on these needs a settling pond to contain all the fines (-200 mesh) removed during the first phase of construction would be in the range of 0.8 to 1.6 ha (2 to 4 acres) with a depth of 3 to 4.6 m (10 to 15 feet).

In this underdrain material preparation process the -40 mesh fraction of till is removed but does not have to be wasted, as it can be used in place of straight till in other applications. As indicated above, with the reuse of the settled fines, there are no unused materials produced from the classifying or processing operations.

The batching and mixing operations are also accomplished through the use of conventional equipment. The attached manufacturers' data (Attachment No. 5) are typical of the type of equipment that would be used to first batch the bentonite clay with the glacial till and then mix the fractions.

Quality control procedures will be planned in detail for the Plan of Operations; however, general quality control aspects for this type of procedure are included in the Exxon paper "Construction Aspects" (previously provided to the DNR).

Comment No. 63

Section 2.3, Mine Waste Disposal Facilities - What is the total proposed area of the MWDF as measured at the outer toe of the embankments?

Response:

The total surface area of the four tailing ponds within their crests is approximately 161.2 ha (403 acres). The total area of the ponds to the outside toe of the dikes is approximately 202.2 ha (505 acres).

Comment No. 64

Section 2.3.1, Waste Rock Transport and Storage - During the construction phase, will surge piles be needed for waste rock and preproduction ore at the mine site? Will roads at the dump site contain high sulfide materials which could be released by traffic? Will the large diameter waste rock contain enough fines to adequately fill the voids between rocks and prevent piping of cover material into the pile? Will surface crushing of waste rock be required to provide riprap material during the construction phase?

Response:

Surge piles will not be required for either waste rock or preproduction ore in the MWDF. Waste rock will be delivered and placed directly into the storage area at the MWDF. Preproduction ore will be stockpiled at the mine/mill site.

Haul roads at the dump sites (MWDF) will be constructed from crushed rock product obtained from an off-site supplier and will not contain high sulfide concentrations.

Large diameter waste rock up to 0.6 m (2 feet) in diameter will only be produced during the first 3 years of mine development after which time underground crushing will be employed, limiting maximum waste rock size to 152 mm (6 inches) in diameter. The larger diameter waste rock will be placed at the base of the waste rock disposal area and subsequently overlain with the finer crushed waste rock. The predicted waste rock gradation when compared to the average gradation of the local till is such that a piping ratio of less than five can be calculated. The piping ratio is

$$\frac{D_{15}\ \text{(filter)}}{D_{85}\ \text{(protected soil)}}$$

where D_{15} is the sieve size opening in mm which 15 percent of the mass of the filter (waste rock) passes through and D_{85} is the sieve size opening which 85 percent of the mass (till) passes in a standard gradation test (Cedergren, H.R., 1977, Seepage, Drainage and Flow Nets, John Wiley and Sons, p. 181). Large hydraulic gradients within the till cover are not anticipated; consequently, piping should not be a problem.

Surface crushing of waste rock will not be required to produce rip-rap during construction. Rip-rap will be developed from uncrushed waste rock.

Comment No. 65

Section 2.3.2, Waste Rock Disposal and Preproduction Ore Temporary Storage - Additional detail is needed on how the preproduction ore will be separated from the waste rock. Such removal will have to be performed without damage to the liner. Also, describe how the waste rock will be placed on the liner and sand blanket without damaging the integrity of the liner. Will the preproduction ore be placed directly on the liner system or over a bed of waste rock?

Response:

Placement of waste rock in the MWDF will be on a prepared surface composed of the underdrain system and liner. Rock placement should not affect the liner which will be adequately protected by the overlying drainage and filter zones.

Waste rock to be temporarily stored in the MWDF will be in the upper portions of the pile as shown on Figure 2.3-3 of the Mine Plan and should not impact the liner during waste rock recovery.

Continuing study of mine/mill operations has eliminated the need for mine backfill stockpiling. Preproduction ore will now be stockpiled in the mine/mill area rather than the MWDF.

Comment No. 66

Section 2.3.3, Tailings Transport - Provide detailed plans and specifications for the construction, operation, and maintenance of the transport system. (1)More detail is needed on the HDPE pipes and routing the pipelines, including specifications (ASTM, etc.) which the candidate pipes should meet. (2)Documentation should be included either in the text or in an appendix which addresses such items as resistance to crushing for a design overburden and live load, soil types used for trench and backfill, (3)resistance to collapse in a vacuum situation, and (4)ability to resist damage either from blockage by settled solids or by pipe freezing. (5)Leak detection, containment and repair, necessity for redundant pipes, and storage or disposition of water drained from the pipe during normal pump maintenance or power loss should be addressed. (6)Specify pump capacity for each pump on the three pipelines.

Response:

(1) The pipe will be fabricated from an extra-high molecular weight high density polyethylene. This material has been selected on the basis of its resistance to abrasion and corrosion. It is not attacked by chemicals in the soil and it does not support the growth of, and is not affected by, algae, bacteria and fungi.

Typically, for the HDPE pipe envisaged, the physical properties of the material would be tested according to the following ASTM procedures:

Density: ASTM D 1505
Tensile Strength: ASTM D 638
Impact Strength: ASTM D 256
Hardness: ASTM D 2240
Long-Term Strength: ASTM D 2837
Stress Life Testing: ASTM 1598

The pipe material will be high density polyethylene rated for 1725 kpa (250 psi) internal design pressure. In drawing No. 051-1-PSI-002, (see report "Tailing Slurry and Solution Transport Pipeline Systems" by Pipeline Systems Incorporated 1982; previously provided to the DNR), the hydraulic gradients proposed for the system are identified. It can be seen, especially in the case of the tailing transport line that the rated allowable pressure is well above the expected pipeline pressures. For the tailings line, it is proposed to use a wall thickness of 36.8 mm (1.45 inches) and an internal diameter of 199 mm (7.85 inches).

Inspection of the hydraulic gradient data for the other pipe systems shows that, in each case, the pipe is specified to sustain an operating pressure considerably in excess of the expected pressure.

(2) Tailings pipelines and other pipes handling process water will be buried at a depth of 1.83 m (6 feet) below ground to avoid damage by freezing or external hazards.

The trench will be generally as shown in the pipeline installation sketch shown in the report by PSI, Inc. The trench will be over-excavated by 150 mm (6 inches). The trench volume below the pipes will be backfilled with sand, gravel or other select material to support the pipe. Generally, the pipe bed material will be free of rock greater than 12 mm (0.5 inch) in size and will contain no jagged or soft rock.

After the pipe has been laid, it will be surrounded with compacted sand, gravel, or other select material and then backfilled with glacial till derived from trench excavation. Backfill will be compacted to about 85 percent Proctor density (ASTM 698).

When a pipe is buried, it is subjected to external loads such as soil pressure and the pressure of surface loads. The performance limits due to internal pressure are related simply to hoop tension in the pipe wall. The performance limit due to external pressure could be wall crushing, wall buckling, or ring deformation depending on the applied loads, and the phyical properties of the soil and the pipe. These aspects of pipe design will be considered in final engineering.

Instrument cable will be buried with the pipe. The cable will be used as a metal source for pipeline locating instruments.

(3) Because the tailings ponds embankment berms are at a higher elevation than the pumping station and the discharge of tailings to the lower depths of the ponds could create a vacuum in the tailings line, a vacuum breaker will be installed at the high point of the pipeline on the tailings pond berm.

(4) Because the pipeline is buried it will not be vulnerable to deliberate or accidental damage from humans, vehicles or machines. The depth of burial below the frost-line excludes the possibility of freezing. Rodent attack is unlikely at the 1.83 m (6 feet) depth.

Slurry characteristics determined by laboratory penetrometer testwork show that the solids are "soft-settling." In this test procedure a sample of tailing solids and water is prepared and allowed to settle for 24 hours. A penetrometer is placed on the solid-liquid interface. Weights are added to the penetrometer until the tip penetrates the solids and reaches the bottom of the containing vessel. The weight required to achieve penetration under standard conditions is a measure of the resistance of the settled solids to re-slurrying after a pipeline shutdown.

The results of the tests indicated that if the pipeline is shutdown during an emergency, the solids are soft-settling and can reslurry when the pipeline is restarted. During scheduled shutdowns of the pipeline, the solids will be flushed out with water prior to shutdown.
In the event of a sudden blockage of the pipeline, the slurry pumps will not be able to develop the pressure required to rupture the line. The increase in pipeline pressure and decreasing flowrate would activate alarms and the pipeline would be shutdown.

(5) The pipe will be received in 11.6-m (38-feet) lengths. All pipe will be inspected for damage on site. Sections of pipe with cuts or gouges will be cut out and rejected.

Each piece of pipe will be fusion butt welded to form a continuous pipeline from the pumping station in the mine/mill site to the discharge point.

Butt fusion welding involves heating both ends of the pipes to be joined, making contact between the two molten ends and joining them together under pressure. The operation is performed using commercially available equipment designed for this purpose. The equipment is easily transported and may be used at any point along the pipeline during the installation of new pipe or the repair of old pipe. The joint which is formed is stronger than the pipes it joins.

A similar technique will be used to install the reclaim water, thickener overflow water, and decant water pipelines from the tailings ponds.

Buried pipelines are inherently safer than pipelines laid on the surface. They are silent in operation and not visible. Typically, vegetation covers the trenched area within 2 years.

In the event of a pipeline breakage, flowrate monitoring equipment would warn the operator to shutdown the pipeline system. Such an event could be cause for a complete plant shutdown. For the case of a pipeline break at the lowest elevation in the pipeline route the contents of the pipe would drain to the low point. The contents of about a 1800 m (5905 feet) length of line would leak from the pipeline. This is equal to a volume of 58.4 m^3 (15,420 gallons) of slurry. Because of the low elevation heads, the rate of leakage would be low and little solid material would escape.

Clean-up would require excavation around the leak and the water and tailings would be pumped to the MWDF. Repair would involve the removal of the damaged pipe and welding in new pipe using portable butt welding equipment. The repaired pipeline would be leak tested using water before backfilling and returning the pipeline to normal service.

Spare plastic pipe would be retained in storage for repair purposes.

Pipeline leaks in conventional flanged or mechanically coupled pipelines typically occur at the flanges or in areas of the pipe where sudden changes in direction are necessary. The use of welded plastic pipe eliminates the flange or other connections and reduces the possibility of leakage. Typically, HDPE pipe can be cold bent to a minimum radius of 25 times the pipe diameter. This allows gradual direction changes to be made and reduces the possibility of pipe wall erosion and minimizes the potential for leaks.

(6) The current anticipated capacities of the pumps are as follows:

Tailings slurry pumps	185.2 m^3/h* (815 gallons per minute)
Reclaim water pumps	1153 m^3/h (5,077 gallons per minute)
Thickener overflow pumps	1030 m^3/h (4,535 gallons per minute)

*Includes gland seal water

Comment No. 67

Will there be any areas on the mining site where the pipelines will be on the surface? If so, these should be indicated on a diagram. What is the width of the proposed pipeline/haul road corridors?

Response:

The tailing pipeline, the water reclaim pipeline, and the tailing thickener overflow pipeline will be fully buried within the mine/mill site and along the haul road from the mine/mill site to the MWDF/reclaim ponds area. At the MWDF/reclaim ponds area, the pipelines will be routed along the embankment crests. Within the MWDF area there will be additional water pipes routed along the crests to transfer tailings pond surface decant and underdrain water to the reclaim ponds. Drawing No. 050-1-80598 in Attachment No. 6 shows the routing of all pipelines within the MWDF area.

There will be some piping on the surface between the water treatment plant, concentrator, and water tanks and tailings thickener. These pipes will be supported in a pipe rack shown on drawing No. 051-7-C-001 also included in Attachment No. 6.

The haul road cross-section is shown in drawing No. 050-1-80597 in Attachment No. 6. The width of the limit of construction for this road (and the adjacent pipelines) has been estimated at 40 m (131 feet). For projecting impacts a corridor width of 61 m (200 feet) was used.

Comment No. 68

Section 2.3.4, Tailing Disposal - More detail should be provided on the carbonate sludge and the potential effect it will have when pumped to the tailings ponds. There is no additional detail contained in the feasibility study or contractor documents.

Response:

The carbonate sludge is a very fine flocculant precipitate and will have no adverse effect when pumped with the tailings to the ponds. The most recent estimate of calcium carbonate sludge is 250,000 m^3 (327,000 cubic yards) as presented in Table 3.1 of the Mine Waste Disposal Facility Feasibility Report. It is expected that the sludge will fill some of the existing voids in the tailings and their actual required storage volume would be somewhat less. However, a conservative estimate of 1 million m^3 (800 acre-feet)

was used to assure adequate disposal design volume for the MWDF for the carbonate sludge and also for the lesser volume of reclaim pond sludge to be disposed in the tailings pond at completion of operations.

Disposal of this sludge is discussed in the MWDF Feasibility Report in Sections 2.4.5 and 3.4.2.

Comment No. 69

Why does the Golder Report No. 11 (pages 7-19) recommend three feet of freeboard versus the five feet required in NR 182.11(1)(q)?

Response:

NR 182.11 (1)(q) states that "Sufficient freeboard measured from the...crest shall...contain the 100-year, 24-hour rainfall event... or a minimum of 5 feet...". Golder Report No. 11 calculated the 100-year, 24-hour rainfall event and maximum wind generated waves expected for the ponds. These calculations indicated that a 0.9 m (3-foot) freeboard was sufficient to prevent overtopping of waves for the 100-year, 24-hour rainfall event and accompanying high winds. As such, their recommendation meets the requirements of NR 182.11 (1) (q). However, regardless of the interpretation of the regulation, based on the normal maximum tailings pond water levels, freeboard ranges from 2.35 to 3.65 m (7.7 to 12.6 feet).

Comment No. 70

The discussion of the MWDF location is not quite correct with regard to water users in that there are several users downgradient of the site at Rolling Stone Lake. Hemlock and Swamp Creeks are also downgradient of this facility and both drain to Rice Lake. Due to the unique nature of Rice Lake extra measures of protection may be required to maintain its water quality.

Response:

There are approximately 25 private water wells and 21 Exxon Minerals Company owned residential water wells within the area of hydrological influence from the Crandon Project. Since the MWDF is located over a ground water high, all of these wells would be downgradient from the MWDF. However, all of them lie outside of the compliance boundary and should not be impacted by the MWDF. (See EIR Chapter 4.0, Sections 4.2 and 4.3 and Appendix 4.1A.)

Comment No. 71

Section 2.3.5, Water Treatment Waste Disposal - Greater detail should be provided on the effect of disposal of Na_2SO_4 sludge on the types of landfills available in Forest County. It is not likely that a typical town dump will be allowed to accept this material. If a large, engineered county landfill such as the Marathon County Landfill is suitable, that should be made explicit.

Response:

Exxon Minerals Company will comply with any applicable regulation for the disposal of sodium sulfate by-product from the water treatment plant. There are no plans to dispose of this material in any currently existing landfill site in Forest County. Ideally, the material could be marketed to Kraft paper mills. Until the material is accepted as being marketable, or if the material cannot be marketed, the following options could be considered:

1) Disposal in an isolated area within the proposed MWDF;
2) Placement in the MWDF;
3) Placement in an approved off-site landfill; or
4) Placement in the mine, either in a specially excavated area in unfractured footwall rock or in backfilled stopes.

We are willing to work with the DNR to determine an acceptable method of disposing of the sodium sulfate until and if its marketability can be established.

The following information regarding the potential marketability of sodium sulfate is provided:

Sodium sulfate, or salt cake as it is commercially known, is consumed by Kraft pulp and paper mills. Wisconsin has three Kraft pulp mills which consume a total of 29 t/d (32 short tons per day) of salt cake, based on a telephone survey.

Wisconsin Kraft Pulp Mills

Company	Location	Salt Cake Consumption (t/d)
Mosinee	Mosinee	3
Nekoosa	Nekoosa	4
Thilmany	Kaukauna	22*

* 27 t/d (30 short tons per day) of Copeland sulfate (80% Na_2SO_4, 20% Na_2CO_3) equivalent to 22 t/d (24 short tons per day) of pure Na_2SO_4.

An additional 20 t/d (22 short tons per day) of salt cake is projected to be consumed by the states of Minnesota and Michigan, and the Canadian provinces of Manitoba and Ontario.

The production of crystallized sodium sulfate from the water treatment plant will range from 0 to 14 t/d (0 to 15.4 short tons per day) depending on the amount of water being treated by the reverse osmosis/vapor compression evaporation (RO/VCE) units.

Prior to sodium sulfate crystallization (removal of soluble impurities), the nearly saturated sulfate solution exiting the VCE unit will be lime neutralized and then clarified to remove insoluble impurities (heavy metals). This post treatment of the VCE brine will help to ensure a marketable salt cake or a non-hazardous secure landfill disposal option.

Comment No. 72

Section 2.3.6, Reclaim Pond Sludge - Describe the method and frequency of sludge removal. Characterize sludge based on the analysis of sludge from similar operations.

Response:

A conservative projection of 100,000 m^3 (131,000 cubic yards) of reclaim pond sludge has been made for the life of the Project. This estimate is based on the water flow rate passing through the two pond system, the suspended solids in the water, the total Project time, and a sludge density. This volume of sludge can be held in the system for the life of the Project with no effect on the operation of the reclaim ponds. Overall, it is approximately 8.5 percent of the total operating volume. If divided evenly between the two ponds, it would amount to approximately 0.6 m (2 feet) of sediment on the pond bottom.

There will be some difference in the sludges between the two ponds. Reclaim pond R2, the first pond to receive the tailings pond decant and underdrain water, will have sludge consisting largely of tailings and calcium carbonate precipitates, while reclaim pond R1 will have a predominance of gypsum precipitates from the pH adjustment step between the two ponds. There may also be some metal hydroxide precipitates in pond R1.

Aside from the conservative sludge estimates, the operation of the tailings pond decant system offers a degree of control on the clarity of the water returned to the reclaim ponds. Some additional ponding with increased retention time in the tailing ponds could reduce suspended solids in the decant water.

If it would ever be necessary, there are suitable sludge removal methods that would not damage the pond liner while still allowing continued pond operation. A small floating suction dredge with depth control on the suction head could be used. In practice, a small depth of sludge (0.3 m [1.0 foot]) would not be removed to maintain an additional layer over the liner. Specific disposal details for the sludge have not been determined, but are not expected to present any problems. If the estimated 100,000 m^3 (131,000 cubic yards) of sludge were distributed evenly over the final tailings surface of pond T4, the depth of sludge would be approximately 0.25 m (0.8 foot). Since there are no crucial timing constraints on reclamation of pond T4, there will be ample time for proper management of the sludge through drying or blending with tailings or cover soil. The sludge could also be incorporated into the thick till grading layer planned as the first step in reclamation of the tailings pond.

Comment No. 73

Section 2.4.1, Rail Spur - Discuss right-of-way maintenance as it relates to aesthetics, erosion control, and the prevention of railroad initiated wildfires.

Response:

Standard railroad maintenance practices will be followed for the railroad spur. Because the spur line will be new and will receive relatively little use, maintenance will primarily relate to control of vegetation in the right-of-way. The ballast section will be kept free of vegetation altogether, either through use of EPA-approved chemical herbicides or other means. Undesirable weeds or woody vegetation within other areas of the right-of-way will be controlled by mowing or through use of EPA-approved chemical herbicides or other means.

The railroad right-of-way will be periodically inspected to ensure all vegetated areas are stabilized and are effectively controlling erosion. If any areas within the right-of-way show signs of erosion, measures will be taken to regrade the affected area and establish vegetative cover.

Other than the measures identified above to control vegetation within the corridor, no additional preventative measures are planned to control fires originating within the corridor.

Comment No. 74

Section 2.4.2, Access Road - Describe the surface material to be used on this road.

Response:

Bituminous concrete will be used for the access road pavement.

Comment No. 75

Section 2.4.6, Sanitary Waste Facilities - Discuss the anticipated volumes and frequency of sludge disposal. Greater detail should be provided as to how much area is needed annually for the disposal of septage. Given the climate in Forest County, there is potential that this material may have to be stored for a significant part of the cold winter months. Please estimate the land area needed and available for landspreading or the available treatment plants for treating this waste.

Response:

The initial preliminary sewage treatment system was designed by CH2M Hill in accordance with Wisconsin Administrative Code Section ILHR 83 as well as U.S. Department of Health, Education, and Welfare "Manual of Septic Tank Practice." The total liquid capacity of the septic tank is 223.3 m^3 (59,000 gallons). This will provide one-day liquid retention time and allow

for 49.2 m^3 (13,000 gallons) of sludge storage. This system will require sludge removal once or twice a year. If the entire septic tank of approximately 223.3 m^3 (59,000 gallons), which includes 49.2 m^3 (13,000 gallons) of sludge, is emptied, the sludge field required is less than 2 ha (5 acres). This assumes an application rate of 0.11 $m^3/9.3\ m^2$ (30 gallons per 100 square feet). Although land area is available for on-site disposal, Exxon does not currently plan to develop such an area. These volumes will be handled by a licensed private contractor.

Initially, pumping might be more frequent to avoid winter sludge disposal problems (if winter disposal is prohibitive for the private comtractor); however, with some operating experience, a sludge pumping schedule could be established to avoid winter disposal.

Additional design work on the soil absorption field portion of the sanitary waste disposal facilities has reduced the estimated sewage flows. This information has been provided to DILHR and the DNR. In the final design work for the septic tank and appurtenances, these reduced flows will be used in refining the design. The reduced sewage volumes will further lessen sludge disposal quantities and disposal effects from those described above. Also see response to comments No. 106 and 133.

Comment No. 76

Section 2.4.8, Fuel Storage and Distribution - Provide a map showing the location of fuel distribution pipelines. Provide specifications for pipeline construction, particularly in areas of potential earth settling or mine subsidence. Provide specifications and the anticipated life expectancy for buried fuel tanks. Provide plans for the containment dikes around surface fuel storage tanks and detail the storm water drainage from these containment structures.

Response:

The fuel distribution system is confined to a single line, approximately 200 m (656 feet) long, from the bulk fuel storage tanks to the fuel tanks located at the fuel delivery borehole to the mine (see drawing No. 051-7-C-001 in Attachment No. 6). No settlement is expected along this pipeline route. The pipeline specification would be C.S. Sch. 40 with welded joints.

Details of the buried fuel tanks are presented in drawings No. 051-0-G-003 and 051-1-G-004 in Attachment No. 7. The anticipated life expectancy for the buried fuel tanks is longer than the Project life.

The area within the containment dikes surrounding the bulk fuel storage facility will be lined with an elastomer membrane to prevent spills and contaminated runoff from reaching ground water. Any minor spills and washdown or runoff from this area will be transferred to the industrial wastewater treatment system. (This system also collects washdown and runoff from around the shops and other areas of potential oil/grit contamination.)

Precipitation collected within the containment berms would not normally be contaminated in any way since the fuel storage and handling systems are totally enclosed and sealed. In such case the precipitation would simply be permitted to flow off into the surrounding area.

The design of the industrial wastewater treatment system will be finalized during detailed engineering. The system will be provided with an oil/water separator to remove oily contaminants. This contaminant material will be transferred to a holding tank for eventual removal from the site. The clear water will be pumped to the reclaim pond.

Comment No. 77

Will collection and treatment of runoff from the fuel oil storage area and the tank unloading area be provided? Please elaborate on the answer and indicate the type of treatment proposed, quantity of runoff, etc.

Response:

See the response to comment No. 76.

Comment No. 78

Section 2.4.10, Potable Water Facilities - The discussion of the potable water supply system should be expanded to contain more detail on such things as well construction, the distribution system and any storage facilities. These questions and others will have to be addressed in detail in the high capacity well approval submittal.

Response:

A comprehensive discussion of the proposed potable water facilities is presented in the application for high capacity well permits (submitted to the DNR in October 1983).

Comment No. 79

Section 2.4.11, Water Treatment Facilities - Details are needed of the water release pipeline similar to those for the tailings and reclaimed water pipelines addressed above.

Response:

At the current stage of project engineering the water discharge pipeline is expected to be constructed of 0.36-m (14-inch) diameter high density

polyethylene (HDPE) pipe and buried a minimum of 1.5 m (5 feet) below ground to beneath the frost line. The exact size and wall thickness of the pipeline will be determined later.

Because the trench will be excavated in glacial till, blasting will not be required and all excavation can be by a backhoe or trenching machine. The trench volume in the pipeline zone will be backfilled with sand or gravel or other select material and the remaining trench volume will be backfilled with till. During construction, exposed areas with potential for runoff of sediments will be controlled with straw bale sediment traps. Seeding and reestablishment of vegetation will follow shortly after trench backfilling.

General HDPE pipe characteristics are discussed in the response to comment No. 66. Current engineering calculations show that HDPE pipe rated at 250 psi internal design pressure would be well above expected pipeline pressures.

The water discharge pipeline should not experience vacuum conditions because vacuum breakers will be installed prior to operation.

Blockage of the pipeline due to settled solids will not be a problem because solids in the discharge water will be less than 20 mg/l. Any settling due to periodic pipeline shutdown will be flushed out during start-up.

The depth that the pipeline will be buried will preclude pipeline freezing.

The pipe will be received in 11.6-m (38-feet) lengths. All pipe will be inspected for damage on-site. Sections of pipe with cuts or gouges will be removed and rejected.

Each piece of pipe will be fusion butt welded to form a continuous pipeline from the pumping station on the mine/mill site to the discharge point.

Butt fusion welding involves heating both ends of the pipes to be joined, making contact between the two molten ends and joining them together under pressure. The operation is performed using commercially available equipment designed for this purpose. The equipment is easily transported and may be used at any point along the pipeline during the installation of new pipe or the repair of old pipe. The joint which is formed is stronger than the pipe it joins.

Buried pipelines are inherently safer than pipelines laid on the surface. They are silent in operation and not visible. Typically, vegetation covers the trenched area within 2 years.

In the event of a pipeline breakage, flowrate monitoring equipment would warn the operator to shutdown the pipeline system.

Clean-up and removal of spilled water will not be necessary due to the good quality of the treated discharge. Repair of the pipeline will involve the

removal of the damaged pipe and welding in new pipe using portable butt-welding equipment. The repaired pipeline would be leak tested using water before backfilling and returning the pipeline to normal service.

Spare plastic pipe will be stocked for repair purposes.

Pipeline leaks in conventional flanged or mechanically coupled pipelines typically occur at the flanges or in areas of the pipe where sudden changes in direction are necessary. The use of welded plastic pipe eliminates the flange or other connections and reduces the possibility of leakage. Typically, HDPE pipe can be cold bent to a minimum radius of 25 times the pipe diameter. This allows gradual direction changes to be made and minimizes the possibility of leaks.

Current plans call for use of three pumps in the system. Two 110-hp pumps and one 170-hp pump. During normal operation (discharge less than 2,000 gallons per minute) one of the 110-hp pumps will be used with the other for standby operation. During maximum discharge (3,000 gallons per minute), all three pumps would be used.

Comment No. 80

Section 2.4.12, Reclaim Water Ponds - The statement that "the reclaim ponds and the tailings ponds will provide surge capacity for the water management system" needs further clarification. The reclaim ponds apparently will be filled to capacity during normal operations and according to Knight and Piesold, it is desirable to reduce or eliminate any pond on the tailing surface in order to achieve drying and consolidation of the tailings. Under these conditions, how long could the mine or concentrator continue operation in the event of an extended water treatment plant shutdown?

Response:

When the water level in the reclaim ponds is at the maximum normal operating level, there is water surge (storage) capacity in the ponds in the pond freeboard depth. Reclaim ponds R1 and R2 have a design freeboard of 2.59 m (8.5 feet) and 0.91 m (3.0 feet), respectively, above maximum operating water level. Approximately 1.55 m (5.1 feet) of the freeboard in reclaim pond R1 will hold 14 days of water flow at a rate of 0.158 m^3/s (2500 gallons per minute). The reclaim ponds freeboard is designed to contain the volume of the probable maximum precipitation (PMP) event including the water from the largest tailing pond (T4). The preferred operating practice will be to keep the water level in the pond below the maximum level so that surge capacity is available without infringing on the freeboard allowance. In Section 3.0 of the "Miscellaneous Details and Analyses" report by Golder Associates, additional pond freeboard information is presented.

The surge capacity in each of the tailing ponds, above highest normal water levels, is in all cases greater than required from a storm and wave run-up standpoint. In an emergency, if the surge capacity in the reclaim ponds was not sufficient, the tailing ponds could be used to store water.

To use the tailing ponds storage capacity and maintain low seepage rates, pumping of the underdrains would continue with underdrain water circulated back to the tailing ponds. Then, depending upon the rate of decant water pumping, water level in a tailings pond could be increased to accommodate surge storage requirements. As the ponded water depth is increased there is an increase in the underdrain flow rate, but it can be accommodated as a result of the design of the underdrain pumping system. If the underdrains were not pumped, they would flood; while this would temporarily increase seepage, it would not affect the integrity of the facility, nor change the stability of the embankments.

Tailings deposited underwater would have a slightly lower density (approximately 10 percent less) than the previously deposited tailings. However, the overall tailings volume change within the pond would be negligible.

Tailing pond T1 has the smallest surge capacity of the four ponds. Its lowest surge capacity (at completion of tailings deposition) is approximately 660,000 m^3 (535 acre-feet) from the tailings surface to a level surface 0.91 m (3 feet) below the pond crest. Surge capacity within the 0.91 m (3 feet) freeboard height is approximately 300,000 m^3 (244 acre-feet). At a water flow rate of 0.158 m^3/s (2500 gallons per minute), these volumes represent 48 and 22 days of surge capacity, respectively. The total minimum surge capacity (i.e., tailings pond T1 and reclaim pond R1 water storage) would be approximately 84 days at a 0.158 m^3/s (2500 gallons per minute) flow rate. These conclusions are based on the fact that the concentrator is still operating and that water continues to flow into and out of the reclaim pond for process purposes. The estimate of 0.158 m^3/s (2500 gallons per minute) is a conservatively high value for total water pumped from the mine.

Comment No. 81

Section 2.4.14, Shop, Garage and Warehouses - Where will drainage of the southside unloading dock be routed?

Response:

The revised design incorporates the shops, garage, warehouse, offices and change rooms into a single building known as the Services Building (see drawing No. 051-1-G-001 in Attachment No. 1). This building is located in the same general area as were the shops and warehouse in previous layouts shown in the Mine Plan. The off-loading and outside areas adjacent to the shops are located to the north and northwest of this building. Spills, grit or other contamination which might occur in these areas will be routed and handled through the industrial wastewater treatment system.

Comment No. 82

Section 2.4.15, Other Water Facilities - In addition to the fueling station drainage, what other waste streams will be routed to the oily water sewer system? What is the volume of water which will flow through the oily water sewer system? Overflow from the oily water sewer system should not be directed to the reclaim ponds unless it can be shown that the pond and mill treatment system can handle the wastes.

Response:

The 1-ha (2.48-acre) area in front of the shops and warehouse and the 0.25-ha (0.62-acre) equipment and material laydown area southeast of the headframe will also drain into the oily water sewer system. The volume of water which will flow through the industrial wastewater sewer system is only that from precipitation runoff. For a 1.25-ha (3.1-acre) area this is approximately an annual average of 1.1 m^3/h (5 gallons per minute). The industrial wastewater sewer system is designed to separate the immiscible oil from water. Once separated, the oil-free water stream flows to the reclaim pond. There is no incompatibility of this 1.1-m^3/h (5-gallons per minute) oil-free water stream with the 1135+ m^3/h (5000+ gallons per minute) water feeding the reclaim ponds or the mill process recycle water treatment system.

Comment No. 83

Section 3.2, Facilities Construction (General) -The clearing of trees and shrubs during periods of snow cover is preferable because the wildfire hazard is miminized, salvage wood increases in volume and value because the logs are protected from dirt, and the lack of leaves reduces the slash volumes.

Response:

Comment acknowledged.

Comment No. 84

Commercial whole tree chipping contractors and the sale of chips for fuel or pulp should be investigated as an alternative to burning. The burial of stumps under a one-time disposal permit may also be an alternative. DNR burning permits will be required for any burning during the fire season.

Response:

Comment acknowledged. To minimize the amount of burning that will be required during clearing of the Project site, consideration will be given to using contractors having whole tree chipping capability for the removal of wood.

Comment No. 85

Provide a grading plan for all disturbed areas showing interim and final grades, along with earth material balances. If negative balances are derived, specify the source of imported fill and/or topsoil If positive balances are found, specify the use or disposal of surplus material. Include in the plans the specifics of the runoff and erosion control program and further describe the scheduling relationship between grading and runoff control. Calculate anticipated maximum runoff volumes from each storm water collection area and maximum flow rates in major collection ditches. Provide plans for all temporary and permanent storm water impoundments, specifying design capacity, retention times, control structures, overflow pipes, weirs, energy dissipaters, and surface stabilization material or methods. Define and differentiate between short-term and long-term erosion control measures (for example, the use of straw bales for periods of more than one year may aggravate siltation release problems because of the need for frequent maintenance with resulting disturbance to other stabilization materials).

Response:

The three attached civil drawings (Attachment No. 8) indicate the grading plans for final grades superimposed on existing topography in the site area.

As described in the Mine Plan, the site will be cleared, grubbed, and rough graded as necessary which will be one of the initial activities in the construction schedule. Since there is no phasing to this work, there will be no interim conditions for any length of time.

The storage area for the salvaged topsoil, estimated at 53,500 m^3 (70,000 cubic yards), is shown on the east side of the mine/mill area. Earthwork calculations for the mine/mill area indicate a net excess of 70,700 m^3 (92,400 cubic yards) of material in addition to the topsoil stockpile. This excess material will be utilized in the construction of the MWDF.

Erosion control will be developed as necessary with the rough grading. To the extent possible, the two permanent surface drainage basins will be used for runoff control (see drawings No. 051-1-C-001 and 051-1-G-002 in Attachment No. 8). The basin areas will be excavated first with grading work generally progressing outward from the basins. Where portions of the storm drainage system are not installed concurrently with the rough grading, separate provision for runoff and erosion control will be made. These provisions will consist of temporary siltation basins or hay or straw bale ditch retention checks.

Graded areas not scheduled for immediate development would be revegetated with a temporary ground cover following the grading work to reduce siltation from runoff erosion. As an area is subsequently developed, any portions of the final storm drainage system not installed with the initial site work would first be installed for the area before beginning other construction.

At that point, runoff would be controlled by the final system, although some hay or straw bale ditch checks might still be used to prevent downstream siltation of the system. Development of the site in this manner will reduce the need for short-term temporary erosion control measures. The long-term control will be through the final surface water drainage system.

The three civil drawings include a culvert schedule which presents the water flow rates in the ditches and culverts, for a 10-year, 24-hour storm. Runoff coefficients and tributary areas are included with the other drawing data.

Except for two small extremities of the mine/mill area (the road to the underground fuel delivery borehole at the southwest and the explosive storage area at the northeast), all surface water will be directed to surface drainage basins No. 1 and No. 2. The drainage basins are sized for a 25-year, 24-hour storm, with pond depth allowance for sediment accumulation and maintenance of freeboard. Runoff in the preproduction ore storage area, which is now located where the backfill sands were originally designated to be stored, is collected and pumped as needed to the water treatment plant feed tank. As shown on the drawing, drainage is also collected separately from three other small areas in the central portion of the mine/mill site. This water is directed through and oil/water separator and then to the reclaim pond.

Typical drainage inlets for paved areas and for ditches, and details of the surface drainage basins are included with the drawings.

Comment No. 86

Section 3.2.1, Mine/Mill Site Preparation - What is the projected volume of wood waste which will have to be handled? Where will the mulched material be stockpiled?

Response:

A Forest Inventory and Timber Appraisal Report prepared for the Crandon Project by Edward F. Steigerwaldt and Sons included an estimate of timber resources recoverable during mine/mill site development (report previously provided to DNR). By adjusting their estimates to actual cleared area for the mine/mill site, and applying percentage waste factors, the amount of wood waste from timber harvesting was estimated. Using a factor of 65 percent waste (culls, branches, and tops) on an air dry weight basis, a wood waste quantity of approximately 1360 t (1500 short tons) was estimated.

The calculations leading to these totals are presented in the attached table. Stumps removed during grubbing would increase these totals.

The disposal options of burning or mulching and reusing, as suggested in the Mine Plan, are still considered appropriate.

(TABLE FOR RESPONSE TO COMMENT NO. 86)

WASTE WOOD FROM MINE/MILL SITE CLEARING
STEIGERWALDT DATA

Acres	Cords	Board Feet
201	2761	186,795
(Revise cleared area to 89 acres)		
89/201	1215	82,190
Air dry tons	2126	154
Waste at 65%*	1382	100
Total: 1482 Tons		

Notes: Cord - 128 ft^3
Wood Volume - 80 ft^3
Air dry weight (hardwoods) - 3500 lbs/cord (1.75 tons per cord)
Air dry weight (hardwoods) - 45 lbs/ft^3 (0.0225 $tons/ft^3$)

* Contained in a Dames and Moore Study for WPSC on wood availability in this area of Wisconsin. (65% represents culls, branches, and tops normally left in the field after harvest - stumps would increase the percentage.)

If the approximate 1361 t (1500 short tons) of waste wood were chipped for mulch and stockpiled, it could be stored adjacent to the topsoil storage area. Assuming a density of 0.32 t/m^3 (20 pounds per cubic foot) for the waste wood, approximately 4320 m^3 (3.5 acre-feet) of storage volume would be required.

Comment No. 87 and Comment No. 88

Section 3.2.2, Temporary Facilities - None of the existing on-site water wells were constructed or approved for potable water supply purposes. Modifications of previously granted high capacity well approvals will, therefore, be required prior to the use of existing wells for drinking water purposes. The use of several strategically located wells should be considered in order to minimize the need for tank trucks and potable water dispensers.

Where will the construction water well be located? Construction details, distribution system and storage facilities should be discussed.

Response:

A high capacity well permit application has been recently submitted to the DNR to cover two wells that will supply potable and construction water for the Crandon Project. One of the wells is a completely new well located southwest of the mine/mill area (N 35,330, E 693,730) which will be the primary potable water supply well during the mine operating period. The other well is located in the MWDF area (N 34,787.24, E 697,267.63) and will be a modification of an existing, previously approved potable water well. During the mine operating period, this well will provide some potable water for use in the area of the MWDF but will primarily be used for water supply for material processing to produce the underdrain and liner materials for construction of the MWDF.

Both of these wells will be built as soon as possible with start of initial site development. They will then be available to meet all potable and construction water requirements throughout the construction period. For the very short time (a matter of weeks) before the well in the MWDF area could be ready for use, other arrangements would be made for supply of potable and construction water. During this time the two existing site wells (WW#1 and WW#2), although not approved for potable water, would be used for construction water and Exxon Minerals Company would arrange to haul in and distribute (through water dispensers) required potable water.

Comment No. 89

Section 3.2.3, Access Road Construction - Please discuss the road surfacing process.

Response:

The access road preliminary design pavement section includes a 76 mm (3 inch) bituminous concrete pavement with an underlaying 0.3 m (1 foot) crushed aggregate base course.

Construction processes for the pavement would follow normal practice used in the area. A central plant would batch and mix the pavement materials followed by truck transfer to the site where paving machines would be used for pavement placement.

Comment No. 90

What off-site landfill will be used for disposal of wood waste created by the construction of the access road corridor?

Response:

The estimated wood waste from the access road construction is approximately 272 t (300 tons). If this wood waste were chipped for use as mulch, the approximate volume would be 841 m^3 (1100 cubic yards). If this volume could not be used in landscaping of the access road, it would be transferred to the mine/mill site for storage with other chipped wood waste.

Unchippable wood waste (stumps) would be burned (a permit would be requested) at a suitable location along the access road. Transfer to an off-site landfill for disposal is still considered as an alternative but not a preferred one.

Comment No. 91

What will ultimately be done with the sediment that is collected in the temporary retention areas near the wetlands and behind the sheet piling at the stream crossings? How much peat is expected to be encountered in the wetland crossings?

Response:

After the various temporary sediment traps along the access road are no longer required, the sediments will be removed and transferred to either the topsoil stockpile area at the mine/mill area or to the soil stockpile areas at the MWDF.

The total estimated wetland/marsh materials removed along the access road is approximately 4800 m^3 (6275 cubic yards). No separate estimate of peat materials within this volume has been made.

Comment No. 92 and Comment No. 93

Section 3.2.4.2, Shafts and Collar - The discussion of shaft construction needs expansion. What type of brine will be used? How large will the holes be and how will they be constructed and spaced? How much area will be affected by the soil moisture freezing? How long will the "ice ring" be intact? What diameter will the total excavation for the main shaft be?

Discuss brine containment and waste brine disposal.

Response:

The plan for development of the Crandon Mine includes construction of four vertical shafts:

1) Main production and service shaft - 7.3 m (24 feet) finished diameter;

2) Intake air shaft - 5.5 m (18 feet) finished diameter;

3) East exhaust air raise - 6.1 m (20 feet) finished diameter; and

4) West exhaust air raise - 6.1 m (20 feet) finished diameter.

Each shaft will have a concrete lined collar through the glacial overburden and weathered subcrop rock. Collar construction will include stabilization and hydraulic control by ground freezing, followed by excavation and concrete lining within the protective frozen soil cylinder.

The stabilized ice wall is formed by closed circuit circulation of a cooling fluid (calcium chloride brine) through a circular pattern of vertical pressure-tested steel-cased boreholes (114-152 mm [4 1/2 - 6 inches] diameter) containing inner 38-mm (1 1/2-inch) down-flow tubes. Monitor boreholes are also provided to measure ground water levels, ground temperatures, and for detection of brine leakage. With this temporary ground stabilization method no foreign materials are introduced to the ground water regime or surrounding soils.

Freezing system design, e.g., number of freeze holes, hole spacing, and required ice wall thickness, is contingent upon the geohydrologic conditions of each site. Preliminary designs for the Crandon shaft collars have been prepared by Ground/Water Technology, Inc. of Denville, New Jersey. Site design details are shown on the four figures included in Attachment No. 9.

Once excavation and lining of the shaft collars are complete, the protective ice walls and the surrounding soils will be allowed to thaw. The ice walls will be intact for various periods depending upon the shaft being constructed. They will range from 14 weeks (east exhaust raise) to 24 weeks (intake air shaft). Abandonment of the freeze pipes will include:

1) Removal of brine for off-site disposal by the freezing contractor;

2) Clean water flushing of freeze pipes;

3) Mechanical perforation of freeze pipe casings at the soil-rock interface and at the hole bottom; and

4) Displacement of freeze pipe flushing water with cement grout delivered from the surface.

Ground freezing is an established shaft collar construction technique for sites with saturated or unstable soils. For additional technique and application details the reader is referred to:

1. Sanger, F. J. 1968, Ground Freezing in Construction. - Journal of the Soil Mechanics and Foundations Division, A. S. C. E. Vol. 94, No. SMI. Proc. Paper 5743. January, 1968.

2. Sanger, F. J. and Sayles, F. H. 1978, Thermal and Rheological Computations for Artificially Frozen Ground Construction. - International Symposium on Ground Freezing. March, 1978. Bochum.

3. Maishman, D. 1982, Ground and Water Control by Freezing - The Application in Shaft Construction. - University of Wisconsin, Extension Course on Shaft Design and Construction. January, 1982.

Comment No. 94

The discussion of blasting should identify the magnitude of the blasts, types of explosives and demonstrate compliance with DILHR requirements.

Response:

The main production and intake air shafts will be developed concurrently. The main production shaft will be developed at a rate of 2 m (6.9 feet) in depth per day (7.3 m [24 feet] finished diameter). This will require an average of 2 blasts per 24-hour day. Each of these blasts will require approximately 97 Kg (214 pounds) of 40 or 60 percent strength straight-gelatin dynamite and 66 no. 6-strength electric blasting caps.

The intake air shaft (5.5 m [18 feet] finished diameter) will be developed at a rate of 2.6 m (8.5 feet) in depth per day and require an average of 2.5 blasts per day. Each blast will require approximately 84 Kg (186 pounds) of 40 or 60 percent strength straight-gelatin dynamite and 45 no. 6-strength electric blasting caps.

All blasting will be conducted to comply with the appropriate DILHR Code (i.e., Chapter Ind 5, Explosives and Blasting Agents), in particular sections 5.64, 5.65 and 5.66. All required permits and procedures will be complied with prior to undertaking these tasks.

Comment No. 95

What is the projected volume of water that will be generated during the shaft construction (i.e., is 2,000 gpm the maximum to be reached 2-3 years after starting construction)?

Response:

During development of the main production and intake air shafts, water will enter the excavations from three sources: (1) precipitation; (2) ground water seepage; and (3) utility water supply.

All shaft drainage will be pumped to surface storage ponds prior to treatment and discharge as required.

Precipitation gains over the total area of the shafts will be less than 0.07 m^3/h (0.3 gallons per minute). Construction plans provide for control of surface runoff around the shaft excavations. Therefore, the effects of precipitation drainage on shaft development are negligible.

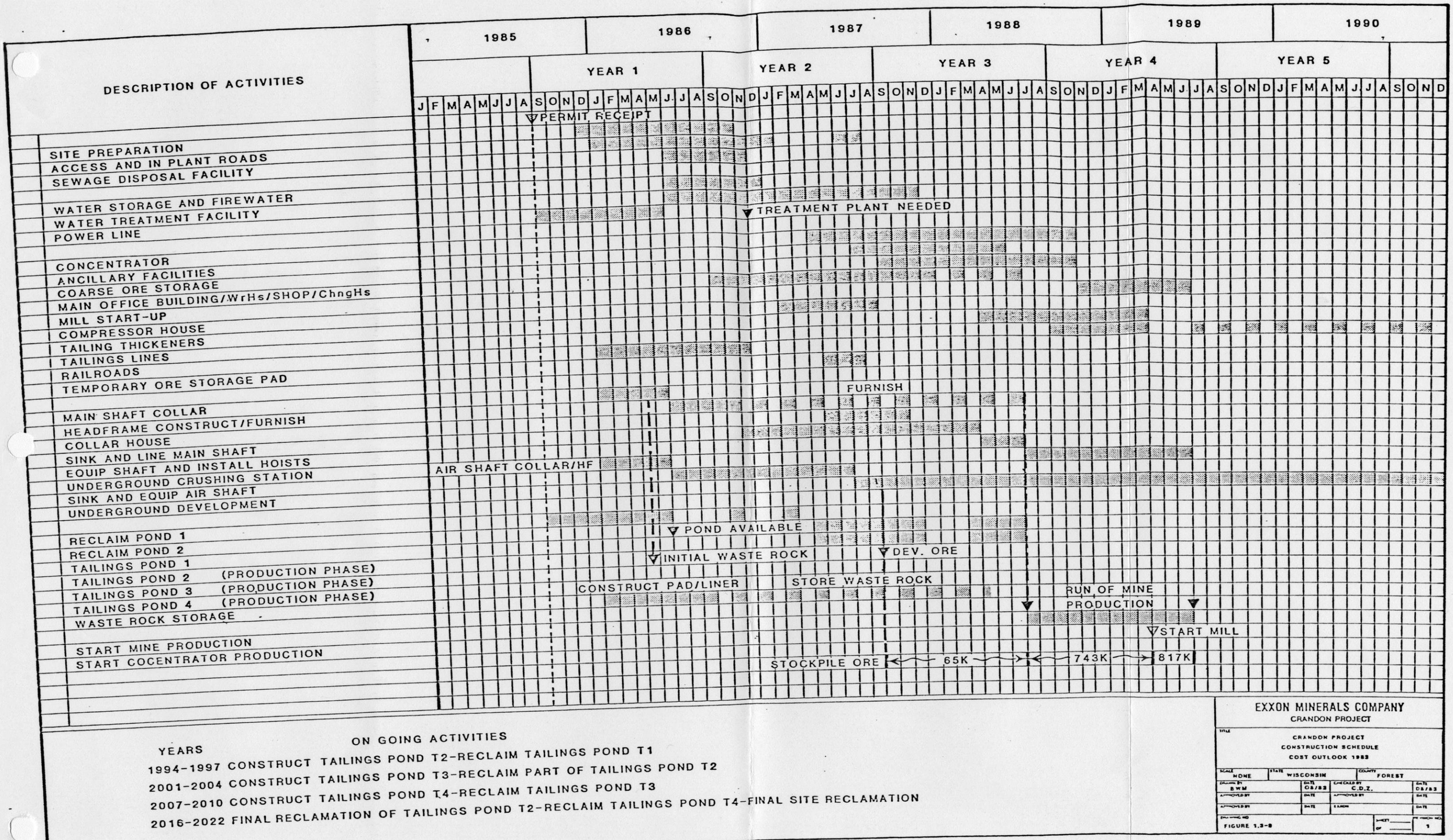
Ground water seepage into the shaft excavations will vary from 0 to 3.4 m^3/h (0 to 15 gallons per minute) in each shaft, and is estimated to average 0.9 m^3/h (4 gallons per minute) (Dames and Moore, April 19, 1978, pumping tests of shaft pilot hole No. 155). During collar excavation and lining, the freezewall methods to be employed will negate ground water influx. When sinking begins in bedrock, ground water quantity will vary with depth, fracture intensity, and reservoir source (overburden aquifer or connate bedrock water). Shaft construction specifications will require rock grouting any time ground water inflow to the excavation exceeds 3.4 m^3/h (15 gallons per minute) in sections not yet permanently lined with concrete.

Utility or process water consumption during shaft development will vary from zero to 1.4 m^3/h (0 to 6 gallons per minute) during different shaft sinking operations. The nominal average use is estimated to be 0.45 m^3/h (2 gallons per minute).

Once intake air shaft sinking is complete and mine level development begins, shaft drainage water will constitute only a small part of the estimated total mine inflow. Until that time, approximately 18 months after the start of shaft sinking, all mine water will be pumped to a surface sedimentation pond prior to discharge. During this 18-month period an estimated 18,925 m^3 (5,000,000 gallons) of water will be pumped from the shaft excavations. Reclaim pond R1 and a small transfer pond at the construction site will be available to receive the shaft construction water when sinking in bedrock begins (see the attached revised construction schedule). Only 3.2 percent of reclaim pond R1's 590,460 m^3 (156,000,000 gallons) normal operating capacity will be required to store the estimated 18,925 m^3 (5,000,000 gallons) of shaft excavation drainage, discounting any treatment and discharge which will be available as an option 10 months after shaft construction begins.

Comment No. 96

Section 3.2.4.3, Underground Development - (1)The discussion of grouting the bedrock-overburden interface is inadequate. Details on the location of grouted sections, thickness of grout layers and total amount of grout to be injected must be presented along with a detailed plan of construction. (2)A similar discussion of the specifications and construction of the groundwater interceptor system is also necessary. Diagrams and cross sections of these two systems would be extremely beneficial. What will the temporary water containment facilities consist of?



YEARS ON GOING ACTIVITIES

1994-1997 CONSTRUCT TAILINGS POND T2-RECLAIM TAILINGS POND T1

2001-2004 CONSTRUCT TAILINGS POND T3-RECLAIM PART OF TAILINGS POND T2

2007-2010 CONSTRUCT TAILINGS POND T4-RECLAIM TAILINGS POND T3

2016-2022 FINAL RECLAMATION OF TAILINGS POND T2-RECLAIM TAILINGS POND T4-FINAL SITE RECLAMATION

EXXON MINERALS COMPANY
CRANDON PROJECT

CRANDON PROJECT
CONSTRUCTION SCHEDULE
COST OUTLOOK 1983

SCALE NONE | STATE WISCONSIN | COUNTY FOREST
DRAWN BY B.W.M | DATE 08/83 | CHECKED BY C.D.Z. | DATE 08/83
APPROVED BY | DATE | APPROVED BY | DATE
APPROVED BY | DATE | | DATE
DRAWING NO FIGURE 1.3-8 | SHEET 1 OF 1 | REVISION NO

(FIGURE FOR RESPONSE TO COMMENT NO. 95.)

Response:

(1) Site geohydrologic conditions will limit the flow of ground water into the Crandon mine to a steady state rate of approximately 0.118 m^3/s (1870 gallons per minute) as documented in the Prickett Associates' report entitled "Ground Water Inflow Model for the Proposed Crandon Mine," December 1982 (previously provided to the DNR). A layer of relatively impermeable glacial till and/or clay-rich weathered bedrock retards ground water entry over much of the mine area. The inflows forecast to occur will be primarily in areas where overburden aquifer sands are in contact with porous weathered rock at the orebody subcrop. The ground water impact modeling presented in EIR Appendix 4.1A reflects these flow mechanics of the site geohydrology, in that only partial desaturation of the aquifer above the mine is forecast.

Any artificial controls applied to reduce the inflow would reduce mine drainage and water treatment and discharge costs. Potential mine inflow control techniques were investigated by Klohn Leonoff Consulting Engineers as described in their June 1982 report entitled "Crandon Project Mine Water Control Plan - Alternative Evaluation and Preliminary Engineering."

Mine inflow path permeability reduction methods evaluated included primarily cement and bentonite grouting techniques. Chemical grouting was eliminated as environmentally unsound, and long-term freezing of the saturated overburden was shown uneconomical. Of the grouting methods described by Klohn Leonoff, the plan to place bentonite grout in the high inflow areas of the orebody subcrop was most practical and potentially effective. In essence, this technique would artificially create flow resistant material similar to that which currently occurs over most of the mine area.

At areas of the orebody subcrop where saturated glacial sands are in contact with porous weathered bedrock, bentonite grout would be injected through surface wells (Figure 1 attached). Klohn Leonoff has recommended a descending two stage technique. The first stage would place 4.5 m (15 feet) of grout in the glacial overburden immediately above the bedrock. A second grouting phase would then be conducted in the upper 4.5 m (15 feet) of the weathered bedrock. The resulting layer of reduced permeability material, or grout blanket, would then be 9.0 m (30 feet) thick (Figure 2 attached).

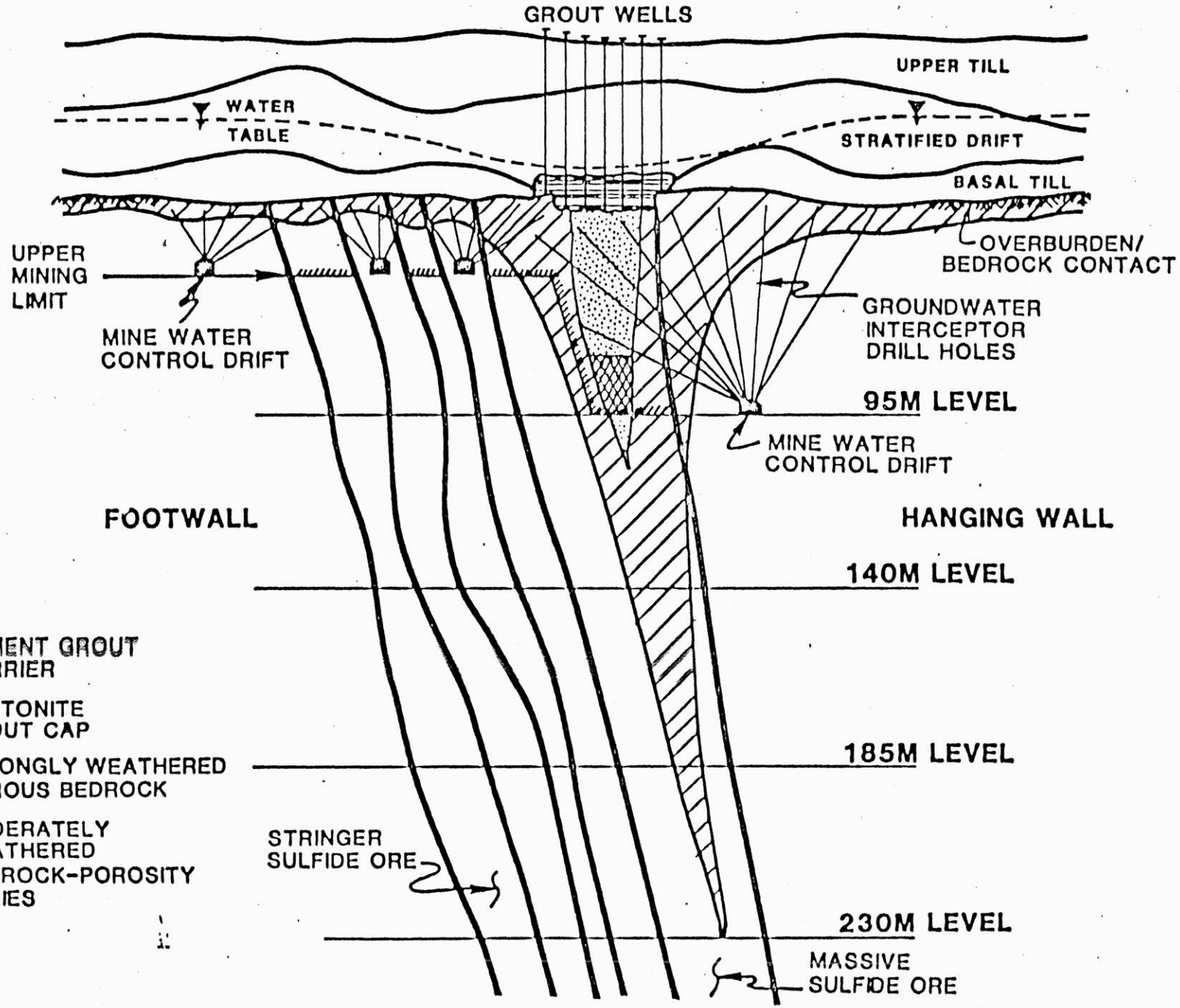
Grout well spacing will be determined by future field testing, but the preliminary engineering work has suggested primary boreholes on a 6 m x 6 m (20 feet x 20 feet) pattern. Such a spacing would require the bentonite grout to travel only 3 m (10 feet) in order to interface with that from adjacent wells. This is within the likely horizontal penetration distance for bentonite slurry injected at a pressure of 690 kPa (100 pounds per square inch) into materials with permeabilities of 10^{-1} to 10^{-3} cm/s.

Following primary hole grouting and testing for effectiveness, a pattern of secondary split spaced holes (Figure 3 attached) would be injected as needed with grout to the point of refusal at 690 kPa (100 pounds per square inch) of collar pressure. These holes should accept only about one-third the grout volume of the primary wells. The combined primary/secondary grout

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CRANDON PROJECT

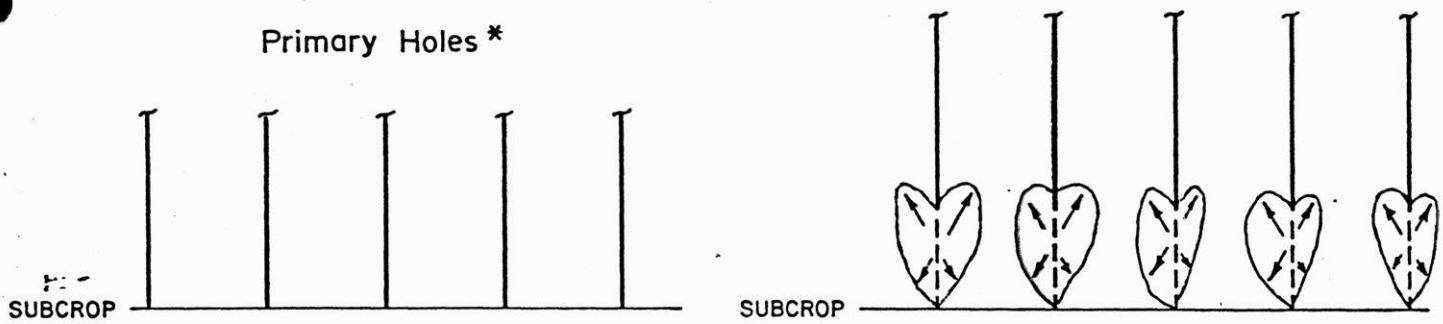
MINE INFLOW CONTROL METHODS

(CONCEPTUAL X-SECTION)



(FIGURE 1 FOR RESPONSE TO COMMENT NO. 96.)

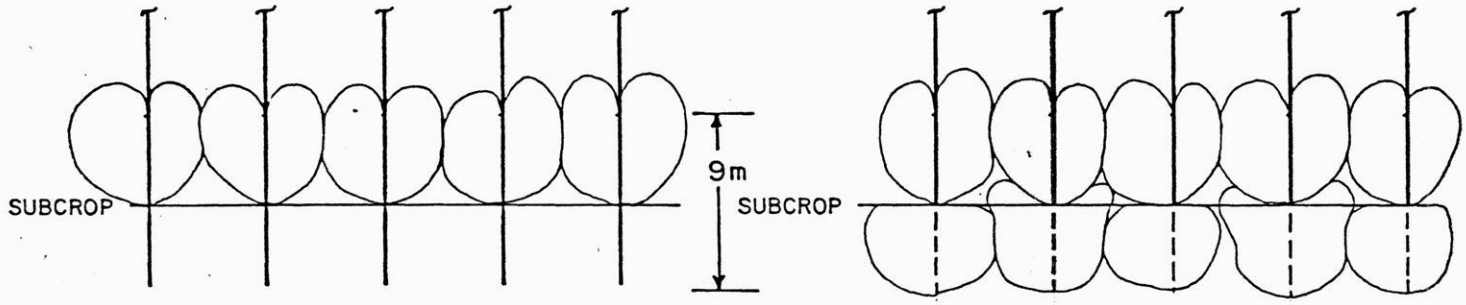
STAGE 1



Drill and case to subcrop

Lift casing 4.5 meters and grout

STAGE 2



Drop casing and drill 4.5 meters below subcrop

Lift casing 4.5 meters and grout

* Offset secondary hole grouting will fill spaces and make cap tight.

(FIGURE 2 FOR RESPONSE TO COMMENT NO. 96.)

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SCALE

KLOHN LEONOFF INC.
CONSULTING ENGINEERS

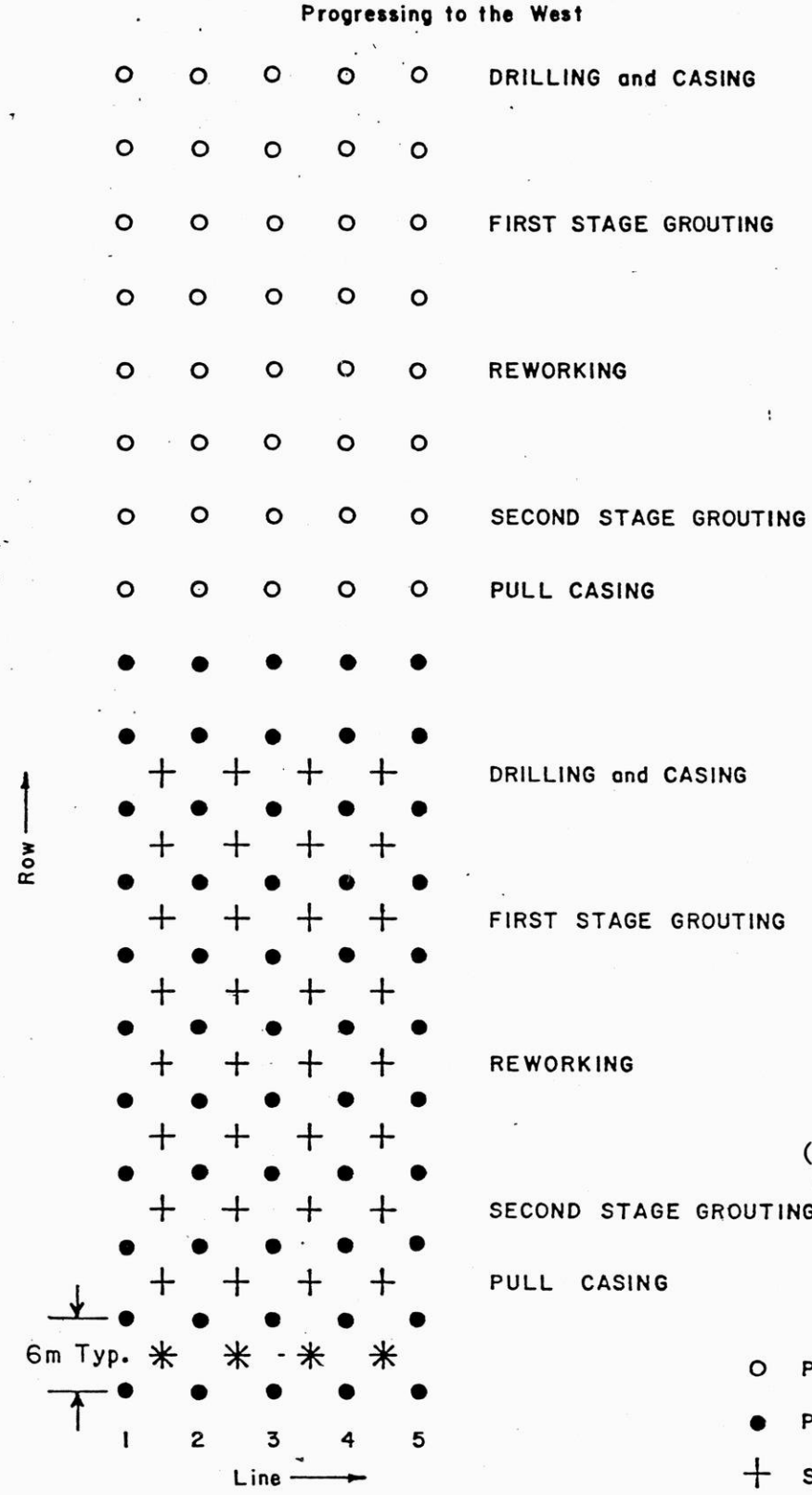
PROJECT: Crandon Mine Water Control

TITLE: Two Stage Grouting Techniques

CLIENT: Exxon Minerals Company
A-MM-0202

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
APPROVED	CC0030	Fig. 10	

NCI-457



(FIGURE 3 FOR RESPONSE TO COMMENT NO. 96.)

EXPLANATION

- O Primary holes in progress
- ● Primary holes completed
- + Secondary holes in progress
- ✳ Secondary holes completed

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SCALE

KLOHN LEONOFF INC.
CONSULTING ENGINEERS

PROJECT: Crandon Mine Water Control

TITLE: Preferred Plan Schedule Layout

CLIENT: Exxon Minerals Company
A-MM-0208

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
4-16-82	CC0030	Figure 12	

APPROVED

injection program should provide a continuous layer of material with reduced (10^{-5} to 10^{-6} cm/s) permeability. Any pumping test wells used initially to locate the grouting targets could subsequently be employed to verify the success of the grout injection program.

Sodium bentonite, the recommended grouting agent, is an inert, thixotropic, colloidal clay. It can be expected to retain a certain degree of elasticity following injection, such that minor soil movements would not affect its permeability reducing performance. Once mining has ceased, the 9 m (30 feet) layer of inert bentonite grouted glacial overburden and weathered bedrock will remain in position and will function in a similar manner to the tills and clays in the site area.

During mine final engineering, further site tests can be conducted to locate potential steady state mine inflow courses and verify the proposed bentonite grouting technique. The extent of any inflow control program instituted will be determined by the potential for lessened environmental effects in balance with its installation costs, offset by appropriately reduced mine drainage, water treatment and discharge costs.

(2) Subsequent to any mine inflow controls which may be applied, a residual ground water seepage interception program will be instituted. Its purpose will be to intercept and contain ground water inflow before any contamination by exposure to mine operations is possible. To accomplish this, interception must occur above the active mine workings.

Initial mine production has been planned for the 230 to 350 m stope horizon, a position at the base of the weathered bedrock ground water inflow courses. Thus, seepage into the mine workings during the early years of the mine is expected to be very localized. Exploratory diamond drilling techniques will be employed to identify active water courses prior to advance of the mine face.

The specific design of the ground water interceptor system will begin during preoperational underground exploration. Conceptually, water encountered on the uppermost mine level will, where possible, be captured in interceptor drill holes and contained to avoid contamination. In most cases, as the mine progresses upward from the initial 230 m level, access for interceptor drilling will be provided by premature development of production drifts temporarily dedicated for mine inflow control. Otherwise, specific mine water control drifts will be developed as required by identification of any area of concentrated seepage. Ultimately, the ground water interceptor system would function, as shown on the conceptual Mine Inflow Control cross-section (Figure 1 attached). Cement rock grouting may be used for local inflow control or diversion.

Actual ground water collection will be from exploration or interception drill holes developed from the access and mine water control drifts. These holes will be typically arranged in a conical fan above the drifts,

increasing the effective radius of the adit as a line sink drain. As is common mine practice, each water producing hole collar will be sealed and equipped with a pipe manifold.

Collected ground water from the interceptor drill holes will be piped through the drifts to the separate clean water sump and pump station. This facility will be located on the 230 m mine level near the main shaft, and will be developed at the start of mining prior to interception of potential ore deposit weathered zone water courses.

The clean water surge sumps on the 230 m level will consist of downgrade excavations in the wallrock adjacent to the pump station. A bulkhead containing the pump station suction pipes will be constructed at the outlet of the sumps. Twin sumps will be provided for ease of maintenance and reserve capacity.

Clean water sump discharge will be pumped up the main shaft in a dedicated pipeline. A bank of stand-by pumps and a second main shaft discharge pipeline will be provided to avoid system interruption. At the surface, the intercepted ground water pipeline will be routed directly to the uncontaminated water tank.

Comment No. 97

Section 3.2.6.1, MWDF and Reclaim Pond Site Preparation - The removal of wetland soils from below the MWDF may be necessary to stabilize the liner in dikes.

Response:

All wetland deposits (peats, mucks, and other organics) will be removed from the MWDF area. Most of the deposits are in the pond bottom areas and are 5 to 10 m (16 to 33 feet) higher in elevation than the bottom grade of the pond and would be removed in pond excavation. Those wetlands in the embankment areas would also be removed completely, down to firm subsoils prior to any embankment construction.

Based on estimated wetland material depths and areas, an approximate volume of 253,000 m^3 (331,000 cubic yards) of material would be removed. Of the total estimated excavation for the MWDF (13,600,000 m^3 [17,800,000 cubic yards]), this wetland material represents about 2 percent. The excavated organic materials will be used as top dressing on embankments and other areas where vegetation is to be established.

Comment No. 98

Section 3.2.7, MWDF and Reclaim Pond Construction - The discussion of the batching and mixing plant and the screening plant could have been supplemented by reference to the INDECO Report. Unfortunately, this Report is very general with regard to the discussion of these plants and does not detail in any way possible water releases and quality control of the product. Details of both of these plants should be provided.

Response:

See response to comment No. 62.

Comment No. 99

This section discusses the retention basin for runoff from the waste rock storage area but does not include a description of details of construction of the ABC liner. These details are not included in the feasibility study and will have to be provided for Departmental review.

Response:

Runoff from the waste rock storage area at the MWDF will be contained in a temporary, membrane lined pond located on the west side of the waste rock area. This temporary pond is sized to hold the volume of a one year net precipitation gain plus one 10-year, 24-hour storm. If the temporary pond approaches its capacity, the water will be pumped to reclaim pond R1.

Final design details for this temporary pond are not available at this stage of Project development; however, pond layout and preliminary design data are included in the INDECO report "Construction of Waste Disposal Facilities" (previously provided to the DNR). In that work INDECO selected a PVC membrane as a liner. Design criteria are also provided in subsection 9.2.2 of EIR Appendix 1.2A. Final details of the liner construction will be completed during Plan of Operations engineering.

Comment No. 100

Figs. 3.2-3 through 3.2-8 - These figures appear to be reductions of full size plan sheets. The full size plan sheets should be submitted to the Department to facilitate review and analysis of erosion control measures. The figures indicate that two tailings ponds will be under construction simultaneously while the project schedules show that only one pond will be constructed at a time. This apparent contradiction should be clarified.

Response:

Mine Plan Figures 3.2-3 through 3.2-8 are simplified figures of the MWDF configuration at each of the six main construction stages. The ponds are constructed sequentially and each stage is from 2 to 4 years in duration. The next pond in sequence is constructed early in its stage and the previous pond is reclaimed in the latter part of the stage. The detail of this scheduling is presented in the INDECO report entitled "Construction of Waste Disposal Facilities" (previously provided to the DNR). Full size drawings from that report, which were used to prepare the EIR figures, are included in Attachment No. 10.

Comment No. 101

The route from the Woodlawn Siding should be indicated and the potential effects of heavy truck traffic on local roads should be addressed.

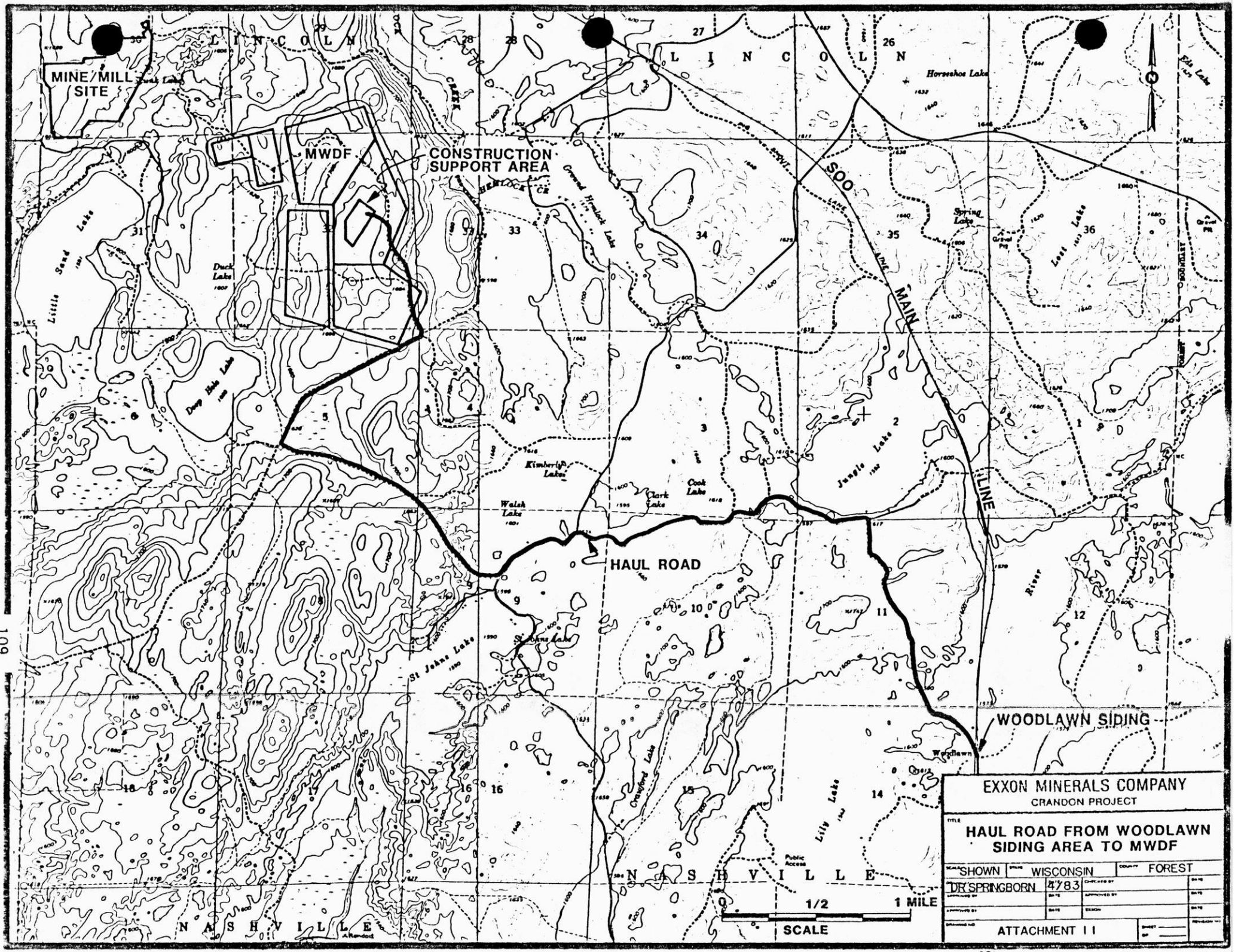
Response:

The attached figure depicts the route from the Woodlawn Siding area to the MWDF. This route will be used for approximately 2 months by trucks hauling bentonite to the MWDF for the first phase of MWDF construction. After construction of the first phase of the MWDF, bentonite will be brought to the mine/mill site on the new railroad spur and use of the Woodlawn Siding will not be required. Approximately 4.8 km (3 miles) of the route to the Woodlawn Siding (of a 9.6 km [6 mile] total) will require grading and compaction prior to use by Exxon Minerals Company for the above purpose. If any damage to the route is incurred as a result of hauling bentonite to the MWDF, appropriate repairs will be made to return the road to its former condition prior to use by Exxon Minerals Company.

Comment No. 102

Section 3.2.8, Pipeline Construction - Details of pipeline construction are needed with particular emphasis on jointing and changes in heading of the

(FIGURE FOR RESPONSE TO COMMENT NO. 101.)



APE-0964

lines. Specifications and documentation demonstrating the life expectancy and durability of the pipeline material should be presented.

Response:

The response to comment No. 66 provides discussion of pipeline jointing procedures. That response also provides information on typical allowable installation radii that can be used for pipeline heading or alignment changes. Direction changes will be made gradually, taking advantage of the HDPE pipeline flexibility and thereby eliminating most fittings and thrust blocks.

The pipeline material choice and preliminary wall thickness selection were made through a study by PSI, Inc. (report previously provided to the DNR) considering tailings design flows and slurry characteristics. The pipeline chosen is expected to remain in service for the life of the Project. Final pipeline wall thickness and material specifications will be determined during detailed engineering. The actual installation will include some test sections of pipe at convenient locations that would be periodically inspected for performance evaluation.

Comment No. 103

Section 3.2.9, Railroad Construction - More detailed plans and discussion of the railroad spur construction, especially near the wetlands and Swamp Creek are needed. A diagram of the stream crossing and a cross section of the entire spur from the main line to the mine/mill site should be provided. If borrow or waste areas will be necessary, where will they be located?

Response:

Preliminary engineering design of the entire length of the railroad spur and siding area were completed by Foth and Van Dyke and Associates, Inc. Portions of the drawing set from that work, showing alignment plan and profile, the typical cross-sections, and the Swamp Creek crossing structure are attached (Attachment No. 11).

The plan drawing noted above shows the locations of the permanent erosion control facilities, such as the ditchs, culverts, and ditch settling basins. The cross-section drawings show the extent of permanent revegetation established with initial construction. In addition to the permanent facilities, temporary facilities will also be employed to the extent necessary to control erosion and minimize siltation. Temporary sheet piling, diversion dikes, ditches and settling basins will be constructed during clearing and grubbing operations to collect disturbed area runoff. Temporary revegetation will be used to provide interim stability to slopes when weather conditions or construction delays preclude immediate establishment of permanent vegetation. The specific activities and detailed plans for these temporary erosion control measures will be completed in the final engineering phase of the work.

The earthwork balance determined during preliminary engineering design of the railroad indicated approximately 22,000 m^3 (28,800 cubic yards) of select borrow material would be required to construct the railroad. This material would be provided by excess material available from development of the mine/mill area or alternatively it could be obtained from the MWDF area during its initial development.

Comment No. 104

Section 3.2.11, Water Supply - The estimated peak demand for water of 45.3m^3 day appears conservative. Provide data used for this estimate.

Response:

The earlier estimate of a peak demand for water of 45.3 m^3/d (12,000 gallons per day) was too conservative. Water use will peak during the first year of construction and will be used for supplying human needs, sprinkling of site roads as required, compaction for fill and for use in concrete production. The heaviest water use will occur from June to November, with an estimated peak demand of 326 m^3 (86,129 gallons) per day. This peak consumption is estimated as follows:

	m^3/day	(gallons per day)
Compaction	225	59,445
Batch plant	60	15,852
Road sprinkling	40	10,568
Human consumption	1	264
Total	326	86,129

Average water demand for the first year will be less, depending on the amount of rainfall, moisture content of the soil being compacted, and the rate of concrete production. Water use during the remainder of the construction phase will be considerably less than the peak demand that occurs during the first year.

Comment No. 105

Provide a plan for potable water supply testing and reaction to unsafe samples.

Response:

Potable water will come from a fresh water well and should not require pretreatment. The testing program has not been developed, but will comply as appropriate with Chapter NR 108 and 109. The testing scheme will be provided to the DNR prior to construction. This testing will include evaluation of the bacteriological quality of the wells.

Comment No. 106

Section 3.2.13, Sanitary Facilities - Please provide documentation justifying the estimated daily sanitary waste flow of 1,500 gpd.

Response:

Since submittal of the Mining Permit Application, there has been additional refinement of estimated sewage flows and plans for handling of sanitary sewage during the construction period. Prior to installation of the permanent septic tank and soil absorption field, the maximum daily sanitary waste flow is estimated to be 10.6 m^3 (2800 gallons).

The permanent septic tank and soil absorption field will be installed as soon as possible and should be available within 6 months after start of Project construction. Portable toilets will be used throughout the site from initial construction until sewer lines and permanent restrooms are constructed. If Exxon or a contractor utilizes a restroom/shower trailer, a temporary sewage holding tank will be used for that facility.

A licensed septic tank pumping contractor will be used to service the portable toilets (and the holding tank if there is one) as necessary. Prior to installation of the permanent septic tank and soil absorption field the licensed contractor will haul the sewage off-site for disposal. After installation, he will transfer sewage to the permanent facilities.

With portable toilets there is approximately 0.015 m^3 (4 gallons) of sewage generated per person per week. With a restroom/shower trailer approximately 0.19 m^3 (50 gallons) of sewage is generated per person per day. During the first 6 months of construction, assuming a peak work force of 400 people with 50 having access to a restroom shower trailer, approximately 53 m^3 (14,000 gallons) of sewage would be generated weekly, or approximately 10.6 m^3 (2800 gallons) of sewage on a daily basis.

Assurances have been received from licensed septic tank pumping contractors that this type of arrangement and their service would be satisfactory. We have not attempted to determine where they have sewage disposal capabilities.

Comment No. 107

Section 3.2.15, Testing and Training Facility - Where will this facility be located and when will it be operated with respect to the overall mine/mill schedule? What will become of the facility once full scale operation begins?

Response:

A pilot plant has been proposed as a means of training mill personnel and determining optimum operating and control parameters for the full scale

plant. This pilot plant has not yet been designed; however, it would essentially be a very small version of the full scale plant and would process one to two tons of ore per hour when operating.

The current plans are to house the pilot plant in a portion of the core storage building. The current estimated building area requirement is 372 m^2 (4000 square feet). Tailings from the pilot plant would be retained temporarily in a small lined basin. Sometime after the establishment of a permanent tailings pond, pilot plant tailings would be transported to the MWDF, probably via truck. A small water reclaim pond will also be provided and would be removed once the operation of the pilot plant ceases.

This pilot plant would be run intermittently for 1.5 to 2 years prior to and during the start-up of the full scale plant and as needed thereafter. When there is no longer a need for the pilot plant, the equipment will be cleaned, removed from the building, and prepared for storage or transported to another facility.

Comment No. 108

Where will reagents be stored during this time and what spill prevention/control measures will be followed? What will be the volumes and characteristics of the wastewater? Where and how will wastewater be treated?

Response:

The pilot plant will not operate with the same schedule as the full scale concentrator, but rather in test campaigns lasting up to 1 or 2 weeks. Each pilot plant run will have specific training and testing objectives. Since the pilot plant will only run with a capacity of about 2 t/h when operating, the total reagent requirements will be considerably less than for the actual concentrator. Reagents will be received in much smaller quantity lots consisting largely of 5-gallon pails and some bags. Sulfur dioxide will be received in standard gas cylinders. All reagents will be stored in the pilot plant and mixed in appropriate size batches on a daily basis. The reagent mixing area will be designed for spill containment. Procedures for safely handling and mixing regents will be taught to various plant operators as part of the function of the pilot plant.

Water is expected to be recovered from the tailings at a rate of approximately 6.8 to 9.0 m^3/h (30 to 40 gallons per minute). This water could be recovered either by decantation from a temporary tailing basin or by direct filtering. This water will be stored in a lined, temporary reclaim pond to be located just south of the pilot plant site (core storage building). Most of this water will be used as recycle process water. Any excess water that accummulates will be transported to the available larger Project reclaim pond. No water from the pilot plant will be directly discharged to the environment.

The attached table shows a set of chemical analyses of water from the tailings produced during pilot testing of the Crandon ores at Lakefield Research of Canada. These data will serve to characterize the water. However, these analyses were obtained from testing where water was not recycled in the process. The analyses for tailings water from massive ore were provided to Mr. Archie Wilson of the DNR in a letter dated April 13, 1981; DNR also obtained samples of the same water during their visit to the pilot plant in 1981.

Comment No. 109

If a temporary storage facility is constructed, details of its construction and operation must be provided for Department review. The location of the temporary storage facility should be specified.

Response:

The pilot plant will be located in the core storage building. Temporary facilities for storing tailings and water for reuse will be located just south of this building. Designs for these facilities are being developed and will be reviewed with the DNR when they are available. Concentrates produced in the pilot plant will probably be stored in drums until shipped with concentrates from the full scale plant. Some pilot plant concentrates will undoubtedly be shipped to smelters for evaluation.

Comment No. 110

Will any air pollution control equipment be utilized in conjunction with the testing and training facility?

Response:

Dust collection equipment will be provided with the crushing and screening equipment for the pilot plant and with the sample preparation area. The building itself will be ventilated. Details will be made available when other design work is completed.

Comment No. 111

Section 3.3, Construction Schedule - According to Figure 3.3-1, the water treatment facility will not be completed until September 1987, approximately one year following commencement of main shaft and equipment air shaft construction. Reclaim Pond #1 should be completed within 3 months after start of the main shaft construction and 8 months after start of the air shaft construction and therefore could be used to store water from shaft construction. What will be done during the 3 and 8 month period when this pond is not in service? Waste rock and preproduction ore storage runoff will also go to reclaim pond #1. Will the storage volume be sufficient to handle construction wastewater before the surface water treatment systems are completed? What is Exxon's contingency plan if the voume is not sufficient?

(TABLE FOR RESPONSE TO COMMENT NO. 108)

TABLE 1

CHEMICAL ANALYSES OF WATER FROM TAILINGS PRODUCED IN PILOT PLANT TESTING

All Values As mg/l Unless Otherwise Specified

Constitutent	Stringer Ore Zinc Scavenger Tailing	Massive Ore Zinc Scavenger Tailing
Aluminum	0.04	0.51
Calcium	102	142
Copper	0.008	0.131
Iron (+2)	5.44	<0.01
Iron (+3)	2.46	<0.01
Potassium	5.57	5.23
Magnesium	0.37	0.207
Manganese	0.065	<0.001
Sodium	65.2	54.2
Zinc	0.171	0.091
Silver	<0.001	0.004
Barium	<0.01	<0.01
Cadmium	<0.001	<0.001
Mercury	<0.0001	<0.0001
Lead	0.04	<0.01
Selenium	0.21	0.28
Chromium (total)[a]	<0.001	0.055
Chromium (hex)[a]	<0.01	<0.01
Arsenic[1]	0.004	0.012
Carbonate (as $CaCO_3$)	<1	60
Bicarbonate (as $CaCO_3$)	8	<1
Chloride	6	8
Fluoride	0.79	0.64
Sulfate	104	367
Thiosulfate	<2	449
Cyanide	0.001	0.023
Carbon Dioxide[a]	300	<0.1
Silica[a]	5.92	1.59
Hardness (EDTA)[a,b]	264	356
pH[a]	6.6	11.3
TDS[a]	691	656
Conductivity[a]	900	1000
BOD_5	63	2
COD[a]	154	284
TOC[a]	14.2	13.1

[a]Data from water sample that was not filtered through 0.47 um filter; all other analyses obtained on sample filtered through 0.47 um filter.

[b]As $CaCO_3$.

Response:

A revised construction schedule is attached to the response to comment No. 95. This schedule shows that the water treatment plant is completed at the end of the 15th month and reclaim pond R1 is completed at the end of the 9th month. Construction of the main mine shaft collar starts during the 5th month. Mine shaft sinking starts during the 14th month of construction. Any water from main shaft collar construction and intake air shaft construction will be routed through an oil/water separator and then to surface drainage basin No. 1 (south side of Project site). Water from main shaft sinking and underground mine development will be sent to reclaim pond R1. Water will be pumped from the reclaim pond to the water treatment plant as necessary. Storage in the reclaim pond will provide water needed for mill start-up. The storage volume in the reclaim pond combined with the ability to treat water at a rate in excess of 250 m^3/h (1200 gallons per minute) will assure the ability to accommodate water from shaft sinking, underground mine development, waste rock storage area, and the equipment laydown area. Note that water from the preproduction ore storage area will be pumped directly to the water treatment plant feed tank at the plant site.

Comment No. 112

What area will be enclosed by the perimeter fence mentioned on Page 3-22?

Response:

The perimeter fence noted on page 3-22 of the Mining Permit Application surrounds the mine/mill site and enclosed an area of approximately 31.6 ha (78.0 acres).

Comment No. 113

A section similar to Section 1.3.3, Construction Operations, of the EIR should be included in the Mining Permit Application after the discussion of the Construction Schedule.

Response:

Comment acknowledged. This subsection is being prepared and will be provided in early 1984.

Comment No. 114

Figure 3.4-1 - What is the area of "open water" shown in the northeast corner of this figure?

Response:

The open water area in the northeast corner of the mine/mill site as shown in Figure 3.4-1, is a deciduous swamp having some open water. This wetland is less than 0.1 ha (0.25 acres) in size and is located approximately 152 m (500 feet) northwest of wetland F116. This wetland is designated but not numbered on Figure 4.3-1E of the August 1982 Wetland Assessment Report prepared by Normandeau Associates, Inc. and Interdisciplinary Environmental Planning, Inc. (previously provided to the DNR).

Comment No. 115

Section 3.5.2.4, Mine and Backfill Dewatering - Provide details regarding the operation of the groundwater interception system and the plans for grouting the bedrock/drift interface.

Response:

The mine water interceptor system and the plans for grouting the bedrock/drift interface are described in the response to comments No. 45 and 96.

Comment No. 116

Section 3.5.2.5, Waste Rock - Provide additional detail regarding waste rock handling, use and disposal. Specifically, address the use of waste rock as riprap and as road surfacing material and provide estimates of the volume of waste rock which will be used for the various purposes and disposed of in the MWDF.

Response:

All waste rock produced in development and operation of the mine will either be used as mine backfill or be used in construction/disposal at the MWDF. All waste rock used in construction of the MWDF, or disposed there, is underlain by the continuous seepage control system used throughout the MWDF. Use of the waste rock as road surfacing material is not planned. Transport of the waste rock will be by 35-40-ton dump trucks from the mine/mill site to the MWDF. At the MWDF, grading and compaction of the waste rock will be primarily managed by a dozer. Approximately 1,900,000 m^3 (2,500,000 cubic yards) of waste rock are expected to be used/disposed at the MWDF. Of the total approximately 900,000 m^3 (1,200,000 cubic yards) will be used as slope protection in the ponds and the remaining 1,000,000 m^3 (1,300,000 cubic yards) will be used to form most of the main interior embankment of the MWDF.

Comment No. 117

Section 3.5.2.6, Backfill Handling Underground - Under what conditions will it be necessary to supplement the coarse tailings with waste rock and glacial sand? Where will the backfill delivery boreholes be located?

Response:

The Crandon mine stopes are to be backfilled with classified (deslimed) mill tailings. Approximately 50 percent of the mill feed tonnage can be prepared as backfill with suitable drainage characteristics. Average backfill production combined with underground retention and use of mine development waste rock will satisfy the normal mine backfill demands. However, shortfalls of backfill tailings material could result from unanticipated operational events. These might include:

1) Periods of lower recovery of backfill sized materials compared to fine tailings due to changes in ore composition; and

2) Interruption of mine backfill operations, followed by a make-up period demand in excess of the backfill plant capacity.

In these cases or others, it will be necessary to supplement normal classified tailings backfill production with make-up glacial sand or crushed waste rock. The mine backfill preparation facilities will be designed with provisions for the future addition of equipment to supply make-up materials, if required during some period of the mine life.

Mine backfill slurry will be pumped from the concentrator in buried surface lines (HDPE) to a pair of delivery boreholes on the south side of the plant area (Mine Plan Figure 3.3-6, Construction Plan - Year 5). These boreholes located in the orebody hanging wall will serve for gravity distribution of backfill to the mine levels. The delivery boreholes will be intercepted by the hanging wall laterals on the mine levels and outfitted for horizontal pipeline transfer of backfill to depleted stope locations.

Comment No. 118

Which of the two options (adding cement to the backfill or leaving an ore wall) is actually being proposed? Whichever it is, a more detailed discussion is needed.

Response:

Long-term rock mass stability in and around mine workings can be achieved by leaving load bearing pillars between open stopes or by backfilling the depleted stopes. Backfill mining methods like that proposed for the Crandon mine allow for more complete ore recovery. During primary mining, ore in every other stope block is removed, with the adjacent undisturbed blocks serving as interim pillars. Once the depleted primary stope blocks are backfilled, they become the functional "pillars" and mining of the alternating secondary stope blocks can proceed (see Mine Plan Figure 2.1-9, Typical Stope Blocks). Ultimately, the entire stoping area is supported and stabilized by backfill.

Both uncemented and cemented backfill are planned for use in the Crandon mine. When uncemented tailing sands are placed in a primary stoping block, it will be necessary to leave a retaining rib pillar on each end of the stope (see attached figure). These rib pillars will have a nominal minimum thickness of 3 m (10 feet), and will serve to contain the uncemented primary stope backfill sands while mining of the adjacent secondary stope blocks proceeds.

If the rib pillar locations contain ore of sufficient value, it can be recovered by use of cemented backfill in the primary stope block. At a typical tailings sand to cement ratio of 15:1, cement stabilized primary stope backfills can be expected to stand unretained while the mining of adjacent secondary stope blocks proceeds.

It is currently estimated that approximately one-third of the total Crandon mine backfill will be strengthened by cement addition for placement in primary stopes. All depleted secondary stope blocks will be backfilled with uncemented tailing sands. Long-term mining area rock mass stability will be assured by the process of stope backfilling, regardless of type.

Comment No. 119

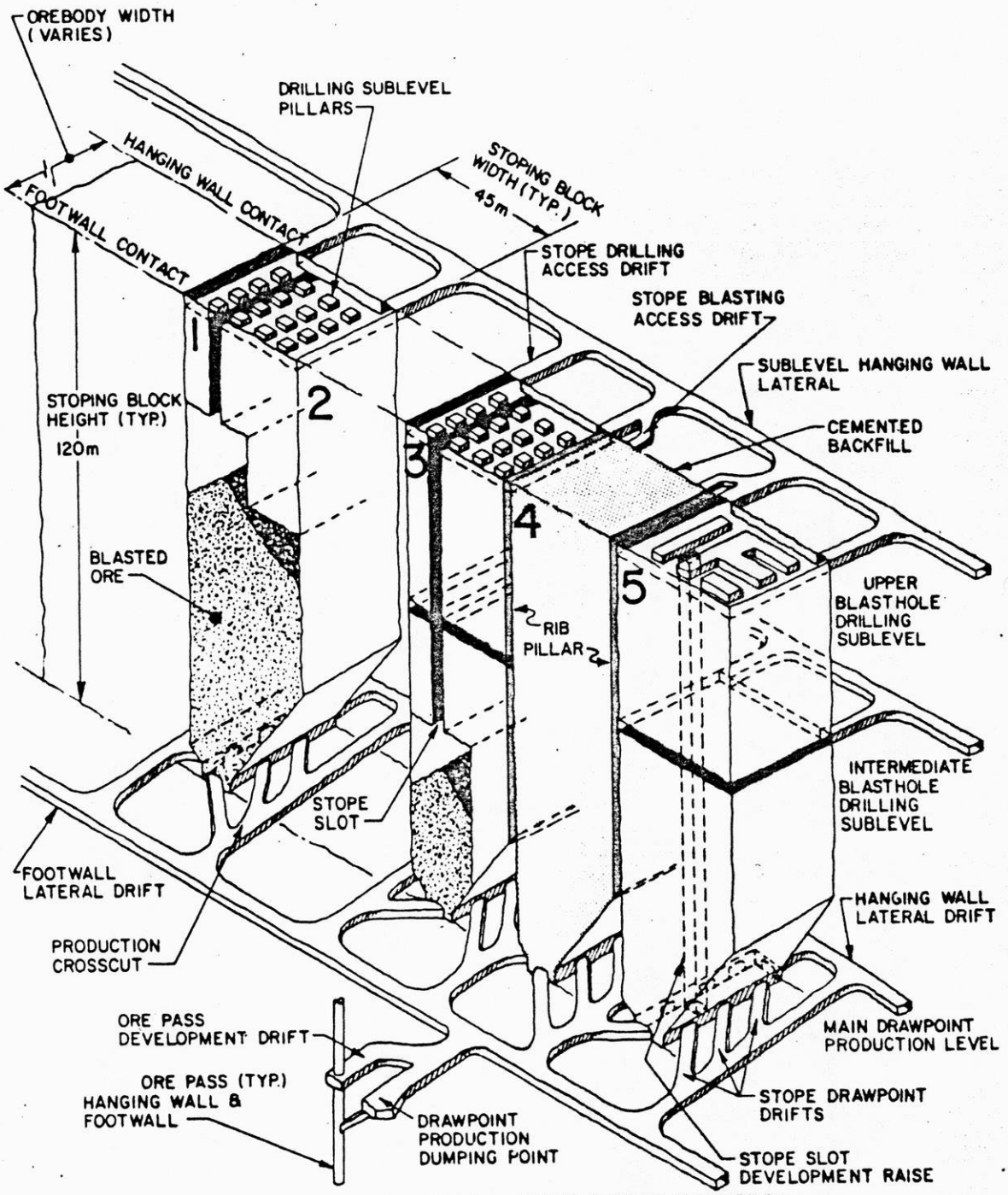
Explain the kind and amount of cement which will be required to stabilize the backfilled stopes and what thicknesses of rock must be left on the sides and bottoms of each stope to assure safety and stability within the mine. Demonstrate that the cement of choice will work with an aggregate that may be predominately sulfides.

Response:

As described in the response to comment No. 118, rib pillars left to retain uncemented primary stope backfill will be a minimum of 3 m (10 feet) thick. Analysis of rock mechanics data further indicates that this nominal minimum dimension should be increased to 10 percent of the stope hanging wall (HW) to footwall (FW) depth for stopes in excess of 30 m (100 feet) deep. Thus, for a stope spanning 50 m (164 feet) from HW to FW, rib pillars 5 m (16.4 feet) thick would be required.

The size of horizontal crown or sill pillars (at the stope blocks top and bottom, respectively) required will depend upon the local stope block geometry, rock mass strengths, in situ stresses, and mining sequence. Such pillars can be left for a variety of reasons including local ground support, backfill retention, and protection of life-of-mine accessways. At similar operations horizontal pillars of this type are typically 10-15 m (33-50 feet) thick. These pillars are often temporary and are subsequently recovered as a mining area nears depletion.

Cemented backfill used in the Crandon Mine will be produced by the addition of Type I Portland cement to the classified mill tailings. Realizing that mill tailings will contain substantial amounts of sulfide mineral, backfill testing programs included evaluation of the use of Type V sulfate-resistant



STOPING BLOCK # 1 – ACTIVE PRODUCTION – STOPE BLASTING NEARING COMPLETION

STOPING BLOCK # 2 – ALTERNATE STOPING BLOCK PILLAR – TO BE MINED AFTER BACKFILLING ADJACENT STOPES

STOPING BLOCK # 3 – ACTIVE PRODUCTION – INITIAL STAGES OF STOPE BLASTING

STOPING BLOCK # 4 – DEPLETED STOPE BLOCK – UNCEMENTED BACKFILL IN PLACE

STOPING BLOCK # 5 – STOPE BLOCK PARTIALLY DEVELOPED

(FIGURE FOR RESPONSE TO COMMENT NO. 118.)

EXXON MINERALS COMPANY
CRANDON PROJECT

UNDERGROUND MINE
TYPICAL STOPE BLOCK
BACKFILL RIB PILLARS

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
S.J. HARVEY	7/82	J.E. GRIMES	8/17/82
APPROVED BY	DATE	APPROVED BY	DATE
D.E. Moe			10/15
APPROVED BY	DATE	APPROVED BY	DATE
		E. Hamilton	10/19/82

DRAWING NO. FIGURE 3.5- SHEET 1 OF 1 REVISION NO. 0

cement. No ultimate strength differences were observed between cemented backfill samples containing Type I or Type V cement, nor were there any indications of long-term strength deterioration for Type I samples.

Strength tests have been conducted on cemented backfill samples prepared with varying tailings sands/cement ratios. It has been determined that a sands to cement ratio of 15:1 will result in cemented backfill strength sufficient for self-support within the planned stope mining dimensions. Lower sands/cement ratio backfills may be prepared for specific situations where additional strength is required (e.g., a 5:1 mixture placed as a floor upon which mobile mining equipment will subsequently operate).

Comment No. 120

Section 3.5.2.7, Water Balance - What constitutes mine "process" water to be collected and discharged to the surface water treatment system? This is somewhat confusing in light of the discussion to recycle 200 gpm for mining processes. How much mine process water will be generated which will be transported to the surface? How is it accounted for in the 335 gpm value; of which 325 gpm is backfill water and 10 gpm is potable water?

Response:

As stated in subsection 3.5.2.7 of the Mine Plan, mine "process" water is simply water used for drilling and dust suppression. The source of this water is the uncontaminated mine seepage sumps. After use, this "process" water drains to the contaminated water collection sumps. This water is, of course, accounted for in the water pumped from the mine.

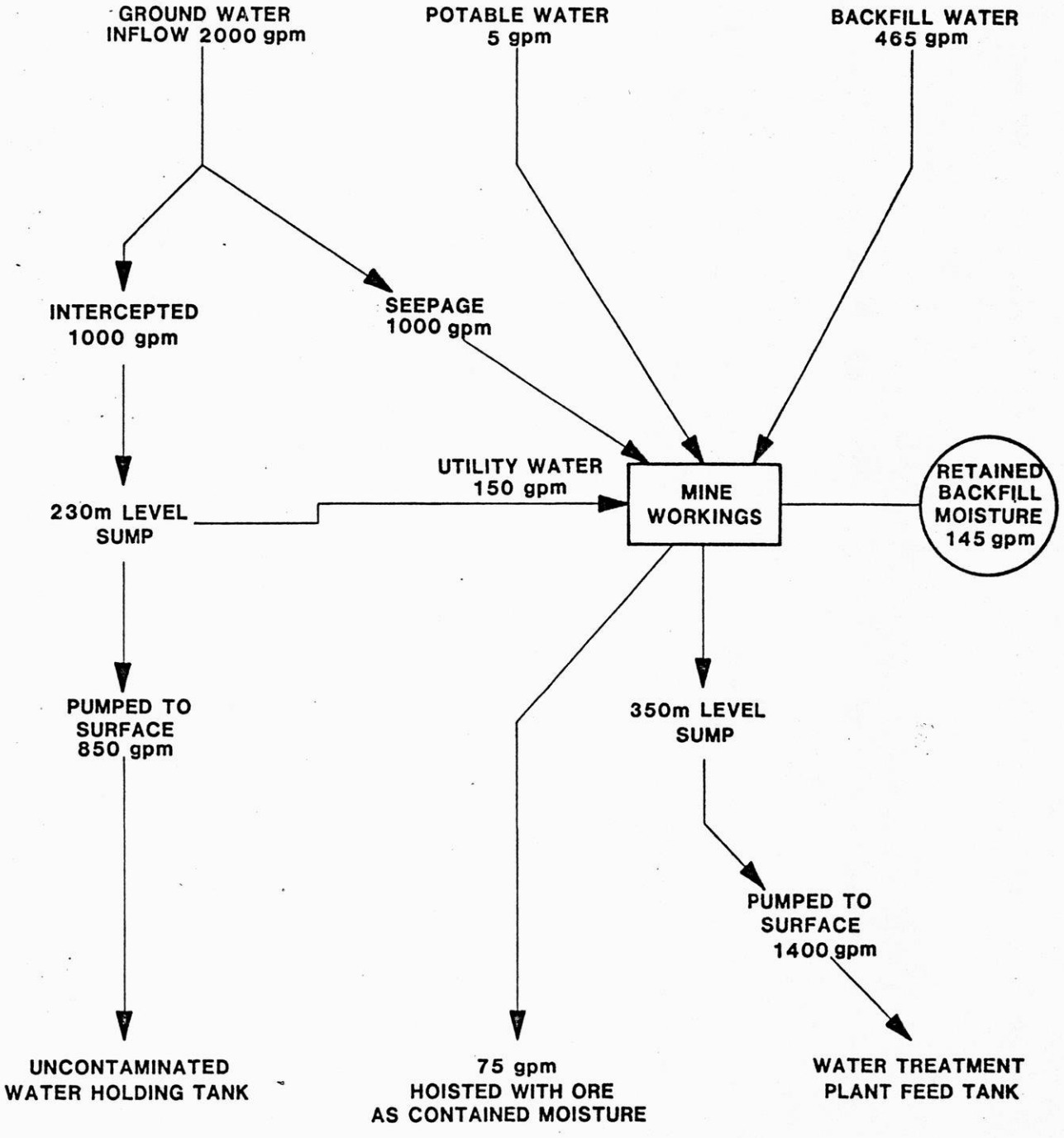
The attached figure is a schematic diagram showing how mine drainage is handled with revised volume projections. The mine "process" water is represented as utility water in this diagram.

Comment No. 121

Section 3.5.3.3, Concentrate Handling and Shipping - The planned 10-day storage capacity for concentrate does not appear to allow much flexibility in the event of extended shipping or market problems. What alternatives are available other than mill shutdown?

Response:

Concentrates will be shipped from the Project via rail. Discussions with officials from the Soo Line Railroad indicate that the history of rail service in the area has been extremely reliable. Therefore, the probability of an extended transportation problem occurring is low. The 2-days storage capacity available for copper and zinc concentrates along with storage capacity in available railcars should be adequate to prevent shutdown of the plant during the day or two that the railroad cannot supply cars due to a



MINE WATER DRAINAGE SYSTEM

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
MINE DRAINAGE SCHEMATIC

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DR SPRINGBORN	9/83		
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE

DRAWING NO. EXHIBIT 13, FIG. B | SHEET ___ OF ___ | REVISION NO.

(FIGURE FOR RESPONSE TO COMMENT NO. 120.)

weather-related problem. Currently, there is an oversupply of gondola cars and this situation is not expected to change in the near future. Also, see the response to comment No. 57.

Severe market problems would likely force a temporary shutdown of the Project regardless of the amount of storage capacity available.

If railcar availability were to become a problem and the planned concentrate storage capacity was inadequate, more covered storage area would be planned and a permit application for the Project site would be made.

Comment No. 122

What type of cover will be used on the rail cars transporting the concentrate?

Response:

The railcars to be used to transport concentrate are open top, rectangular cars called gondola cars. They have a steel bed and sides which will completely contain the concentrate without spillage. After loading, the cars will be covered with a plastic cover made especially for this application. These covers are commonly used for this application. Typical cover material is a woven polyolefin fabric.

Comment No. 123

Section 3.5.3.4, Surface Backfill System - How will backfill in the temporary storage area be reslurried? All associated pipelines and the proposed routes must be presented on a diagram. What will the backfill storage area be lined with? Where will runoff be directed?

Response:

The temporary storage of backfill in the area north of the mine/mill site is no longer part of the Project plan. Temporary storage of backfill will be provided in storage bunkers inside the mill building.

Comment No. 124

Section 3.5.3.6, Water Balance - Figure 3.5-8 shows the water balance during full mill operation. Does this mean that this is the maximum amount of water and wastewater which will pass through each line shown? If not, please show the maximum amount expected.

Reponse:

Figure 3.5-8 is a water balance for the mill and related process facilities and was not meant to depict the whole Crandon complex. A detailed overall water balance for the mine, mill, tailings and reclaim ponds is presented on Figure 3.5-17 in subsection 3.5.6. The flow rates listed on Figure 3.5-8 or 3.5-17 were used for preliminary design. Maximum flow rates for water

treatment and discharge are addressed in the WPDES Permit Application. Maximum and minimum flow rates for all streams will be assessed in final engineering.

Comment No. 125

Section 3.5.3.10, Spills and Odors - Where will the spilled materials be disposed of if the material is not recycled?

Response:

There should be no disposal of reagents. Recovered reagents will be collected in such a manner to assure that they can still be used as intended. Reagent storage and preparation facilities will be designed with the criteria that any spills are to be contained for recovery and use.

Comment No. 126

Section 3.5.4.2, Tailing Slurry and Water Transport Systems - As mentioned previously, the routes of all pipelines (buried and unburied) associated with the project should be shown on a figure or series of figures.

Response:

The response to comment No. 67 provided a drawing showing the routing of tailings and water lines in the area of the MWDF. The routing of these same pipes within the mine/mill is presented in drawing No. 051-7-C-001 in Attachment No. 6. The route of the tailing pipeline and water reclaim pipeline will follow the haul road between the mine/mill site and the MWDF and is shown on the attached figure. The overall routing is shown in Figure 2.3-6 of the Mining Permit Application.

Comment No. 127

Expand on the procedures and equipment which will be utilized to detect and repair leaks in the pipelines.

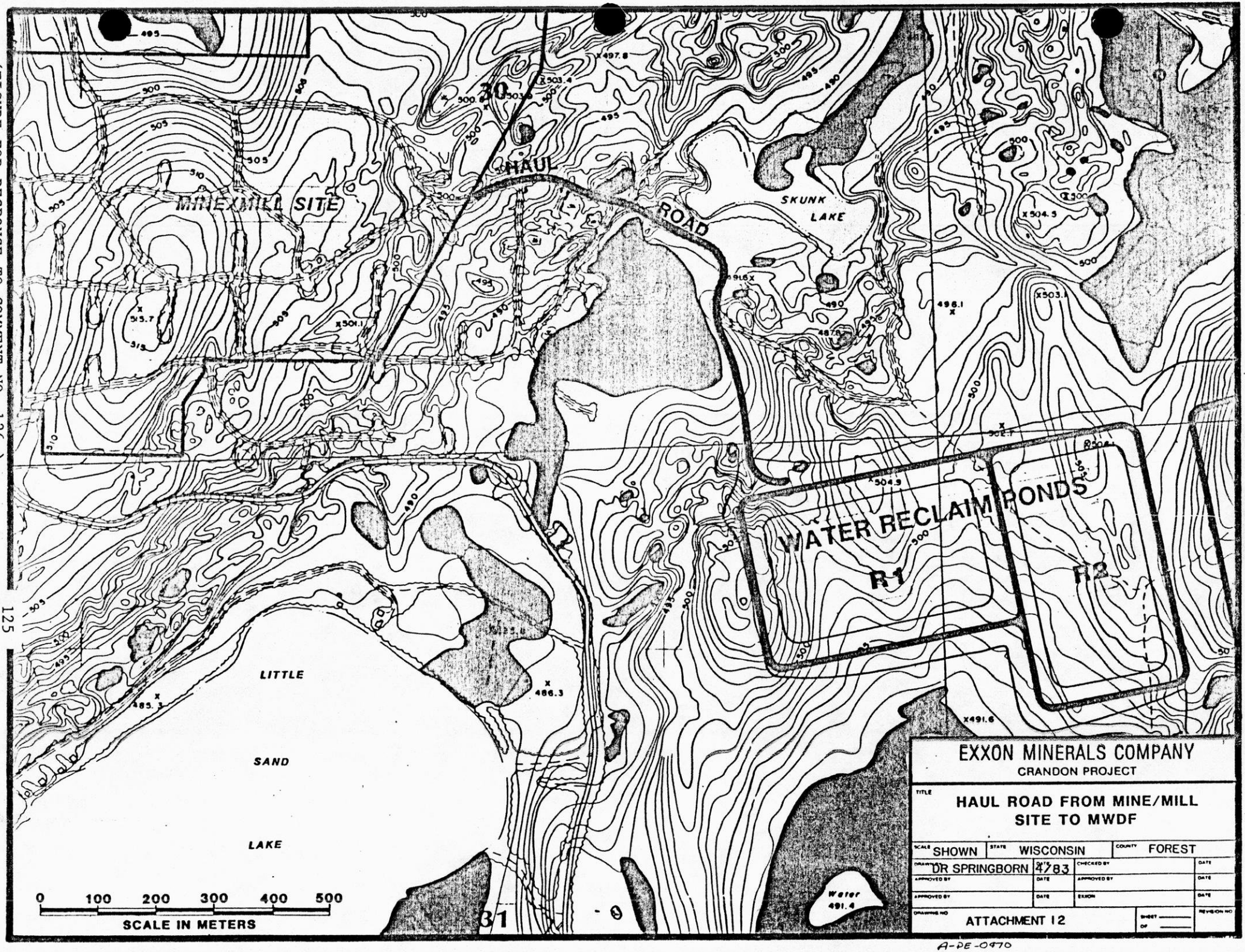
Response:

Leak detection systems and actions designed to prevent ground water contamination in the event of a pipeline failure are described in the response to comment No. 66.

The pipeline corridor will be visually inspected by periodically walking along the route. Physical inspection of pipe materials is best conducted at the pump station during scheduled maintenance. Physical measurements of pipe wall thickness will be completed routinely. If necessary, flanged pipe test spools can be inserted into the pipelines at selected intervals and in easily accessible locations.

Spare plastic pipe will be stored on-site so that it is available for repairs when required. Repairs to HDPE pipelines are expected to be needed

(FIGURE FOR RESPONSE TO COMMENT NO. 126.)



A-DE-0470

infrequently and the pipeline life in slurry service is expected to be longer than would be anticipated for pipelines constructed of alternative materials. For water service, the life of HDPE pipe is expected to be longer than would be expected for carbon steel pipe.

Comment No. 128

Section 3.5.5.2, Water Treatment System - How long can the mine and mill continue in operation under the conditions described on the bottom of page 3-55?

Response:

Assuming that the total water pumped out of the mine is 530 m^3/h (2335 gallons per minute) and that none of it can be discharged, and that 194.6 m^3/h (857 gallons per minute) are still required as make up in the mill, the remaining 335.6 m^3/h (1478 gallons per minute) would be pumped to the reclaim ponds if the treatment plant was completely shutdown. Assuming 310,950 m^3 (82,153,000 gallons) of available freeboard volume (75 percent of total freeboard) in two reclaim ponds, the mine and mill could continue to operate for 39 days before this freeboard volume is used up. This still leaves freeboard for the 100-year, 24-hour storm and allowance for wave run-up. In addition, there is freeboard volume available in the operating tailing pond that could be used to store additional water. However, it is highly unlikely that the treatment plant would be totally shutdown for extended periods of time.

Contaminated water from mine	1335 gpm
Uncontaminated	1000 gpm
	2335
Less water needed in mill	857
	1478 gpm

Freeboard available 82,153,000 gal (75 percent of total)

$$\frac{82{,}153{,}000 \text{ gal}}{1478 \text{ gal/min}} = 55{,}584 \text{ min or about 39 days}$$

Comment No. 129

What standards will be used to determine whether or not the "uncontaminated" water from the mine requires treatment?

Response:

As uncontaminated mine water is pumped from the surge tank to the excess water discharge tank, it will be continuously monitored for pH, turbidity, and conductivity. Although details of the monitoring program are not yet developed, periodic samples of this water will be obtained for chemical analyses.

If this water is intercepted at ground water quality (see EIR Table 2.3-8), it should not require treatment. However, if it is determined that the quality of the intercepted ground water is such that the total effluent will not meet WPDES permit effluent limits on a long-term basis, appropriate treatment technology will be used.

Comment No. 130

Section 3.5.5.4, Water Treatment Wastes - Identify the prospective landfill site and delineate the 2-3 acre cell within the tailing pond area which could be used for disposal of the reverse osmosis sludge if the sludge is not marketed. Which of these options is actually being proposed?

Reponse:

See response to comment No. 71.

Comment No. 131

Section 3.5.6, Overall Water Balance - The overall water balance for "mature" operation has been presented. How will the water balance vary from start-up through shutdown?

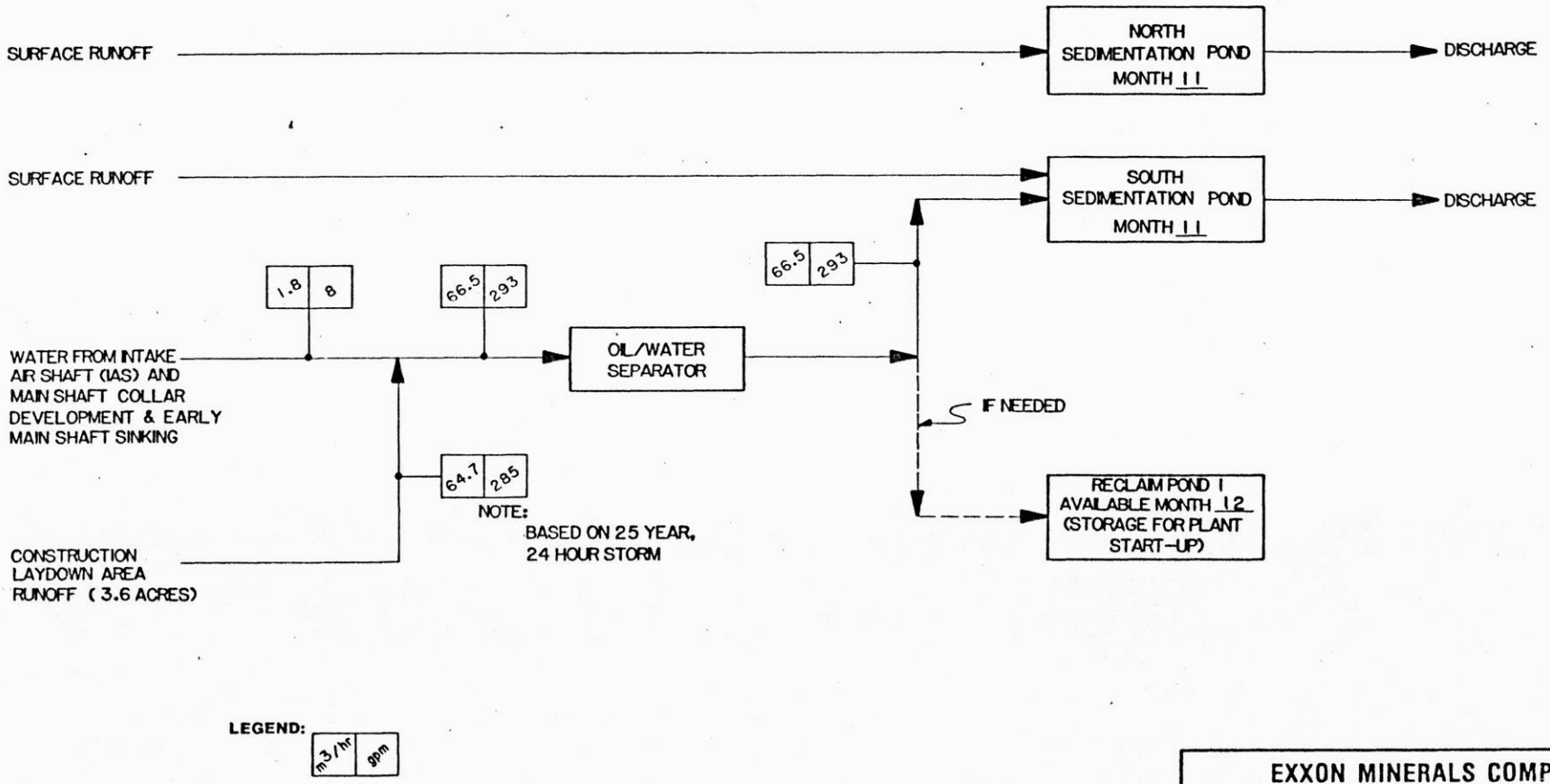
Response:

Water balances for construction, start-up, and mine closure cannot be accurately shown because they represent periods when conditions will change continuously. However, Figures 1 and 2 (attached) show conceptually how water will be handled during these periods; volumes shown on these figures are the flow rates currently being considered in the design.

Figure 1 shows the balance for the first 18 months of actual construction. The north and south sedimentation ponds would be constructed early and will remain in use throughout the life of the Project as part of the erosion control system; they will serve to remove sediments from surface runoff and control the direction and rate of discharge of the runoff. Water from the intake air shaft sinking and main shaft collar development will be collected and sent to the oil/water separator near the northwest corner of the south sedimentation pond. Water from the separator will flow into the south sedimentation pond. During this same period, allowance has been made to collect runoff from a 1.45-ha (3.6-acre) area designated "Construction Laydown Area." There is potential for oil contamination in this water and it will also go to the oil/water separator. The flow rate shown is 64.7 m^3/h (285 gallons per minute) which is equivalent to a 25-year, 24-hour storm event. The average flow rate from this area is estimated to be about 1.3 m^3/h (5.7 gallons per minute) over the year.

Figure 2 shows how water will be handled during construction months 19 through 39. Again both sedimentation ponds are available to receive surface runoff from the Project site. Runoff from the preproduction ore storage area will be collected in an adjacent sump and pumped directly to the water

(FIGURE FOR RESPONSE TO COMMENT NO. 131.)



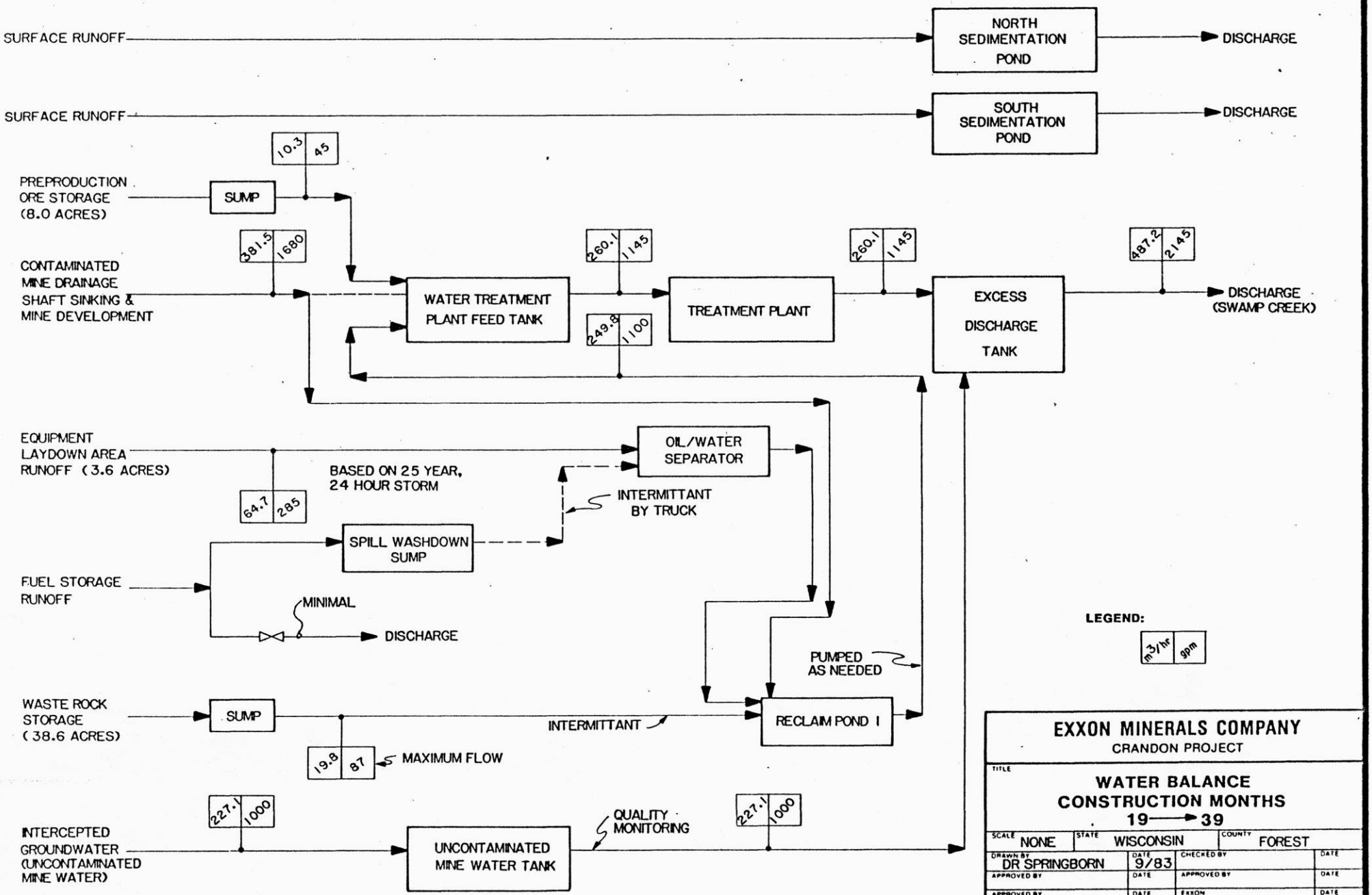
EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
WATER BALANCE CONSTRUCTION MONTHS 1 ⟶ 18

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DR SPRINGBORN	8/83		
APPROVED BY	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE

DRAWING NO
FIGURE 1
SHEET ___ OF ___
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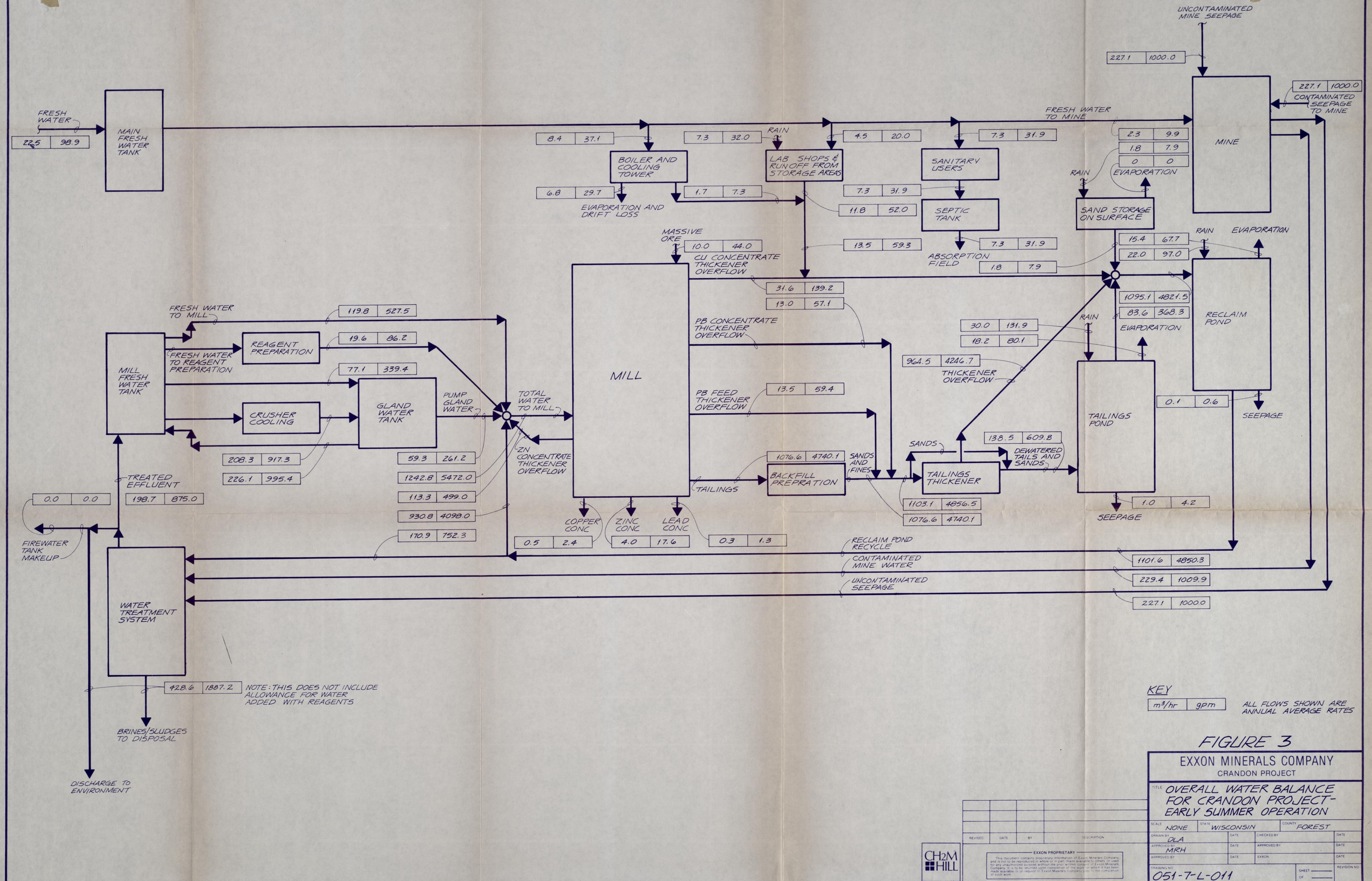


(FIGURE FOR RESPONSE TO COMMENT NO. 131.)

treatment plant feed tank or, alternatively, it could go to the reclaim pond if necessary. The runoff volume shown in Figure 2 of 10.3 m^3/h (45.2 gallons per minute) assumes collection of runoff from a 25-year, 24-hour storm and pumping that volume to the treatment plant over a 14-day period. The contaminated water from mine shaft sinking and mine development will reach a peak flow rate of about 382 m^3/h (1680 gallons per minute) and then decrease to 227.1 m^3/h (1000 gallons per minute) or less. This water will be sent to the reclaim pond and pumped to the water treatment plant feed tank as necessary. It should be noted that the peak flow of contaminated mine water of 382 m^3/h (1680 gallons per minute) occurs before significant quantities of uncontaminated mine water (intercepted ground water) are encountered. Therefore, the total water flow from the mine should not exceed 454.2 m^3/h (2000 gallons per minute). Storage in the reclaim pond will provide water needed for mill start-up. Water from the equipment laydown area will continue to be treated by an oil/water separator and pumped to the reclaim pond. Runoff from the fuel storage areas will be discharged in a controlled manner by opening a valve to allow collected precipitation to drain. If a small fuel spill occurs, the spill and wash down water will be collected in a blind sump. The contents of the sump will be pumped into a tank truck and hauled to the oil/water separator; water effluent then goes to the reclaim pond. Runoff collected from the waste rock storage area will be collected in a drainage basin and pumped to the reclaim pond and stored for use as process water during plant start-up. The volume shown is the water volume that accumulates during a 10-year, 24-hour storm event and is pumped to the reclaim pond over a 30-day period.

The mill is currently expected to start processing ore 40 months after the start of construction. A water balance for early operation is shown in Figure 3 (attached) and is a balance for milling a maximum of 5750 t/d (6340 short tons per day) of massive ore. The important point is that the handling of process water and mine water will be the same as for mature operation. The ore throughput during start-up will be increasing gradually during this period and water flows to and from the tailing pond and reclaim ponds will be increasing until they approach the volume flow rates for the mature operation of the mill.

It would be premature to develop a water balance for the closure of the Project, but the concepts can be discussed. Water will continue to be pumped from the mine until all salvageable equipment has been removed and mine closure operations have been completed. Contaminated water pumped from the mine will continue to be treated. Water coming from the tailings area will be retained in the reclaim ponds. Water will be pumped from the reclaim ponds at a controlled rate to the treatment plant, treated, and discharged. The treatment plant will continue to operate during the reclamation period as long as there is water requiring treatment prior to discharge.



KEY

m^3/hr	gpm

ALL FLOWS SHOWN ARE ANNUAL AVERAGE RATES

FIGURE 3

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: OVERALL WATER BALANCE FOR CRANDON PROJECT- EARLY SUMMER OPERATION

SCALE	STATE	COUNTY
NONE	WISCONSIN	FOREST

DRAWN BY	DATE	CHECKED BY	DATE
DLA			
APPROVED BY: MRH	DATE	APPROVED BY	DATE
APPROVED BY	DATE	EXXON	DATE

DRAWING NO. 051-7-L-011 | SHEET ___ OF ___ | REVISION NO.

REVISED	DATE	BY	DESCRIPTION

CH2M HILL

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Comment No. 132

This section states that the average amount of water to be discharged is 1893 gpm yet Figure 3.5-16 indicates that this is the maximum value. Please clarify this discrepancy.

Response:

Subsection 3.5.6 states that the average amount of water to be discharged is 0.119 m^3/s (1893 gallons per minute). The discharge volume shown in Figure 3.5-16 includes 202.8 m^3/h (893 gallons per minute) of treated water and an allowance for a maximum of 227.1 m^3/h (1000 gallons per minute) of uncontaminated mine water. This gives a total discharge flow rate of 0.119 m^3/s (1893 gallons per minute). The designation "maximum" in Figure 3.5-16 will be removed in the revised Mine Plan.

Comment No. 133

Section 3.5.7.2, Treatment of Sanitary Wastes - Please explain how you arrived at an estimated average daily flow rate of 32 gpm.

Response:

The 7.3 m^3/h (32 gallons per minute) estimate was initially developed from a total work force estimate of approximately 920 people and a 0.19 m^3 (50 gallons) per day per person consumption of water which would become sanitary sewage. The current work force estimate is 703 people. With allowance for visitors and approximately 10 percent contingency, 800 people are now being used for estimating sanitary sewage waste generation.

Also, in following Wisconsin Administrative Code H63.15(3)(C)2 a total per day per person sanitary sewage waste generation rate of 0.13 m^3 (35 gallons), 20 gallons sanitary waste and 15 gallons for showers, is being assumed. Using these new criteria and adding 2.84 m^3 (750 gallons) per day of base flow (per code), the total daily sanitary sewage flow is estimated to be 108.8 m^3 (28,750 gallons). This daily flow is equivalent to an approximate average flow of 4.54 m^3/h (20 gallons per minute).

Comment No. 134

Final details of the septic system must be included in the mining permit application once they have been finalized.

Response:

Comment acknowledged. The Mining Permit Application will be updated when the sanitary waste disposal system is finalized. A soils report, covering the soil absorption field, has been submitted to DILHR and is currently undergoing review by them.

Comment No. 135

Indicate on a diagram where the soil absorption field is proposed to be located.

Response:

The mine/mill area plot plan (drawing No. 051-1-G-001 in Attachment No. 1) shows the soil absorption field located on the south side of the mine/mill site.

Comment No. 136

Section 3.5.7.3, Refuse - Where will the refuse (all types) be stored on the site prior to off-site disposal? What volume of each waste type is expected to be generated? The off-site disposal site for mill refuse will have to be specified.

Response:

The normal refuse for disposal is expected to total approximately 2000 tons per year and consist of the following wastes:

Waste Type	Percent
Paper and garbage	75
Metal (unsalvageable)	10
Plastic	5
Wood	5
Miscellaneous	5

These wastes will be collected in dumpsters located around the site. Periodically, garbage trucks will collect the waste and haul it to an approved landfill for disposal. Exxon Minerals Company is currently reviewing suitable facilities and will attempt to secure a committment for a facility for future disposal of Project waste.

Salvageable metal scrap will be removed from the site as soon as practical to avoid creating large temporary stockpiles on-site. Smaller scrap metal pieces will be collected in bins and larger pieces will be stored in a suitable outside area (such as the equipment laydown area southeast of the headframe). Scrap rubber for reuse or disposal will also be temporarily stored in the same area or a similiar one. Schedules will be developed with salvage haulers to pickup the salvage frequently enough to avoid creating large temporary stockpiles.

Comment No. 137

Section 4.0, Environmental Protection - (1)It should be stated in the mining plan what remedial actions will be taken if private water supply wells in the vicinity of the mine area are adversely affected by the mining operation. (2)Also, discuss what measures would be taken to reduce the effects of drawdown if mine inflow is much greater than anticipated.

Response:

(1) In 1979, the Towns of Lincoln and Nashville were informed that public or private ground water supplies which may be affected by Crandon mining operations would be replaced by Exxon Minerals Company. In 1983, owners of individual water supply wells within the drawdown area of the proposed Crandon Mine were given written notice that any impairment of ground water supply by mining operations would be corrected by Exxon Minerals Company. Replacement of the water supply would be accomplished by either deepening the existing well and installing a compatible pump, or by drilling a water supply well at some distance from the affected well and providing distribution from the central pressurized source to the affected property. A statement will be added to Section 4.3 of the Mine Plan noting that remedial actions have been planned for water supply wells that may be affected in the vicinity of the mine.

(2) The predicted steady state rate of uncontrolled ground water inflow to the proposed Crandon Mine is 0.118 m^3/s (1870 gallons per minute) (see response to comment No. 45 with respect to Prickett Associates' study). For the purposes of site area impact modeling, a stress of 0.126 m^3/s (2,000 gallons per minute) was employed, representing a contingency of 7 percent. Since, during mine development and operation, all practical efforts will be made to control and reduce this rate of ground water inflow, it is highly unlikely that flows in excess of 0.126 m^3/s (2,000 gallons per minute) will ever be experienced.

However, the disruptive effects of excess mine water are well known and prudent mine plans will therefore include contingency measures. For the Crandon Mine there will be several excess inflow contingency options.

First, the excess inflow could be controlled by surface source pumping or inflow path grouting as described in the Klohn Leonoff mine water control methods study (see response to comment No. 45). Secondly, mine pumping systems have been designed for the conservative maximum inflow of 0.126 m^3/s (2,000 gallons per minute) employed for site impact modeling, including pumps and shaft columns. Surface surge storage capacity will exist in the reclaim and tailing ponds for temporary handling of excess inflow. The response to comment No. 170 presents available freeboard volume in the reclaim ponds and estimates capacity of the system for handling excess water.

Ground water inflow to the mine will not occur in major quantities until mine level development intersects the orebody weathered zones (Prickett, December 1982). Mining plans provide for construction of the intercepted

ground water and normal mine drainage sumps and pump stations at the very start of underground development. These facilities are located near the main shaft, exterior to the orebody weathered zones. They will, therefore, be available for full capacity duty prior to mining entry into any areas of potential ground water seepage.

Comment No. 138

Section 4.1, Air Quality Protection - Discuss the disposition of the dusts collected by the air pollution control devices.

Response:

All dusts and sludges collected by the air pollution control equipment will be recyclable. All concentrates will be recovered for shipment and other dusts and sludges will be recycled to the process streams.

Comment No. 139

The total pollutant emissions listed on page 4-1 are not correct. They were taken from Table 4.1-7, but the totals from that table do not agree with the totals from Tables 4.1-2, 4.1-4 and 4.1-6 which include all emissions from project operations. Table 4.1-7 does not include mobile source emissions during mill operations. The pollutant emission totals listed in this paragraph should be 118.0, 23.3, 167.9, 183.0, 15.7, and 0.9, respectively.

Response:

These tables are being revised as part of the Air Permit Application discussions with the DNR's Bureau of Air Management and corrected pages also will be provided for the Mine Plan.

Comment No. 140

In addition, this project is not necessarily exempt from the requirement to obtain a PSD (prevention of significant deterioration) permit. This determination depends on the amount of pollutants emitted, and emissions from some potentially major sources associated with the project (see next comment).

Response:

In a letter dated July 11, 1983 from the DNR's Bureau of Air Management the conditions were determined for the Project not to be subject to PSD requirements.

Comment No. 141

Tables 4.1-1 through 4.1-6 do not include emissions estimates for some air contaminant sources described or mentioned in the project description.

Those sources not included are:

1) Existing gravel access roads

2) Temporary on-site diesel power generators

3) Burning of stumps and brush during site clearing

4) Wind erosion from MWDF stockpiles

5) Screening and stacking plant to produce MWDF liner and underdrain materials

6) Primary crusher and related ore handling facilities

7) Ore loading, hauling and dumping in the mine

8) Removal of rock from shaft during underground mine construction

9) Sulfur dioxide emissions from SO_2 scrubbing tower

10) Fugitive dust emissions from MWDF during operation

11) Burnt pebble lime facility

Response:

These tables will be revised to reflect information provided as part of the revised Air Permit Application.

Comment No. 142

Section 4.2.2, Erosion and Drainage Control - Erosion control during construction of the proposed discharge structure on Swamp Creek should also be addressed in this section.

Response:

Area disturbance for construction of the discharge structure on Swamp Creek will be minimal. Lightweight equipment, swamp mats and other appropriate precautions will be taken to lessen working difficulties and disturbance in the wetlands in the area of the discharge structure.

In the construction zone for the discharge structure, straw bales or geotextile materials will be used to trap silts to minimize sediment runoff to Swamp Creek. These measures will be continued after completion of construction until the soils have stabilized and sediment runoff is no longer a problem.

Comment No. 143

Where will the mine water be routed prior to completion of the water treatment plant?

Respone:

See response to comment No. 131.

Comment No. 144

Where will the "influent surge system" with a volume of 2.75 MG be located? What will this system consist of?

Response:

Contaminated mine water and runoff water from the preproduction ore storage area will be pumped to the water treatment plant feed tank. This tank will have a capacity of 3,785 m^3 (1,000,000 gallons). Some water from the reclaim water tank will also be fed to the water treatment plant for treatment for reuse. These tanks are located just east of the water treatment plant along with other water tanks. These systems will consist of tanks and treatment plant feed pumps. The flow rate to the treatment plant will be controlled by automatic valves between the feed pump and treatment plant.

Uncontaminated mine water will be pumped to the uncontaminated mine water tank. This tank has a capacity of 946 m^3 (250,000 gallons). This water will be discharged from the site, but provisions are made to use this water as make-up if needed.

Comment No. 145

Discuss the expected water quality of the runoff collected from the waste rock storage area.

Response:

The exact chemical characteristics of surface water runoff from the waste rock can not be determined until operation. However, based on leach tests conducted on waste rocks, a water quality projection was made. This is shown in Appendix C of "Design Criteria - Water Management Program" contained in Appendix F, Volume 3, "Phase III Water Management Study," CH2M Hill, 1982 (previously provided to the DNR).

The following data for waste rock runoff quality were calculated based on leach test data and should be used for estimating purposes only:

Constituent	Concentrate mg/l
Cu	7.2
Fe	304.
Zn	15.7
As	0.9
Ca	8.3
Mg	78.7
Cd	0.01
Al	49.2
SO_4	1396.

Data presented in EIR Appendix 1.2A, Table 3.4 show that waste rocks are not classified as hazardous waste according to U.S. EPA extraction procedure tests. Any runoff from the storage pile will be collected in a sump and transferred to the reclaim pond.

Comment No. 146

The "approved disposal area" for the oil waste should be specified. The oil-water separator (interceptor system) will require a Department review.

Response:

Oily waste from the oil/water separators will not be permanently stored on the Project site. If the oily waste cannot be accepted by a secondary refinery and it is not classified as a hazardous waste, it will be taken along with other refuse to a disposal site that is licensed and operated according to procedures approved by the State of Wisconsin. If the oily waste is classified as a hazardous waste, arrangements will have to be made to dispose of the material in a hazardous waste disposal site. It is unlikely that this waste will be classified as hazardous.

The oil/water separator consists of a chamber with floating, oil-absorbent material. Water flow through the chamber and ability to collect oil are not affected by the water level in the chamber. The oil-absorbent material will be removed as necessary and replaced with fresh absorbent material. The design of the separator can be reviewed with the Department if necessary.

Recent correspondence received from B. Zellmer of the DNR included a list of 10 waste oil recyclers and/or haulers in the State of Wisconsin.

Comment No. 147

As stated previously, design details for all retention basins on the site must be provided.

Response:

The three civil drawings included in Attachment No. 8 indicate the locations for the two surface drainage basins to be used at the site. Typical drainage inlets for paved areas, ditches, and details of the surface drainage basins are included with the drawings.

Comment No. 148

Section 5.0, Risk Assesment (General)- As reflected in the following comments, some attempt should be made to present estimated frequencies of various occurrences. This information should be available since it is stated on page 5-2 that the risk assesment is based on historical data and semi-quantitative techniques. Further, the contingency measures for many of the potential incidents are not detailed as is required by s. NR 132.07(3)(i).

Response:

Additional data, where available, and amplification regarding frequencies of various occurrences are included in subsequent responses. Some accident probabilities such as in-plant spills are not catalogued by the mining industry or regulatory authorities and projections of probabilities are based on the field experience and judgement of personnel in the industry.

In subsequent responses, additional information on contingency measures has been provided where appropriate to satisfy the requirements of NR 132.07(3)(i). Further detail on contingency measures will be developed in later Project stages during final engineering and operation.

Comment No. 149

No risk scenarios were provided for the effect of reagent and fuel spills affecting the ground water. Given the volume of materials that will be present at the mine/mill and previous ground water contamination incidents in Wisconsin involving many of the same compounds, ground water contamination is a real risk and should be addressed.

Response:

Risk scenarios involving reagents and fuel spills affecting ground water were not presented since they do not constitute a calculable risk. Reagent storage areas and handling facilities in the mill will have concrete floors and be designed to contain spills. Solid spills will be thoroughly reclaimed. Liquid spills will be contained in blind sumps and the contents will be used as originally intended. Liquid spills will be recycled to original bulk containers or to mixing tanks as appropriate.

The fuel storage facility will be lined and have containment dikes sufficient to retain the entire contents of any tank (see response to comment No. 154).

Since these facilities are designed to contain any spilled reagent or fuel, there is no risk of ground water contamination from these sources.

Comment No. 150

Section 5.32, Concentrate Spills - The discussion of concentrate spills considers airborne transport off-site as the only plausible consequence to the environment. Given the number of wetlands, lakes and streams in the vicinity of the mining site, isn't it also possible for a spill to occur in or near one of these water bodies? The effects of a concentrate spill in or near a surface water body should be discussed along with any clean-up procedures that would be used. Is there any historical data for the mining industry regarding the frequency of spills and derailments? What impacts have such spills created in the past?

Response:

The possibility exists that an accident involving transportation of concentrate could result in a spill into a water body. However, the probability of such an occurrence is small and impacts minor. Accident probabilities are dependent on carrier and location. Although specific probabilities of accidents involving shipment of concentrates are not available, probabilities of various industrial accidents are provided in Reliability and Risk Analysis, by N. J. McCormick, Academic Press, 1981. The probability of a train crash is listed as 1×10^{-1} to 1×10^{-2} events per year. This range would probably be reduced to less than 1×10^{-2} to 1×10^{-3} events per year when considering the probability of the postulated accident occurring over water.

Even if such a low probability incident did occur the risks would be short-term, highly localized, and primarily a mechanical disturbance of the environment. The high density of the material would promote rapid settling, should it be introduced to a surface watercourse. There is very limited potential for heavy metal being leached from the concentrate because of the high insolubility of the metal sulfides in water. Under equilibrium conditions, the solubility of the metals in water is less than the U. S. Environmental Protection Agency (EPA) limits established for the protection of freshwater aquatic life or human health (U. S. EPA, 1980). Should very low pH water be encountered, it is possible for the concentrates to dissolve. However, even under these conditions, the metals would be attenuated by the sorption properties of soils. A persistent, high concentration source will not be established.

Because the concentrates are both inert and immobile, remedial measures can occur in a timely manner to recover the spilled material. Because of the economic value of the concentrate, recovery operations would occur immediately. Specific techniques used to recover spilled concentrate will depend on the amount of concentrate spilled and the location. However, the concentrate will be recovered to the maximum extent practicable.

Comment No. 151

It is stated on p. 5-6 that "Health effects caused by inhalation of particles in the respirable range are generally exhibited after long-term (chronic) exposure." However, short-term exposure can also cause health problems, especially in sensitive populations such as people with chronic respiratory ailments, children and older people. It is possible that short-term localized health problems could be caused by derailment of concentrate cars in a town under dry, windy weather conditions.

Response:

Derailment of concentrate cars in a town under unusually dry, windy weather conditions will present neither short-term nor long-term risks to people with respiratory sensitivities. As stated in the response to comment No. 150, the concentrates are dense and inert and their economic value dictates that recovery of the product would occur as soon as practicable after the spill.

Also, the concentrate is not a dry powder and will not be readily suspended by wind unless the material is not recovered and dries. The concentrate will be shipped at 8 to 12 percent moisture which will preclude immediate dusting of the material after an accident. Following the spill and before the concentrate is allowed to dry, sufficient time would be available to clean the area to preclude any impact to sensitive populations.

Comment No. 152

Section 5.3, Reagent Spills - Simply stating that the likelihood of reagent spills is negligible is insufficient. Some statistical information regarding reagent spills in the mining industry should be presented.

Response:

Documentation of reagent spills in the mining industry is not available. The statement made in Section 5.3 is based on judgement and personal experience of professionals in the industry. The reagent transport, handling and storage facilities were selected to reduce the potential for spills and the containment facilities in the mill will prevent any spills from affecting the environment off-site. Based on the experience of mill workers in Exxon Minerals Company, the probability of a major spill resulting from transportation of reagents to the Crandon Project is very low and we would not anticipate a major reagent spill over the life of the Project.

Comment No. 153

It is stated on p. 5-9 that sulfur dioxide, sodium cyanide, sodium dichromate, and sulfuric acid are the only reagents considered to present a potentially significant risk. The polypropylene glycol methyl ether, methyl isobutyl carbinol and possibly the aryldithiophosphoric acid could also present potentially significant risks.

Response:

The risks associated with the three additional reagents mentioned, polypropylene glycol methyl ether, methyl isobutyl carbinol and aryldithiophosphoric acid are minor to nonexistent. In-plant controls and containment facilities will preclude environmental impact from reagent spills in the mill and associated facilities. Transportation of these reagents, as with the other reagents discussed in Section 5.3, is the only mode of potential environmental risk.

The likelihood of these kinds of spills occurring within the Project boundary is considered negligible. The access road will be maintained and the posted speed will ensure safe operation. The railroad spur will be inspected and maintained regularly. In addition, the grade will be less than one percent and the operating speed will be slow. All equipment will be maintained in a condition which complies with all the Department of Transportation requirements. Therefore, equipment failure also becomes a negligible factor. Should a spill occur in transit, the effects would be short-term, reversible, and would constitute little to no threat to human health.

Polypropylene glycol methyl ether and methyl isobutyl carbinol are common reagents used as frothers in the flotation process. They are relatively stable, non-corrosive, and non-reactive agents, requiring no special handling, and present no special health or safety hazard from acute or chronic exposure. Methyl isobutyl carbinol will be stored outside the mill building.

Aryldithiphosphoric acid is listed as a secondary process reagent and its routine use is not currently planned. It was one of the collector reagents used in metallurgical test work; however, it is not as selective in the flotation process as the combination of xanthate reagents that are proposed for use. It is seldom used in the treatment of massive sulfide ores. This product is sold in the ammonium salt form and shipped as an 80 percent aqueous solution; there is little or no acid form of the compound in the shipped product. The low potential for use of this material and the fact that it is shipped as an aqueous solution of a neutralized material accounts for the low level of risk associated with this reagent.

Comment No. 154

Section 5.4 Fuel Spills - Why does this assessment focus only on small quantity spills and totally disregard larger scale spills such as rupture of a storage tank? How would large scale spills be handled?

Response:

Storage tank ruptures were not addressed in the risk assesment because the fuel storage facilities are designed to ensure a tank rupture would result in no environmental impact. The fuel storage tanks will be located within containment dikes sufficient in size to hold the entire tank volume.

The area within the containment dikes surrounding the fuel storage facility will be lined with an elastomer membrane to prevent spills and contaminated runoff from reaching soil, surface water or ground water. Any minor spills, washdown, or runoff from this area will be transferred to the industrial wastewater treatment system. (This system also collects washdown and runoff from around the shops and other areas of potential oil/grit contamination.) Precipitation collected within the containment berms would not normally be contaminated in any way since the fuel storage and handling systems are totally enclosed and sealed. A valved outlet pipe through the embankment at the lowest portion of the diked area will allow a control mechanism for uncontaminated precipitation release. When the valve is opened, precipitation or any uncontaminated water which was contained would simply be permitted to flow into the surrounding area.

Comment No. 155

What will be done with the contaminated soil that is removed from a spill site if the spill occurs during the construction period?

Response:

If a fuel spill occurs that dictates removal of the contaminated soil, the soil will be disposed such that water contamination will not occur. As stated, however, in the response to comment No. 154, the fuel storage tanks will be contained, even during construction, in lined facilities.

If a major tank rupture occurs, the recoverable fuel will be removed and stored in suitable containers and, if necessary, the soil can be removed. The actual disposition of any affected soil will be specified in the SPCC plan which will be developed at a later stage in Project development.

Comment No. 156

Section 5.5, Leachate Control System Failure - The discussion of liner, cap and underdrain systems should include documentation of similar installations being used at other mill facilities or other industries along with an evaluation of their performance.

Response:

The liner proposed for the leachate control system will be developed from processed till (soil material larger than 3/4 inches removed) mixed with bentonite. This mixture would be "blended" and moisture conditioned to a uniform consistency using a batch system similar to that used in the concrete industry; transported to the liner construction area by truck; and dumped, spread and compacted. However, further study is planned for other methods of liner construction including in-situ mixing techniques to assess facility performance variability.

Techniques for spreading a processed aggregate in constructing the underdrain layer would be similar to those used in highway construction with special considerations developed to protect the underlying liner. Grade

control and soil material quality assurance methods are well established. Drainage performance characteristics of the underdrain system can be established either in large scale laboratory tests orfrom in-situ field measurement (i.e., determination of the in-situ permeability of base and subbase soil materials).

The combination of liner, drainage and filter layers is an application of technology which has been used in landfill and other waste containment facilities. The following list includes sites where either similar concepts, in part or in total, have been implemented, are under construction, or have recently been designed:

SITE	LOCATION	TYPE OF WASTE	STATUS
Oaks Sanitary Landfill	Montgomery Co., MD	Municipal waste	Under construction
Key Lake	North Saskatchewan	Uranium tailings	Operating
Crystal Lake Landfill	McHenry Co., IL	Municipal waste	Operating
Landfill No. 2	Virginia Beach, VA	Municipal waste	Under construction
Hawkins Point	Baltimore, MD	Hazardous waste	Designed
Loudoun Co. Landfill	Loudoun Co., VA	Municipal waste	Designed

To date, all Exxon Minerals Company sponsored studies related to the seepage control system have been submitted to the DNR including:

1) General Properties of Common Liners, Crandon Project, Project Report 6.1, Golder Associates, December 1981.

2) Evaluation of Prospective Common Liners, Crandon Project, Waste Disposal System, Project Report 6.2, Golder Associates, December 1981.

3) Geotechnical Review, Crandon Project Waste Disposal System, Project Report 2, Vols. 1-3, Golder Associates, October 1981.

4) Parametric Seepage Rate Estimates, Crandon Project, Waste Disposal System, Project Report 3.1, Golder Associates, March 1982.

5) Underdrain Review, Crandon Project, Waste Disposal System, Project Report 3.2, Golder Associates, March 1982.

6) Laboratory Testing Programs, Crandon Project, Waste Disposal System, Project Report 5, Golder Associates, May 1982.

Comment No. 157

It is stated on page 5-18 that the long-term effect on ground water is reversible. Please expand on this statement.

Response:

The statements on page 5-18 relate to the assessment of risk associated with the low probability of failure in the leachate control system. Although

this unlikely event is mentioned, the potential effects are further mitigated by the attenuative capacities of the soil beneath the MWDF. However, if an increase in MWDF seepage occurs, for whatever reason, it is likely to have slightly higher (i.e., because of larger water quantity not quality) than predicted concentrations of those substances which have little attenuation by the soil beneath the MWDF. The most likely substance for which this scenario (i.e., risk) might occur is sulfate.

However, sulfate is readily dispersed and diluted in water. Therefore, the statement indicating that any effects are reversible provides an assessment of the long-term implications of the unlikely event. Two major factors are related to this statement. First, any cause of an increase in the sulfate concentration will be evaluated and the failure mechanism corrected as soon as possible (e.g., repair of the reclamation cap). The quantity of increased seepage will occur for a short time period, and after repairs are completed, will return to the previous water flow rates. As this occurs, the dilution and dispersion of any substance will also return to its previous condition (i.e., "reversible"). The second factor is that with time the concentration of substances in the leachate will decrease and smaller and smaller contributions will be dispersed and diluted by the water. Therefore, greater and greater dilution and dispersion will occur "reversing" any effect the previous temporary increases in seepage may have caused.

Finally, because the MWDF is in a recharge area, percolating water is readily available to disperse and dilute any substance from a source it is close to and prior to its reaching an environment which would have exposures to any organisms. This is particularly important to prevent violations of any standards and to assure a "reversible" effect prior to the substances being available to the environment beyond the compliance boundary.

Comment No. 158

What measures will be taken if various degrees of failure or inadequate performance occur? Is pumping the only remedial action?

Response:

Many redundant measures have been designed for the MWDF to have a low probability of failure or inadequate performance (see Mine Permit, p. 5-19). However, as stated in the Monitoring and Quality Assurance Plan, several monitoring programs and associated parameter measurements will be obtained to determine the operating conditions of Project facilities and to assure compliance with issued permits and standards. The Contingency Plan provides the implementation procedures to be followed in the unlikely events of failure or inadequate performance.

The measures presented in the Contingency Plan involve early analysis and evaluation of a problem, followed by a determination of its consequences and the time-frame for manifestation, and finally implementation of mitigation and corrective actions. The degree of failure or inadequate performance would also dictate the degree of response. Proper evaluation and cost-effective correction would be dependent on the nature and severity of the problem.

Since no particular failure or inadequate performance is anticipated, and since no such "hypothetical" problem was presented in the comment, no preconceived remedy or corrective action can be presented at this time. However, pumping is not the only remedial action which might or could be implemented. Other possible contingency measures include localized grouting of a failure area of the pond liner, installation of supplemental underdrain pumping wells in the event of an underdrain collection pipe failure, intermediate resealing of a pond, and replacement of the reclamation cap. Again, the Contingency Plan provides for a full and thorough evaluation of any developed problem with provisions for rapid and adequate remedial actions as necessary.

Comment No. 159

Section 5.6, Accidental Detonation of Surface Stored Explosives - There is no such agency as the Wisconsin Department of Industrial Health and Labor Relations as referenced on page 5-22. What is the expected frequency of accidental detonations based on historical data from the mining industry?

Response:

The correct citation for the agency referred to in Section 5.6 is the "Wisconsin Department of Industry, Labor and Human Relations." With regard to detonation of surface stored explosives, Exxon Minerals Company does not expect any. Historical data from the mining industry indicate accidental detonation of surface stored explosives would constitute an extremely rare event. A report prepared by the U. S. Department of Labor, Mine Safety and Health Administration, January 1981, The Explosion Hazard in Mines, does not cite any surface explosions being caused by detonation of surface stored explosives. Verbal communications with Mr. Dick Watson with the Bureau of Mines in Pittsburg, Pennsylvania confirm the rarity of such an event.

Comment No. 160

Section 5.7, Forest Fires - Discuss the measures that will be taken to prevent forest fires resulting from the controlled burning during the site preparation phase.

Response:

If controlled burning is conducted to eliminate waste wood that remains following Project clearing activities, a DNR burning permit will be obtained if any burning is to occur during the fire season. Measures specified on the burning permit will be followed to prevent forest fires.

Comment No. 161

What is the expected frequency of on-site fires during construction and operation? How many incidents are projected to occur over the life of the project?

Response:

Because of safety standards employed during construction and operation, there is little probability of an on-site fire during the life of the Project. On-site fires have not historically been a serious problem in zinc, copper, and lead mining and milling facilities.

Using data on surface fires at underground mines published by the Bureau of Mines in "An Annotated Bibliography of Metal and Nonmetal Mine Fire Reports," December 5, 1980, we would estimate the probability of a surface fire at the Crandon Project at less than one fire during the life of the Project. The duration of this postulated fire based on the same report would be less than 4 hours. Because of the fire prevention standards, and detection systems to be used at the Crandon Project, the probability of fires and their duration should be less than the probability presented here and as such on-site fires do not represent a serious risk.

Comment No. 162

Discuss the potential for fires starting along the power line corridor and the railroad spur and also the prevention measures to be taken.

Response:

In general, the potential of electrical fires starting along the powerline corridor is very low based on the experience of Wisconsin Public Service Corporation in their service area (personal communication, Wisconsin Public Service Corporation, October 25, 1983). Following preparation of the corridor for the powerline, it will be maintained in a vegetative cover of herbaceous plants and low growing shrubs. Growth of undesirable woody plant species in the corridor will be controlled through the use of EPA-approved herbicides. The edges of the corridor will be maintained by periodically trimming the limbs that may extend into the right-of-way. The powerline corridor and adjacent access road will serve as a fire break for any local fires that may occur in areas bordering these Project-related facilities.

As indicated in the response to comment No. 73, the ballast section of the railroad spur will be kept entirely free of vegetation through the use of EPA-approved herbicides. Undesirable weeds and woody plants within the right-of-way also will be controlled by mowing or through the use of EPA-approved herbicides. During Project operation the railroad spur will receive limited use (approximately 15 round trips between the siding and the mine/mill site per week). These conditions will minimize the potential for fires along the railroad spur. The railroad spur also will provide a fire break which will help to control spreading of local fires originating in forest land along either side of the corridor. In summary, the design of the railroad spur and the operations on it will be very similar to other industrial spur tracks.

Comment No. 163

Section 5.8, Mine Subsidence - Simply because mine subsidence does not represent a hazard to people off-site does not mean that it is not a credible source of risk. The evaluation of mine subsidence must be redone in much greater detail especially when one considers the fact that potential for significant surface subsidence is grounds for denial of the mining permit.

Response:

The original ground surface above the proposed Crandon Mine will be maintained by a permanent bridge or "crown pillar" of bedrock left undisturbed above the mine workings.

The mining methods and stope sequences planned for extraction of the Crandon orebody were selected to control mine area rock mass stability and preclude surface subsidence. A permanent bridge or "crown pillar" of bedrock directly beneath the glacial overburden will be purposely excluded from mining activity. This bedrock barrier will maintain surface stability and prevent piping of overburden materials into active mine workings.

Beneath the orebody crown pillar, stoping methods and sequences will be arranged to maintain local rock mass integrity and avoid disturbance of the crown pillar. All proposed mining methods provide for backfilling of stopes immediately following ore extraction. Depletion of reserves will generally proceed from depth and the orebody extremities toward the surface, with mining directly below the permanent crown pillar planned for the final third of mine life. These practices, combined with the fact that approximately 8 percent of the mineable ore will be left in place as pillars throughout the mine, will assure perpetual stability of the mine area bedrock surface and glacial overburden.

The selection of mining methods for preservation of the crown pillar was based on a suite of physical testing programs including soil mechanics, rock mechanics, and mine backfill. These studies determined the soil characteristics, rock mass strengths, inherent rock stresses, and backfill properties such as density, compaction, and percent cement addition necessary for a structurally safe mine design.

John D. Smith Engineering Associates Limited, mine rock mechanics specialist, prepared a summary report, "Evaluation of Surface Effects" in April 1982. Their analysis integrated all the related test work and described and quantified potential subsidence mechanisms:

1) Overburden Compaction - Because of the consolidated nature of the glacial overburden, partial dewatering of these soils will result in little additional compaction and resultant subsidence.

2) Gross Rock Failure - Mine stope dimension, methods, development sequences, and backfilling practices have been designed to preclude failure of the crown pillar or rock surrounding the ore deposit during

and after normal mine operations. Maintenance of the surface is contingent on the stability of the bedrock subcrop.

3) Backfill Compression - Long-term, post-operation, rock failure mechanisms investigated included rotational failure of the hanging wall, wedge failure of the hanging wall, and crown pillar collapse. Each of these failure modes is related to backfill compressibility and placement practices. The properties are such that with proper placement, particularly beneath the crown pillar, the bedrock surrounding the mine workings should remain perpetually stable.

The summary conclusion of all subsidence evaluations is that the combined effects of any bedrock/soil movements will result in less than 0.15 m (6 inch) maximum change in surface elevations over the ore deposit. Settlements of this magnitude distributed through glacial overburden of varying thickness will have a negligible effect on surface topography or land use.

Comment No. 164

Section 5.9 Mine Fires - What is expected frequency of mine fires?

Response:

The frequency and consequences of mine fires at Crandon are expected to be small. Based on information in a report by the Bureau of Mines entitled "An Annotated Bibliography of Metal and Nonmetal Mine Fire Reports," the Crandon Project would not expect mine fires at a frequency greater than 0.2 fires per year. These fires would be minor in nature and as stated in Section 5.9 of the Mine Plan they will have short duration and be highly localized.

The estimate of no more than one fire in 5 years is much more than Exxon Minerals Company expects will actually occur. The estimate is based on industry records from all types of copper, lead, and zinc operations from 1968 to 1979. Over 40 percent of the fires reported were ignited by electrical short circuits which should be a minor potential source in a mine using primarily diesel production equipment. Also, over 40 percent of the applicable industry fires resulted from combustion of timber or insulation which should be a minor problem in a mine using limited amounts of timber for support and little or no insulation.

Comment No. 165

Section 5.10, Tailing Pipeline Failure - This section should discuss industry experience with HDPE pipelines. Exxon should expand on how leaks would be detected, repaired and cleaned up. Will there be a backup pipeline system if the tailing pipeline requires massive repair and is thus temporarily unusable?

Response:

The anticipated life of HDPE pipe has been assessed largely from manufacturers' literature and experience. In water transport service, a 50 year pipeline life might be achieved. This is much longer than the proposed Project life for active pipeline use of approximately 25 years.

Additional information on the characteristics of HDPE pipe and industry experience with HDPE pipelines is presented below:

Resistance to Corrosion

Corrosion tests performed by PSI, Inc. (Conceptual Engineering Study by PSI, Inc.," Tailings Slurry and Solution Transport Pipeline System," p. 10 of Laboratory Report) indicated that corrosion rates for steel in contact with tailings slurry would be high. In contrast, HDPE is inert to a wide variety of chemicals as evidenced by corrosion tests performed by a leading manufacturer of HDPE materials. In addition, HDPE does not rot, pit, corrode, or lose wall thickness by reaction with the surrounding soil. It is unaffected by algae, bacteria, or fungi.

Abrasion Resistance

The abrasivity of the tailings slurry is low as evidenced by Miller number determinations performed by PSI, Inc. (Exhibit 1 of PSI, Inc., report). In addition, test work performed for a leading manufacturer by Williams Brothers Engineering, Tulsa, Oklahoma, compared a proprietary brand of HDPE pipe to steel in controlled pipe loop pumping tests. HDPE out performed steel by a factor of four to one.

Friction Factor

Friction pressure loss in HDPE pipe is less than pressure loss in steel or cement lined pipe. Typical "C" valves used in the "Hazen and Williams" formula for calculating pressure loss are:

HDPE Pipe	155
New Steel Pipe	140
Cast Iron Pipe	130
Concrete Pipe	120

The favorable friction factor for HDPE pipe results in lower pumping energy consumption and reduced pipeline pressure.

Fusion Welding

Steel and HDPE pipe can be installed in a continuous fusion welded line. Lined steel pipes are joined by flanged connections. A pipeline with many flanged connections is more prone to leakage than a welded line. On this

basis, the unflanged fusion welded HDPE pipeline will be superior to flanged pipeline. Therefore, this review indicated that the superior corrosion and abrasion resistance exhibited by HDPE pipe and the life and reliability of HDPE pipelines can be expected to be superior to the life of pipelines fabricated from competing materials, including steel.

In addition, several recent applications of slurry pipeline transport have selected HDPE over other materials. Examples of the use of HDPE in mining industry slurry service are:

1) Pinto Valley (Miami, Arizona);

2) Lornex (Highland Valley, British Columbia);

3) Phelps Dodge (Morenci, Arizona);

4) Inspiration Consolidated Copper Company (Miami, Arizona); and

5) Exxon Minerals Company (Highland, Wyoming).

Information on leak detection and repair of damaged pipe and clean-up around a pipeline break is presented in the response to comment No. 66.

Spare plastic pipe will be retained in storage for repair purposes; however, there will not be a separate backup pipeline system.

Comment No. 166

Section 5.11, Pond Embankment Failure - Discuss the industry's experience with embankment failures (major and minor) and also specify the contingency measures to be implemented if failure does occur.

Response:

There is no mining industry experience of embankment failures with an underdrain system design as proposed for the Crandon Project. There is almost no possibility of such a failure.

Although we do not expect any partial or complete sectional failures of the embankments, in the unlikely event something of this nature occurred, immediate response would be implemented to provide public safety. After that, appropriate reclamation and restoration of the affected areas would be initiated in conjunction with a thorough evaluation of the resulting consequences. Additional evaluation would occur to enable necessary remedial actions to prevent another failure.

However, in the unlikely event that embankment leakage would occur, the Contingency Plan (see p. 12) would implement a program of immediate repair of any such location and the additional construction and/or design for the facility to prevent any further erosion. Following these activities, further evaluation of the cause of any leakage would occur immediately, and necessary design or construction improvements would be implemented as an additional preventative mechanism.

Comment No. 167

The possibility of a failure of the liner and underdrain on the side slopes of the ponds, causing leakage into the dikes thus destabilizing the embankments, should be addresssed.

Response:

The unlikely possibility of failure of the liner and underdrain on the side slopes of the tailing ponds embankments and the consideration of contingency measures have been discussed in the Mine Plan in subsection 5.5.1, pp. 5-18, 5-19; Section 5.11, p. 5-27; and in the Contingency Plan on pp. 11 and 12. The discussions and plans presented in these documents were supported by studies conducted by Golder Associates (see Project Report 11 - Miscellaneous Details and Analyses, Crandon Project Waste Disposal System; previously provided to the DNR)

In Section 12, Slope Stability Analysis, of the Golder report is a discussion of the safety factors inherent in the embankment design. One of the conservative assumptions used in the analysis was that seepage from the pond would saturate a large portion of the embankment. As Golder indicates, in reality this cannot occur. However, an analysis was completed to determine the seepage effect related to forces exerted on the embankment and foundation. Results indicated a minimum safety factor against slope failure of 2.1. This is greater than the recommended minimum safety factor of 1.5 (see Golder Report, reference 4). Golder concluded that the embankments, even if saturated, have stable slopes. Therefore, it is unlikely that the liner and underdrain will fail, and that even if they did, the embankments would be stable above the minimum safety factor and likely preclude any embankment failure.

Comment No. 168

How was the Probable Maximum Precipitation Event (PMP) calculated?

Response:

The value for the Probable Maximum Precipitation event (PMP) and the other storm frequency and intensity values were taken from the "Rainfall Frequency Atlas of the United States," Technical Paper 40, May, 1961, from the United States Department of Commerce, Weather Bureau.

Comment No. 169

Section 5.12, Water Treatment System - Discuss the frequency of shutdown and need for maintenance of this type of system as experienced at other facilities.

Response:

Data showing the frequency and duration of equipment shutdowns for water treatment plants of similar or identical design are shown in the attached tables (data from CH2M Hill, 1983). Reasons for equipment shutdowns are

(TABLE FOR RESPONSE TO COMMENT NO. 169)

LIME PRECIPITATION TREATMENT OF MINE WATER FOR DISCHARGE
EQUIPMENT SHUTDOWN AND MAINTENANCE DATA

UNIT OPERATION	REASON FOR SHUTDOWN	FREQUENCY	DURATION OF SHUTDOWN
Neutralization	• Lime Addition Valve Plugs	Unplanned	• No downtime; back-up system available.
	• Loss of Ferric Sulfate Pump	Unplanned	• No downtime; back-up system available.
	• Agitator Motor Failure	Unplanned	• 1-3 days; stop treating process water and use softening equipment for process water treatment to treat mine water.
	• pH Control System Failure	Unplanned	• 1/2 day replacement; plant continues to operate.
Clarification	• Rake Drive Motor Failure	Unplanned	• 1-3 days; stop treating process water and use softening equipment for process water treatment to treat mine water.
	• Loss of Polymer Feed Pump	Unplanned	• No downtime; replace with backup.
	• Sludge Pump or Valve Failure	Unplanned	• 1/2 day; replace with backup.
	• Shutdown for Normal Cleanout	1 per year	• 1-2 days; stop treating process water and use softening equipment from process water treatment to treat mine water.
Filtering	• Filter Media Replacement	1 every 3 to 5 yrs.	• 1 week; operate treatment line at about 67% capacity.
	• Feed or Outlet Valve Failure	Unplanned	• 1-2 days; operate at 67% capacity.
	• Air Blower Failure	Unplanned	• No downtime; 1-3 day repair; air scouring for filter net used.
	• Backwash Pump Failure	Unplanned	• No downtime; replace with backup.
	• Backwash or Air Line Failure	Unplanned	• 1 week; operate at 67% capacity.
pH Adjustment	• Agitator Motor Failure	Unplanned	• No downtime; 1-3 day repair.
	• pH Control System Failure	Unplanned	• No downtime; 1/2 day to replace signal transmitter.
	• Loss of Acid Pump	Unplanned	• No downtime; replace with backup.

(TABLE FOR RESPONSE TO COMMENT NO. 169)

TREATMENT OF MINE AND PROCESS WATER FOR RECYCLE TO PROCESS
EQUIPMENT SHUTDOWN AND MAINTENANCE DATA

UNIT OPERATION	REASON FOR SHUTDOWN	FREQUENCY	DURATION OF SHUTDOWN
Neutralization	Same as for treatment of mine water for discharge		
Reactor/Clairfier	• Loss of Soda Ash Feed Pump	Unplanned	• No downtime; replace with backup.
	-- Others; same as for clarification in treatment of mine water for discharge		
Filtering	Same as for treatment of mine water for discharge		
Reverse Osmosis (RO)	• Membrane Replacement	3-yr Interval	• 1 week; stop treating process water.
	• Cleaning of RO Module	6-12 times/yr	• 1 day; operate at 67% capacity.
	• Replace Cartridge Filter	12-15 times/yr	• No downtime; 2 to 4 hours to replace.
	• Booster Pump Failure	Unplanned	• No downtime; replace with backup.
	• Feed or Reject Control Valve Failure	Unplanned	• 1 day; operate at 67% capacity.
	• Membrane Failure	Unplanned	• 1 day; operate at 67% capacity or immediately replace with backup.
	• SHMP or Acid Pump Failure	Unplanned	• No downtime; replace with backup.
	• Flow element or pH Element Failure	Unplanned	• 4 hours; operate at 67% capacity.
Evaporator	• Feed or Condensate Pump Failure	Unplanned	• No downtime; replace with backup.
	• Recirculation pump-Impeller Failure	Unplanned	• 1-2 days.
	• Recirculation Pump-Other	Unplanned	• 1 day-2 weeks depending on problem.
	• Compressor Failure-Impeller	Unplanned	• 1-2 days.
	• Compressor Failure-Other	Unplanned	• 2 days to 3 weeks depending on problem.
	• General Maintenance Inspection	1 per year	• 1-2 weeks.
Brine Softener	Same as for Reactor/Clarifier		
Crystallizer	• General Maintenance Inspection	1 per year	• 1 week.
	• Feed, Product, or Condensate Pump Failure	Unplanned	• No downtime; backup available.
	• Recirculation Pump Failure-Impeller	Unplanned	• 1-2 days.
	• Recirculation Pump Failure-Other	Unplanned	• 2 days to 3 weeks depending on problem.

also shown. The reasons for shutdown are those that could occur during the operating life of the treatment systems. Note that for many of the unplanned or unpredictable reasons for a shutdown, there is spare equipment, pumps for example, that will enable nearly continuous operation with no significant loss in operating time.

During partial or complete shutdown of either the mine water or process water treatment system, Crandon Project water can be held within the storage capacity of the facilities (i.e., reclaim or tailing ponds) until full operating conditions are restored as needed. In no case would water not meeting WPDES Permit standards be expected to be discharged.

A number of unplanned occurrences are shown in the attached tables. This does not imply that a large number of failures are expected nor that there will be frequent failures. Unplanned failures may never occur and not constitute high frequency risks. However, the list is provided to indicate that we are aware that certain failures could occur and that sufficient redundancy (spares, both installed and available standbys) will prevent long shutdowns of the treatment plant.

There will be a preventive maintenance program for the water treatment plant designed to keep unplanned equipment failures to a minimum. This is represented in the attached tables by the normal shutdowns for general inspection, cleanout, filter media replacement, and reverse osmosis (RO) module cleaning and replacement. As part of normal maintenance, a pump, for example, will be taken out of service periodically for general maintenance and the installed spare started. This causes no shutdown and ensures that unplanned failure of the pump would be a rare occurrence.

Equipment such as mixers and reactor/clarifiers are quite simple, very reliable, and require little maintenance beyond normal inspection and cleaning. An unplanned shutdown of a reactor clarifier is estimated by one equipment vendor (EIMCO) to occur possibly once in 10 years; however, with normal maintenance, this event should never occur.

There will be six mixed media filters installed in the plant, three will be used for treating mine water, and three for treating a combination of mine water and reclaim pond water for recycle. If a filter used for treating mine water is shutdown for media replacement, the plant can still operate at about 67 percent capacity. During this short period of reduced capacity, excess contaminated mine water would be collected in the overflow system on the water treatment plant feed tank and be pumped to the reclaim pond. If a filter used for treating water for process recycle is taken out of service for media replacement, the treatment capacity for that part of the plant will simply be reduced. This will have no effect on other operations, because additional makeup water, if needed at that time, can be pumped from the uncontaminated mine water tank.

Reverse osmosis systems operate quite reliably. At the water treatment plant for the R. D. Nixon Power Plant in Colorado Springs, Colorado, there have been no shutdowns due to a failure of the RO systems. The availability of spare high pressure booster pumps and periodic cleaning of the RO modules ensures operating availability. As indicated, membranes would be replaced after about 3 years of operation.

Vapor compression evaporators use very reliable equipment. The water treatment plant at the R. D. Nixon Power Plant has experienced only one shutdown of their evaporators. This was a planned shutdown to replace the original compressor impeller with an impeller having different alloy steel.

Most reagent feeding systems will have backup capability. For example, if a lime addition system to the neutralizing mixer plugs, a parallel system will take over. Other reagent feeding systems have backup metering pumps available.

Comment No. 170

How many days of water treatment plant outage can be tolerated by the system? Given the sophisticated nature of the equipment and technology to be used, it will probably take more than "several days" to put the water treatment plant back on line if certain pieces of the equipment (the VCE or RO units) need servicing. If the capacity of the reclaim ponds is exceeded due to extensive maintenance, where would the wastewater be routed?

Response:

Assuming that the total water pumped out of the mine is 530 m^3/h (2335 gallons per minute) and that none of it can be discharged, and that 194.6 m^3/h (857 gallons per minute) are still required as make up in the mill, the remaining 335.6 m^3/h (1478 gallons per minute) would be pumped to the reclaim ponds if the treatment plant was completely shutdown. Assuming 310,950 m^3 (82,153,000 gallons) of available freeboard volume (75 percent of total freeboard) in two reclaim ponds, the mine and mill could continue to operate for 39 days before this freeboard volume is used up. This still leaves 25 percent of the freeboard available for the 100-year, 24-hour storm with allowance for wave run-up. In addition, there is freeboard volume available in the operating tailing pond that could be used to store additional water. However, it is highly unlikely that the treatment plant would be totally shutdown for extended periods of time.

Contaminated water from mine	1335 gpm
Uncontaminated	1000 gpm
	2335
Less water needed in mill	857
	1478 gpm

Freeboard available 82,153,000 gal (75 percent of total)

$$\frac{82{,}153{,}000 \text{ gal}}{1478 \text{ gal/min}} = 55{,}584 \text{ min or about 39 days}$$

If the uncontaminated water does not require treatment, then more than 40 days of downtime could be accommodated without infringing on the freeboard volume of the reclaim ponds. Although the proposed treatment technology appears to be "sophisticated," it represents well proven technology in use throughout the world. If the volumes of the

the reclaim ponds are nearing capacity because mine water is being pumped to them and the treatment plant is not operating, operating procedures could be modified and water could be pumped to the operating tailings pond.

Comment No. 171

The probability of, and potential impacts associated with surface water discharge pipeline failures, should also be addressed.

Response:

There is little probability of failure of the surface water discharge pipeline. The pipeline will not be exposed to corrosive materials nor extremes in internal or external pressures which could result in pipe failure. At the current stage of Project engineering the water discharge pipeline is expected to be constructed of 0.36-m (14-inch) diameter high density polyethylene (HDPE) pipe and buried a minimum of 1.5 m (5 feet) below ground to beneath the frost line. Current engineering calculations show that HDPE pipe rated at 250 psi internal design pressure would be well above expected pipeline pressures.

The water discharge pipeline should not experience vacuum conditions because vacuum breakers will be installed prior to operation.

Blockage of the pipeline due to settled solids will not be a problem because solids in the discharge water will normally be less than 20 mg/l. Solids settled due to periodic pipeline shutdowns will be flushed out with start-up.

The depth that the pipeline will be buried will preclude pipeline freezing and eliminate vulnerability to deliberate or accidental damage from humans, vehicles or machines.

The pipe will be received in 11.6-m (38-feet) lengths. All pipe will be inspected for damage on-site. Sections of pipe with cuts or gouges will be removed and rejected.

Each piece of pipe will be fusion butt welded to form a continous pipeline from the pumping station on the mine/mill site to the discharge point.

Butt fusion welding involves heating both ends of the pipes to be joined, making contact between the two molten ends and joining them together under pressure. The operation is performed using commercially available equipment designed for this purpose. The equipment is easily transported and may be used at any point along the pipeline during the installation of new pipe or the repair of old pipe. The joint which is formed is stronger than the pipe it joins.

Buried pipelines are inherently safer than pipelines laid on the surface. They are silent in operation and not visible. Typically, vegetation covers the trenched area within 2 years.

In the unlikely event of a pipeline breakage, flow rate monitoring equipment would warn the operator to shut down the pipeline system.

Clean-up and removal of spilled water will not be necessary due to the good quality of the treated discharge. Repair of the pipeline will involve the removal of the damaged pipe and welding in new pipe using portable butt-welding equipment. The repaired pipeline would be leak tested using water before backfilling and returning the pipeline to normal service. Spare plastic pipe will be stocked for repair purposes.

Pipeline leaks in conventional flanged or mechanically coupled pipelines typically occur at the flanges or in areas of the pipe where sudden changes in direction are necessary. The use of welded plastic pipe eliminates the flange or other connections and reduces the possibility of leakage. Typically, HDPE pipe can be cold bent to a minimum radius of 25 times the pipe diameter. This allows gradual direction changes to be made and minimizes the possibility of leaks.

Comment No. 172

Contingency plans for the reclaim ponds are not discussed in this section. A contingency plan for these ponds might consist of taking one of the ponds off line and repairing the liner. Provide information on what effect this would have on the water treatment plant.

Response:

Removal of one of the reclaim ponds would have no effect on operation of the water treatment plant.

Comment No. 173

Section 5.13, Air Pollution Control Systems - Section NR 154.06(9) contains requirements for a malfunction prevention and abatement plan for air emission sources, and the plan should be included in this section.

Response:

The requirements for a malfunction prevention and abatement plan will be included as a part of the Air Permit.

Comment No. 174

Section 5.15.3, High Precipitation - Discuss the potential failure of the drainage and erosion control structures as a result of high precipitation, especially during construction. What remedial actions will be taken?

Response:

Except for the tailing and water reclaim ponds (discussed in Section 5.11), other Project water retention facilities retain relatively minor amounts of water. The largest drainage basin in the mine/mill area has a volume of approximately 8500 m^3 (6.9 acre-feet). Failure of a facility like this (either the embankment or the outlet structure) would cause localized

erosion damage in the immediate area of the basin. However, the total water volume available is not large enough to cause more widespread or major damage. These failures are easily repaired.

The temporary facilities (straw bale berms or ditch checks and earth berms and overflow pipes) used during construction will be planned to impound water from relatively small areas and thus contain relatively small volumes of water. As with any construction project, facilities of this nature are continually maintained during their temporary use and rebuilt, enlarged or otherwise modified to assure they perform satisfactorily. However, even in the event of a complete failure, the water volumes are small and localized erosion would be the worst damage anticipated. Vegetation cover in the area would also reduce the extent of the erosion effects and act to stabilize the soils.

Remedial actions for failures of this nature or for similiar failures of other drainage structures such as the mine/mill site culverts would be corrected by rebuilding the failures. Regrading and reestablishment of washed out vegetation would be included to stabilize damaged area. If it was determined a facility was underdesigned, the design would be upgraded.

Comment No. 175

Section 5.18.1, Conclusions - The second to last line of this section should read "... pollution control ..." rather than "... population control ...".

Response:

Comment acknowledged and the last sentence of subsection 5.18.1, Conclusions will be revised to the following:

> For example, the safety systems incorporated to comply with MSHA and the pollution control measures taken in compliance with DNR and U.S. EPA provide a strong measure of protection to the environment and to public health.

Comment No. 176

Section 6.0, Emergency Notification Procedures - How will the Environmental Compliance Engineer (ECE) determine whether an incident presents a hazardous condition? How long will it take to implement the notification plan? What types of incidents will be channelled through Exxon Minerals Co. management before notifying the outside agencies?

Response:

The Environmental Compliance Engineer will review incidents with Project Operations Management and other Exxon Minerals Company management as appropriate. A determination will be made as to whether the incident will result in a potentially hazardous condition, including the movement or accummulation of toxic wastes in the ground or surface water, soils and vegetation, and other consequences of the operation of importance to public

health, safety and welfare. If such a condition exists, then appropriate government agencies will be notified. The response time will be dependent on the nature of the event, but would not be expected to exceed 24 hours from the time the event is determined to be reportable. Normally, Exxon Minerals Company management will be notified prior to agency notification. However, procedures are in place to assure that this internal notification process will not adversely affect timely notification of the agency.

Comment No. 177

A record of all incidents reported to the ECE should be kept and periodically submitted to the Department. If an incident requires corrective action, the Department should be notified, regardless of whether or not hazardous conditions exist.

Response:

Various regulatory requirements governing the operation establish criteria for reporting of incidents. These criteria will be followed.

Comment No. 178

The spill reporting measures, as outlined in various codes, should be included.

Response:

Comment acknowledged.

Comment No. 179

It should be stated in this section that Exxon is required by Section NR 154.06(2)(f) to report air pollution control equipment malfunctions to the DNR within eight hours of their occurrence.

Response:

Comment acknowledged and appropriate revisions to Section 6.0 of the Mine Plan will be made.

Comment No. 180

Section 7.0, Geological/Geotechnical Investigations - As mentioned previously, the discussion of grouting the bedrock/overburden interface is inadequate. Exxon should expand the previous discussion of grouting in the mining plan so that this section could simply refer to that discussion. This section indicates that Exxon intends to conduct a pumping test over the ore body. The plans for this pumping test should be presented in detail and will require a high capacity well approval.

Response:

A more detailed discussion of grouting the bedrock/overburden interface is presented in the response to comments No. 45 and 96.

When the design of the pumping test program over the orebody has been established, the plans for such a test will be presented to the DNR in a High Capacity Well Permit Application.

Comment No. 181

Isn't Exxon planning on doing any more "exploratory" drilling into the orebody? This is the type of drilling that the code is referring to, since these holes would be exempt from regulation under ch. NR 130 as long as the mining plan details the termination procedures to be used for the drilling sites.

Response:

At the present time, Exxon Minerals Company has no plans to conduct additional drilling into the orebody from the surface for the purpose of orebody definition. Such drilling would be conducted from underground workings during the mine development and operational phases of the Project.

Surface drilling into bedrock and/or the orebody may occur during the final engineering and construction phases of the Project for the purpose of collecting hydrological information for the detailed design of the mine water control system.

Any drilling into bedrock from the surface would be terminated in accordance with the procedures specified in Chapter NR 130.

Comment No. 182

Section 8.0, Pre-Blasting Survey - The pre-blasting survey is not optional or on an as-needed basis. The mining permit application must contain the plans (i.e., methodology) for the survey and the survey must be completed and submitted to the Department prior to blasting.

Response:

The plan for conducting the pre-blasting survey required in accordance with NR 132 is as follows:

1) All permanent structures within an 0.8-km (0.5-mile) radius of any of the four mine access or ventilation shafts will be inspected (see Attachment No. 12).

2) Such inspections will be made just prior to the start of site blasting, with an appropriate allowance of time for submission of survey results to state agencies prior to commencement.

3) Property inspection elements will include:

- Foundations
- Concrete Slabs
- Exterior and Interior Masonry
- Structural Framing
- Exterior and Interior Wall Treatments
- Ceiling and Floor Treatments
- Windows and Doors (framing and glass)
- Visible Plumbing
- Exterior Utility Services
- Exterior Structures (antennas, flag poles, etc.)
- Miscelleneous elements as required

Inspected elements will be fully documented, including photographs where appropriate. Element age and state of general maintenance will be noted. Inspections will be conducted by state licensed professionals.

4) Inspections will be made with property owner consent, and universally in the case of Exxon Minerals Company owned structures.

5) Copies of the pre-blasting survey inspection sheets, photographs, and property condition report will be submitted to each private owner and state agencies. File copies will be retained for use at the mine site.

The nominal 0.8-km (0.5-mile) survey radius planned will likely exceed the limit of any measurable blasting effects. In fact, neither seismic stress nor air blast concussion of a magnitude sufficient to cause structural damage is expected immediately adjacent to the shaft collars. Seismic motion from bedrock blasting will be dampened by the overlying glacial sands and gravels (minimum 21 m [70 feet] thick). Air blasts will be muffled by the length of shaft coursed to reach the surface.

VOLUME II, RECLAMATION PLAN

Comment No. R1

The reclamation plan as proposed is a good start towards completing the requirements of chapter NR 132, Wis. Adm. Code, but it is not considered complete at this time. Detailed comments follow which point out weaknesses in the plan, but a few general remarks are presented first.

Response:

Comment acknowledged.

FINAL USE

Comment No. R2

A basic weakness is that the final use of the mine site has not been discussed satisfactorily. Final use should be a unifying factor throughout reclamation planning, but is largely ignored in this document. Section 4.4.1 provides the general statement that the tailings area will be "reclaimed to a natural landscape in terms of vegetation and wildlife populations", but no attempt is made to provide a comprehensive plan that will assure such a result. Establishing a 500 acre black spruce and poplar forest (Appendix B, Mine Plan) is a return to neither natural conditions or good wildlife habitat. An acceptable reclamation plan geared to wildlife habitat must include a comprehensive site map showing proposed plant communities that provide food and cover for the wildlife species of choice (in this case probably deer/grouse/woodcock).

Response:

A final use plan compatible with the principal land uses currently existing in the site area will be determined based on recommendations provided by local governmental jurisdictions and the DNR. These discussions of final use are expected to occur in the next few months and are expected to focus on recreation and/or forestry use of the reclaimed area and the undisturbed adjacent lands owned by Exxon Minerals Company.

In the final plan, illustrations will be included of vegetative cover types and land use in the reclaimed areas at several intervals during and after Project development. The type of illustrations to be included and the periods of Project development to be illustrated will be determined jointly with the DNR. The long-term goal of the plan will be to allow ecological succession to occur in all the reclaimed areas. Also, the plan will be designed so that no long-term maintenance program will be required to maintain plant associations or communities that are atypical of the area or to perpetuate only selected species in certain areas (e.g., limiting plants on the reclamation cap to only those having shallow rooting systems).

To ensure the establishment of a variety of woody plant species in the MWDF area, selected plantings will be proposed at various locations on each of the reclaimed tailing ponds. This will ensure the establishment of diverse plant communities which will enhance the recreational attributes of the reclaimed areas and will provide habitat for a variety of indigenous wildlife species. As plant succession progresses in the reclaimed areas, the wildlife species inhabiting these areas also will change. The plan will not include a specific management scheme that will require maintenance of a certain stage of plant development or succession for the benefit of one or two target game species. Rather, the plant communities will be allowed to develop to be compatible with adjacent undisturbed communities.

To accommodate a variety of plant species with various rooting habits on the reclamation cap of the tailing ponds, it will be necessary to examine the cap design to ensure that its integrity and purpose are not adversely affected by the plant species expected to occupy this reclaimed area. If root penetration is determined to affect the performance of the cover to the extent that compliance with ground water quality or final use requirements is jeopardized, consideration will be given to the following alternatives which would allow progressive plant succession in the MWDF area: (1) increase the depth of till over the drain and seal layers, (2) incorporate a coarse sand or gravel layer in the cap design that would inhibit root penetration, and (3) a combination of the above two. These alternatives would allow ecological succession to occur in the reclaimed MWDF area and would not require a long-term maintenance program to maintain a vegetative cover consisting of only selected plant species. Any changes in cap design will be described in the revised Mine Plan and Reclamation Plan.

Ultimately, a revised Reclamation Plan will include a new subsection on the agreed final use of the Project site. This comprehensive final use plan will include a narrative discussion and supporting graphics which illustrate how the Project area will be unified with the adjacent lands not disturbed by mining activities.

Comment No. R3

Whether reclaiming for wildlife or some other use, the area would still require a greater diversity of species. Black spruce is adapted to wet areas, and the reclamation cap may be too droughty for optimal growth of this species. In addition, black spruce is very susceptible to windthrow. Tip ups can be expected to occur regardless of species planted, but covering a 500 acre plateau with this species seems especially risky.

Response:

As indicated in the response to comment No. R2, a comprehensive final use plan for the Project area, including the MWDF area, will be included in the revised Reclamation Plan. This plan will allow the establishment of a variety of plant species on the reclamation cap over the tailing ponds. Some of the species that eventually become established will be susceptible to windthrow; however, the cap will be designed so that tip ups will have no adverse effect on the seal layer.

Comment No. R4

It appears that reclamation of the tailings cap is not being approached from the correct perspective, that the wrong question is being answered. The question should be: How can the cap be designed to accommodate naturally invading species?, instead of: How can the vegetative cover be controlled to minimize damage to the cap as it is now proposed? A well thought out final use goal may provide direction in revising this plan.

Response:

Comment acknowledged and the revised Reclamation Plan will include a comprehensive final use plan (see the response to comment No. R2). The design of the reclamation cap will be reexamined to determine what changes may be required to accommodate all plant species that could invade the cap following final reclamation.

SURFACE DRAINAGE

Comment No. R5

Another topic deserving more attention is surface drainage/erosion control. Though erosion control is discussed in different sections throughout the report, no attempt has been made to quantify the potential runoff. This information is necessary for determining the size and location of retention basins and other erosion control structures. A comprehensive view of runoff control for the entire mine site should also be provided.

Response:

One of the objectives in the development of the Reclamation Plan was to plan the reclamation of facilities in a manner that would avoid the need for long-term continual maintenance and attention. The handling of surface drainage and erosion control has been considered and planned for to avoid the need for retention basins and similiar structures since these would require some sort of continuing maintenance.

The location of the MWDF in Area 41 does not change the basic characteristic of the site as an upland area with surface drainage in all directions. Upon completion and reclamation of the MWDF the final grades will be some 10-20 m (33-66 feet) higher than existing grades but the area will remain an upland area with surface drainage in all directions. The design of the reclamation cap seepage control system reduces infiltration through the cap to a minimal level and changes the infiltration/runoff/evaporation - transpiration balances in the immediate area of the MWDF. However, this is expected to have minimal effects on the overall hydrological system as it is currently operating in Area 41. Precipitation that would normally infiltrate, but is now prevented from infiltration because of the seal, will move to the perimeter of the MWDF through surface runoff and through the drain layer overlying the reclamation seal. At the MWDF perimeter the excess water will infiltrate and provide ground water recharge. The hydrological system is altered in the vicinity of the MWDF, with reduced infiltration below the cap, but that is offset by having the infiltration occur around the perimeter of the MWDF.

This water balance for the MWDF reclamation cap was studied and estimated by Owen Ayres Inc. Their report "Waste Disposal Facility Reclamation Cap" has been provided to the DNR. Overall when considering the total area of Area 41 there is very little change in the hydrological system.

The reclamation grades planned for the MWDF are fairly flat and the overall surface grades are established to develop approximately uniform runoff rates around the perimeter of the MWDF. The objective in this design was to not concentrate or combine flows and therefore avoid the need for ditches, culverts, basins, or other structures to handle the flows.

However, it is important that this excess water does infiltrate in the MWDF perimeter area (within a few hundred feet of the facility) to assure the performance of the MWDF and maintain the overall hydrological balance in the area. This is also true for snowmelt during spring thaw. To assure the system works as intended there may need to be minor regrading in the MWDF perimeter area to eliminate existing surface drainage channels or possibly to add some swales or shallow basin areas to temporarily retain runoff and encourage infiltration. This work is minor in nature and would be accomplished during preparation of the MWDF Plan of Operations.

The reclamation of the mine/mill area has been planned to achieve the same objective, that is to eliminate the need for permanent drainage facilities that are required after reclamation. Again, the reclamation grades have been chosen to avoid concentrating flows and to the extent possible to reestablish drainage systems and flows existing prior to development of the Project.

Comment No. R6

In Appendix B of the Mining plan (Volume I) there is a statement that sediment basins on the mine waste disposal facility will be designed for the 10-year, 24-hour storm. NR 182.11(1) 1 requires that they be designed for the 100-year, 24-hour rainfall event. This error suggests that all the sediment basins on the mine site are similarly designed, since no other guidelines are given. Therefore data must be supplied to support the design plans.

Response:

The sediment basins presented with the construction and phasing plans for the MWDF are temporary basins, installed prior to a construction phase and removed after vegetation has been established and erosion control is no longer required. Later, however, as a phase of reclamation was to occur, when once again soils would be exposed to erosion, then the temporary silt control basins would again be utilized. As planned for these purposes, the silt retention basins are either to consist of straw bale dams or small earthen dams with overflow pipes to be located in existing drainage swales or depressions.

As indicated in response to comment No. R5, the MWDF is located in a topographical high area and there are no large quanities of surface flow through the site. Therefore, only minor surface water diversion is associated with the MWDF and there are no major water diversion or other water handling structures required. Also, during operation of the facilities with the tailings pond(s) open, total runoff in the area of the MWDF will be reduced by that amount falling in the pond(s).

Our studies have not identified any major problems in meeting our objectives in developing a surface water handling system with minimum facilities which effectively manages and controls surface runoff. This is true during the construction, operation, and reclamation periods when the temporary facilities are used and even more true after reclamation has been completed and only a very minimum of facilities are required. Work during Plan of Operations engineering will provide additional final detail for the temporary facilities and for any minor permanent facilities that would be required. Both of these categories of facilities will be designed following NR 182 regulation and using a 100-year, 24-hour rainfall event.

The surface drainage basins in the mine/mill area have been sized to contain runoff volumes from a 25-year, 24-hour rainfall event.

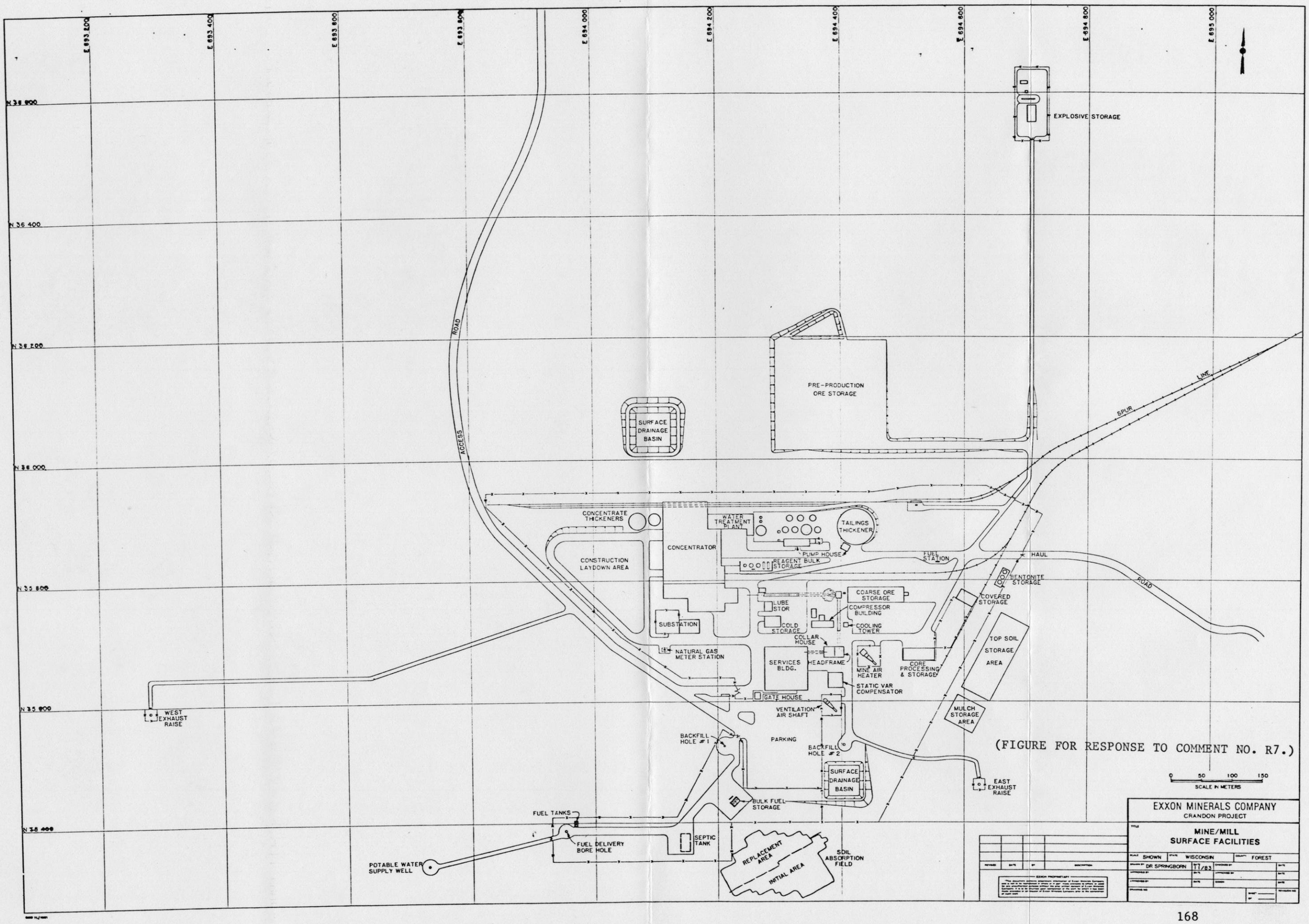
TOPSOIL STOCKPILES

Comment No. R7

During departmental review of the reclamation plan it became evident there was some confusion about the disposition of salvaged topsoil. Clarification is needed regarding excavating, storing, and controlling erosion of the topsoil. The figures provided do not clearly show locations of storage or erosion control practices. It is also not clear in the report if glacial till being saved for reclamation is considered separately or not.

Response:

The construction plan that has been developed for the mine/mill area includes clearing and grubbing of 35.7 ha (88.1 acres). Topsoils will then be stripped in this area to a depth of 0.15 m (6 inches), resulting in a topsoil volume of 53,500 m^3 (70,000 cubic yards). The topsoil will be stockpiled on the east side of the mine/mill site as shown in the attached figure. A vegetative cover will be established on the topsoil stockpile to control erosion. Excess glacial soils from the mine/mill site recovered during initial site grading will be removed to the MWDF for reuse there. There will be no glacial till stockpile at the mine/mill site. Glacial till required for reclamation regrading in the mine/mill site will be returned from the MWDF area at the time of reclamation.



(FIGURE FOR RESPONSE TO COMMENT NO. R7.)

DETAILS

Comment No. R8

Section 2.4.2, Fertilizer Use - This section should state clearly that each site will be analyzed to determine the best fertilizing and seeding practices.

Response:

The following statement will be added to subsection 2.4.2, Fertilizer Use:

As major Project facilities are constructed and the areas associated with, or adjacent to, these facilities are graded and ready for establishment of vegetative cover, soil samples will be taken and analyzed to determine the most appropriate fertilizer application. Each of these areas also will be analyzed (i.e., topography, exposure, drainage and future use) to determine the best seed mixture and practice for seeding.

Comment No. R9

Section 2.4.3, Species Selection - This section implies that erosion control will not always be important during the period from October to May. On the contrary, erosion control is a must all year round. If barren soils are not stabilized in the fall, the frozen exposed ground is susceptible to spring rains and erosion.

Response:

Subsection 2.4.3, Species Selection will be revised to indicate that erosion control during the period October to May is equally as important as from May to October. Construction areas having exposed soils that will not be disturbed from October to May will be stabilized in late summer or early autumn with grass-based seed mixtures. These seed mixtures will be supplemented with mulch and/or soil surface stabilizers to ensure establishment of vegetative cover prior to the non-growing season. Vegetative cover will be established as early as possible on these areas so that the soils are stabilized and erosion potential is minimized.

Comment No. R10

Section 3.2.2, Site Preparation - 1) If trees and stumps are chipped and stockpiled, a location for the stockpile must be designated. A permit may be required for burning the stumps and brush. 2) Where is the outlet to the storm water drainage system? The mining plan shows (Fig. 3.2-1) a single runoff retention basin during construction. No indication is given as to how water will be directed to it. The reclamation plan shows (Fig. 3.3) four retention basins will be constructed during the first year of the construction phase. The mining plan has the four drainage basins (Fig. 3.2-2) appear after constructon is completed. No contour lines are provided to substantiate the surface drainage plans.

Response:

The figure attached to the response to comment No. R7 shows an area designated for waste wood mulch storage on the east side of mine/mill site.

If burning is chosen for disposal of stumps or other wood waste a permit application will be submitted to the DNR.

The three attached civil drawings (Attachment No. 8) depict the surface water drainage system planned for the mine/mill site. The system utilizes two surface drainage basins for handling nearly all of the mine/mill site uncontaminated surface runoff. Details of the outlets for the basins are included in the drawings. As shown in the drawings, there are some other minor discharges from mine/mill site extremities where it is not practical to route runoff back to one of the drainage basins. Also, as shown in the plans all surface water with potential to be contaminated is collected and handled separately.

As described in the EIR, the entire site will be cleared, grubbed, and rough graded as necessary which will be one of the initial activities in the construction schedule. Since there is no phasing to this work, there will be no interim conditions for any length of time.

Erosion control will be developed as necessary with the rough grading. To the extent possible, the two permanent surface drainage basins will be used for runoff control. The basin areas will be excavated first with grading work generally progressing outward from the basins. Where portions of the storm drainage system are not installed concurrently with the rough grading, separate provision for runoff and erosion control will be made. These provisions will consist of temporary siltation basins or hay or straw bale ditch retention checks.

Graded areas not scheduled for immediate development would be revegetated with a temporary ground cover following the grading work to reduce siltation from runoff erosion. As an area is subsequently developed, any portions of the final storm drainage system not installed with the initial site work would first be installed for the area before beginning other construction. At that point, runoff would be controlled by the final system, although some hay or straw bale ditch checks might still be used to prevent downstream siltation of the system. Development of the site in this manner will reduce the need for short-term temporary erosion control measures. The long-term control will be through the final surface water drainage system.

Comment No. R11

Figures 3.2, 3.3, and 3.4 - Fig. 3.2 shows the topsoil stockpile location on the mine and mill site. Figs. 3.3 and 3.4 show that location as a vegetated erosion control dike. Are these structures one and the same? The area depicted in the different figures is not the same.

Response:

The figure attached to the response to comment No. R7 presents the current revised layout of the mine/mill area facilities. The topsoil storage area has been relocated to the east side of the site. An approximate 1.4-ha (3.5-acre) area is required.

Comment No. R12

Figures 3.3, 3.4, 3.5 and 3.6 - Final paved areas are not clearly designated, especially around the tailings thickeners. The landscape phasing plan shows this area will be vegetated in construction year 5 (Fig. 3.5), but the erosion control plan for the operation phase (Fig. 3.4) specifically excludes vegetation from that area.

Response:

Drawing No. 051-1-C-003 in (Attachment No. 13) reflects the current revised mine/mill site configuration and depicts all paving in this area. The landscape plan, including phasing of the plan, is being revised and will be submitted to the DNR in December 1983. Any discrepancies between the landscape phasing plan and the erosion control plan will be corrected in the revised Reclamation Plan.

Comment No. R13

Section 3.2.3, Reclamation Phasing Plan - A report by the Sanborn Group, Inc. (1982) is cited as providing a comprehensive desciption of a typical landscape design. This document has been requested by the Department, but has not yet been received.

Response:

The report prepared by the Sanborn Group, Inc. entitled "Site Master Plan" is being revised to reflect changes in the construction schedule and minor modifications in the location and size of facilities in the mine/mill site. The landscape plan is a part of the Site Master Plan Report and it is also being revised to incorporate the above changes in Project design and schedule. This report will be provided to the DNR in December 1983.

Comment No. R14

Figures 3.2.3, Reclamation Phasing Plan - Two types of topsoil stockpiles are mentioned: temporary and permanent. These must be described in greater detail. How much salvageable topsoil is expected to be found? Will these stockpiles include the glacial till which will be substituted for topsoil during final reclamation.

Response:

In the revised mine/mill site plan there is only one topsoil area located on the east side of the site. Based on stripping the topsoils to a depth of 0.15 m (6 inches) in the cleared mine/mill site area, a quanity of

53,500 m^3 (70,000 cubic yards) of topsoil will be salvaged. Portions of this stockpile will be reused during construction as areas of the mine/mill site are completed and landscaping/reclamation work is performed. The majority of the topsoil stockpile will be maintained for the entire operating period to be reused during the final reclamation of the mine/mill site. Only the topsoil materials will be stockpiled at the mine/mill site.

In addition to the topsoil, earthwork calculations indicate an excess of approximately 70,700 m^3 (92,400 cubic yards) of material in the mine/mill site. This excess material will be transfered to the MWDF for use there; similiarly any till material needs for final reclamation grading work in the mine/mill area will be returned from the MWDF during final reclamation. Glacial till will be stockpiled separate from topsoil in the MWDF.

Comment No. R15

Section 3.2.3.1, Year 1 Landscaping - More information is needed on the planting of native species in the retention basins and power line corridor. What species will be selected, and what is their source? Section 3.9.3.3 states that existing retention basins will be stabilized with vegetation when reclamation begins. How does this tie in with the native plantings already present?

Response:

Within the powerline corridor from State Highway 55 to the mine/mill site the only areas proposed to be seeded are those that are entirely cleared of vegetation and where soils are disturbed, e.g., around transmission towers and the access road used during construction. Typical species that could be used in the powerline corridor and in the retention basins include: orchard grass, reed canary grass, cord grass, timothy, oats, perennial rye, creeping foxtail, birds foot trefoil, sweet clover, alsike clover, red clover, white clover, goldenrod, sunflower, and aster.

During final site reclamation, regrading will eliminate the retention basins to allow natural drainage. The vegetation established in the retention basins following construction will be removed during this reclamation grading. After the final grades have been established, these areas will be seeded with plant species similar to those identified above.

Seed suppliers within the State of Wisconsin, such as Wild Life Nurseries, Oshkosh; Sperka's Woodland Acres Nursery, Crivitz; and Strand Nursery, Osceola, will be the source of native plant seeds. Agricultural plant seeds will be obtained from local commercial suppliers.

Comment No. R16

Section 3.2.4.1, Plant Materials - A clearer description is needed of the source for transplanted native stock. Will the source be elsewhere on the mine site.

response:

If it is cost effective and suitable stock is available, some specimens for use in landscaping the mine/mill site will be taken from property owned by Exxon Minerals Company immediately around the mine/mill site or in those areas designated for future Project facilities, such as the tailing ponds area in the MWDF. Prior to transplanting, all stock selected in the Project area will be marked and inspected by a qualified horticulturalist to ensure the specimens are disease free, structurally acceptable and suitable for landscaping purposes. Commercially grown stock will be obtained from nurseries whose stock meets the requirements of the Wisconsin Nurserymen's Association. Examples of such nurseries include: Evergreen Nursery, Sturgeon Bay; Silver Creek Nursery, Manitowoc; and Bruce Company, Middleton.

Comment No. R17

Section 3.2.5.2, Long-Term Maintenance - A description should be provided on the methods for maintaining clear zones (e.g. herbicide use, burning or mowing).

Response:

As part of the long-term maintenance program, clear zones will be maintained around the perimeter fence surrounding the mine/mill facilities, in the rights-of-way for the access road, railroad spur, and haul road and slurry pipeline corridor. These areas will be maintained in herbaceous vegetation and/or low growing woody species to minimize the potential for fires.

Growth of woody species within these "clear" areas will be controlled by mowing and selective application of EPA approved herbicides. Also, see the response to comments No. 73 and 162.

Comment No. R18

Section 3.3, Railroad Spur - A map showing the entire length of the railroad spur is needed. This figure should depict the erosion control practices along the route, especially of the Swamp Creek and wetland crossings.

Response:

The attached plan and profile and detail drawings (Attachment No. 11) from the plan set of preliminary engineering drawings for the railroad spur depict the entire alignment from the Soo mainline to the mine/mill interface point. Drainage structure locations, typical sections showing revegetation, and settling basin details are included. The plan sheets also show the approximate slope intercept lines along the entire route, showing the limits of revegetation after construction.

Locations of the temporary erosion control facilities to be utilized during construction, such as the straw bale silt traps and the sheet piling at the area of the Swamp Creek crossing structure, would be determined during final engineering.

Comment No. R19

Section 3.3.3, Erosion and Vegetation Maintenance - If herbicides are being considered for brush control their use should be discussed. Use of herbicides may be subject to Department approval.

Response:

Herbicides will be used to selectively treat undesirable woody plant species that encroach within the railroad spur right-of-way. Only EPA approved herbicides will be applied. Selective applications of herbicides will be completed by a private contractor in accordance with standard railroad maintenance practices.

Comment No. R20

Section 3.4.1, Construction Procedures and Erosion Control - In the final Reclamation Plan, when construction practices adjacent to navigable water are described, reference should be made to the appropriate Chapter 30 approval.

Response:

In the final Reclamation Plan where construction practices adjacent to navigable water are discussed, reference will be made to the appropriate Chapter 30/31 Permit approval.

Comment No. R21

Section 3.5, Tailings Transport System - A map of the entire tailings transport corridor must be provided which shows specific erosion control measures to be used.

Response:

The attached drawings (Attachment No. 14) depict the preliminary plan and profile for the waste rock haul road and tailings transport system corridor. Drainage structure locations, approximate limits of revegetation and the typical cross-section are included. Specific details and locations of the temporary erosion control measures used during construction (straw bale silt traps or similiar measures) would be determined during final engineering.

Comment No. R22

Section 3.6, Water Discharge System - The crossing of wetland areas and the development of a discharge structure on the bank of Swamp Creek should be discussed in this section.

Response:

The water discharge pipeline corridor is shown on the attached figure. The corridor is approximately 9.8 km (6.1 miles) long and has a nominal width of 15.0 m (49.2 feet). The actual width of the corridor that will be disturbed during pipeline installation is estimated to be 6.0 m (19.7 feet) which results in a total estimated disturbed area of 5.9 ha (14.5 acres). Approximately 75 percent of the route length is across high ground which will present no special construction difficulties. Trench excavation, pipe laying, and backfilling will be completed in sections to avoid having open trenchs for extended periods.

Installation of pipe through the wetland areas will require additional precautions. Muck and organic soil conditions as well as season of the year will determine the most effective equipment to use. To the extent possible, the wetland soils will be kept separate from the subsoils as they are excavated and placed along the trench. The soils will be backfilled later in the original sequence, i.e., subsoils will be backfilled before the mucks. In areas where there is potential for erosion, the materials will be contained with silt fences (filter fabrics) or other appropriate methods. Because of the nature of wetland soils, wider disturbed areas will result in the wetlands. Lighter equipment and swamp mats will probably be used unless a winter time construction schedule is determined to be beneficial. Selection of a contractor with appropriate experience and prior satisfactory results on other similar projects will be an important criterion.

Comment No. R23

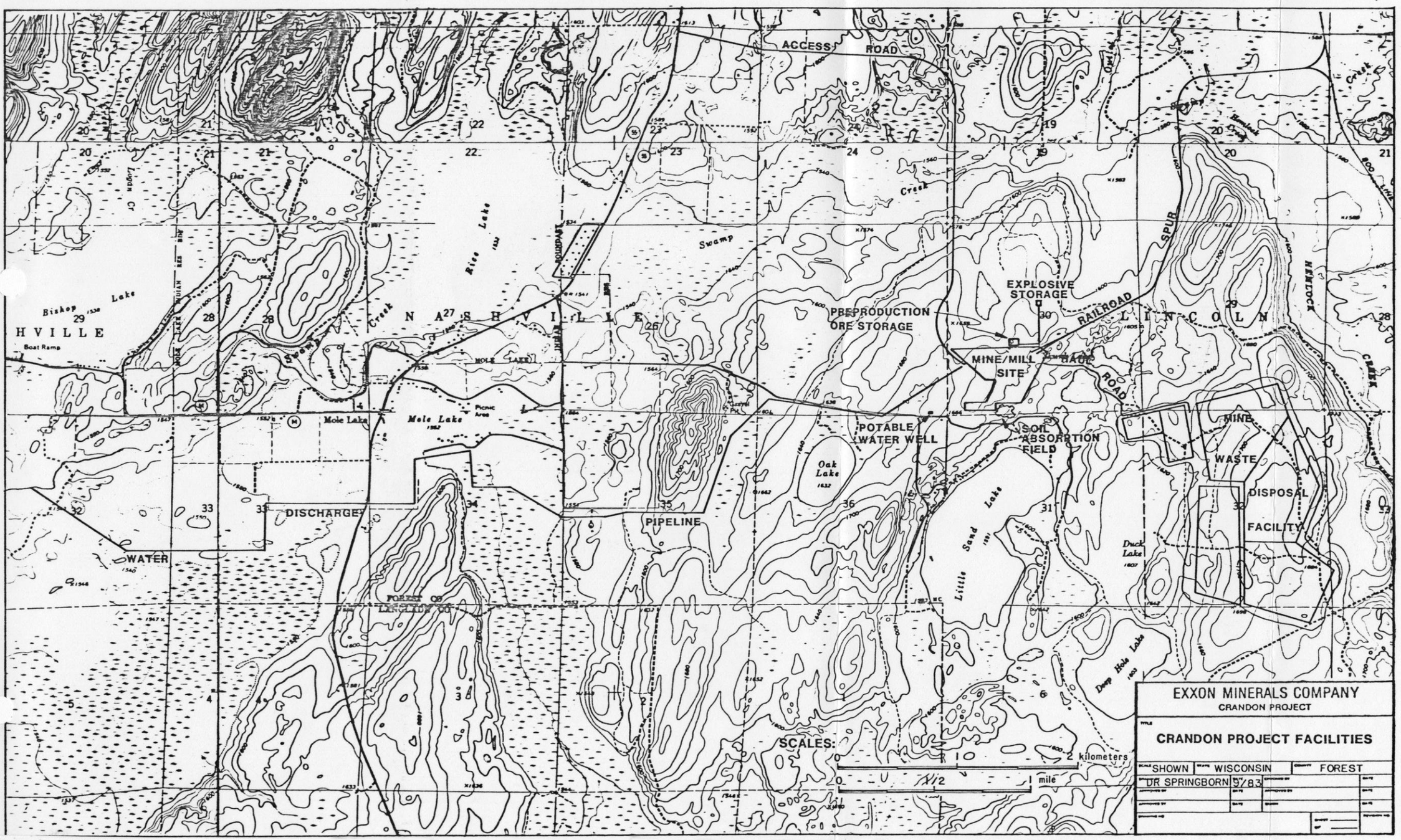
Section 3.9.1, Removal of Facilities - 1) Reclamation of the access road must be addressed. A plan for reclaiming the road must be in place in the event a 'permanent need' has not been established for it during the mine operating period. 2) The plan should state that the railroad corridor will be reclaimed so as to blend in with the surrounding area, in terms of both grading and revegetating.

Response:

The response to comment No. 5 presents a plan for the reclamation of the access road in the event no other use or need for the road becomes established during the Project life.

The grading work planned with the reclamation of the railroad spur (and the other corridors) is kept to a minimum in an attempt to preserve as much of a corridor as possible. This will provide a corridor which will be of benefit for wildlife movement, hiking, skiing, or other activities.

(FIGURE FOR RESPONSE TO COMMENT NO. R22.)



Comment No. R24

Figure 3.10, Final Landform Grades in Mine/Mill Area - This figure is far too site-specific. A map showing final grades for the entire mine site is needed to assess how the site will fit in to the surrounding area.

Response:

The attached drawing (Attachment No. 15) depicts the landform grades in the mine/mill site and the surrounding area after final reclamation. The final topography is shown by different contour lines types thoughout the area depicting: (1) existing surrounding topography that has not been altered; and (2) topography altered during construction and final reclamation

As indicated in the response to comment No. R2, a discussion will be included in the revised Reclamation Plan describing how the reclaimed mine/mill area will be unified with surrounding undisturbed lands.

Comment No. R25

Section 3.9.3, Reclamation Grading and Soil Placement - The sources for borrow fill used in final grading are not adequately described. this section states that "most borrow fill will be acquired from the SE portion of the site . . ." Where is the remainder expected to come from?

Response:

Required borrow to develop the final reclamation grades will come from materials maintained at the MWDF. The final reclamation grades have been planned so that the original drainage patterns are reestablished, to the extent possible, and also to minimize required earthwork. This minor borrow requirement is small considering the earthwork volumes managed in construction and reclamation of the MWDF.

Comment No. R26

Section 4.2.1, General Criteria - The glacial till excavated from the tailings disposal site is expected to be of adequate quality and quantity to build all embankments and complete the final cover. There must be a discussion of alternative sources in the event there is insufficient till available from the tailings area.

Response:

Extensive geotechnical investigation has determined the extent of glacial till throughout the MWDF area. The design of the MWDF was developed to achieve, to the extent possible, a balanced earthwork condition. Review of the existing earthwork balance will be an on-going activity, with the sequencing of the MWDF development providing the opportunity to manage the balance. Very minor pond depth adjustments can create large earthwork balance differences, affording the opportunity for achieving a final balanced earthwork condition at the completion of reclamation.

Comment No. R27

Section 4.2.3.4, Construction Support Area - Provide details on the design and construction of the runoff control structure. How will size be determined? To the extent possible the support area should be vegetated to prevent unnecessary runoff.

Response:

The attached drawing (Attachment No. 16) presents a plan and section of the proposed construction support area. The retention pond shown will collect surface runoff and also handle water used in processing soils to prepare underdrain materials. In addition to the process water requirements a 100-year, 24-hour rainfall event will be used to size the retention pond. There will be relatively little area in the construction support area that is unused; however, any open spaces will be revegetated to reduce erosion. The detailed design for the construction support area will be completed during Plan of Operations engineering.

Comment No. R28

Fig. 4.14, Approximate Reclaimed Surface of Tailings Ponds - This figure must be combined with Figure 4.17 (Reclaim Ponds). Presented separately, these figures are not very useful, especially since they are drawn to different scales.

Response:

The attached drawing (Attachment No. 17) presents the final reclamation grades in the MWDF area including the reclaim ponds.

Comment No. R29

Section 4.4.4, Permanent Vegetation - This section must include a discussion on establishment of ground layer species.

Response:

The following discussion on establishment of ground layer species will be added to subsection 4.4.4:

Following final grading of the area underlain by the reclamation cap of each tailings pond, herbaceous vegetation will be established to stabilize the soil surface and to minimize erosion. The plant species to be seeded on the reclamation cap will be similar to those identified in the response to comment No. R15. A drill seeder or broadcast seeder will be used for seeding. Invasion of woody plant species from adjacent communities will be allowed to occur in the grass/legume vegetative cover. If wet areas should develop where water drains from the drain layer of the reclamation cap, plant species, such as reed canary grass, giant smartweed, cord grass, three-square bulrush and cattail, will be established.

Comment No. R30

Section 4.4.4.3, Species Selection - This section reports that final species selection will be determined by on-site testing of trees on pond T1 following completion of the tailings cap. No further mention is made of the proposed study. According to the Feasibility Report (p. 9-26) a final cover of black spruce and poplar will be established, with no indication that research may identify better suited species. The idea of a well planned study should be further developed. Details of this study must be included in the reclamation plan. A list of test species appears in Table 4.3. These species all have shallow root systems, but other types of root systems should also be examined in this experiment. If tree roots do penetrate the seal, this ought to be studied during operation because natural invasion cannot be completely prevented, and cap improvements are best made prior to final closure.

Response:

The following information will be included in subsection 4.4.4.3 of the revised Reclamation Plan:

Assessment of species adaptability would utilize traditional means such as percent survival and growth rate measurements (e.g., Evans, 1972). Specific factors which could possibly affect plant survival and rate of growth would be incorporated into any finally selected experimental design. Included among those factors would be, for example, influence of ground cover types on species establishments, the use of seed, bare root and containerized stock, fertilizer requirements and ground preparation practices.

Separate plots would be established to evaluate the pattern of natural invasion by locally native species. The overall experimental design of the study would be such that the direct comparisons could be made between the direct seeding methods and the 'method' of natural invasion.

An investigation of rooting patterns of direct seeded species and of naturally occurring species as affected by various plot treatments would be initiated to obtain information on potential rooting patterns within the tailings cap system. Because of the complex nature of root system investigations (e.g., Evans, 1972), precise experimental outlines are not feasible until such time as site conditions have been more definitely established.

Reference:

Evans, G. C., 1972. The quantitative analysis plant growth. Studies in Ecology; Volume I. University of California Press, Berkeley. 734 p.

Comment No. R31

Section 5.1, Monitoring and Long-Term Maintenance - As written, this section is incomplete. Post-closure monitoring of vegetation must be described in detail. The monitoring will provide information on the relative success of the reclamation effort and highlight any problems that may arise.

Response:

As indicated in Section 5.1 of the Reclamation Plan, the specific details of the post-operation monitoring program will be determined in conjunction with the DNR. A monitoring program will be developed that will allow determination of plant species composition, relative frequency of occurrence, relative dominance and relative density. Measurements to determine percent cover (proportion of an area covered by the vertical projection of plant crowns or basal area to the ground surface) also will be included in the monitoring program. Biomass sampling will be performed to allow comparisons against biomass values recorded for other plant communities.

Data for the vegetation monitoring program will be collected using plots, plotless techniques, or a combination of the two methods. The details of the plot sampling (i.e., shape, size, number and method of distribution of the plots) will be determined jointly with the DNR. Monitoring will be conducted annually over a representative segment of the reclaimed area for the first 5 years following final reclamation. Upon completion of 5 years of monitoring, the results will be evaluated and will serve as the basis for determining the scope of any future monitoring.

Photographic evaluations will be included as part of the monitoring program to depict the vegetative conditions in as graphic a manner as possible. These photographs will be used to show the changes in vegetative composition which occur over time as a result of normal ecological succession. Photographs will be taken annually at marked points of reference to ensure a representative cross-section of the reclaimed area is included. These ground level photographs will be used in conjunction with the aerial photographs, as described in Section 5.1 of the Reclamation Plan, to monitor the development of vegetation in the reclaimed areas.

Comment No. R32

Section 6.0, Reclamation Costs - The estimated reclamation costs must be supported with a more detailed cost breakdown.

Response:

A breakdown of reclamation costs is included in the response to comment No. 5.

Comment No. R33

Appendix 1.1A cites this section as fulfilling the requirements of ch. NR 182.08 (2)(j), which specified the need for an engineer's cost estimate for site closing. Such a report is missing from this section, but must be provided before the reclamation plan is considered complete.

Response:

The estimated reclamation costs will be presented as an engineer's cost estimate prepared and signed by a engineer registered in the State of Wisconsin. Exxon Minerals Company will submit the certified cost estimate after final agreement on the Reclamation Plan with the DNR.

Comment No. R34

Section 7.0, Notification - This section is supposed to provide the names of persons legally and operationally responsible for long-term maintenance (ch. NR 132.08(e)(2)). This section merely directs all questions to the unnamed Technical Services Manager. This does not meet the requirements of the code.

Response:

The person who will be legally and operationally responsible for long-term maintenance has not been identified and probably will change periodically during the life of Project operation. The DNR will be notified prior to start-up of the name of the individual who will have the responsibility for long-term maintenance. The Department also will be notified of subsequent changes in the name of the individual having this responsibility.