[Project description]. December 1982

Exxon Minerals Company
Rhinelander, Wisconsin: Exxon Minerals Company, December 1982

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CRANDON PROJECT

AIR QUALITY PERMIT APPLICATION REPORT

NOTICE OF INTENT
(NOI)

EXXON MINERALS COMPANY
RHINELANDER, WISCONSIN

DECEMBER, 1982

AIR QUALITY PERMIT APPLICATION REPORT

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1.0 REGULATORY REQUIREMENTS

The Wisconsin Air Quality Program requires owners of all non-exempt stationary sources of potential air pollution to apply for a permit to construct from the Wisconsin Department of Natural Resources (DNR, 1982a). Several factors must be considered in determining what must be addressed in the permit application including: source type (major or minor); source location (attainment or non-attainment area); and whether the source is new or existing.

The implementing portion of Wisconsin law is statute section 144.391. This section provides for major source (144.391(2)) and minor source (144.391(3)) permits. Under Wisconsin air law, the proposed Crandon Project (Project) will be classified as a new minor stationary source. An application is required for a construction or new operation permit under this category. Within 20 days of receipt of the application, the DNR must inform the applicant of "...the plan, specification and any other information necessary to determine if the proposed consruction or operation will meet the requirements of ss.144.30 to 144.426 and 14.96 and rules promulgated under these sections." (144.392(2)). The DNR must also prepare an analysis of the submitted information and present a prelminary determination of approvability of the permit application within 30 days after receipt of the requested information (144.392(3)). The notice, coment and hearing requirements for an air permit for a mining applicant are governed by the mining permit master hearing process (144.392(9)).

1.1 Wisconsin Administrative Code, Chapter NR 154

The governing regulations supporting Wisconsin statute 144.391 are found in Chapter NR 154 of the Wisconsin Administrative Code. These rules require the submittal of a Notice of Intent (NOI) prior to permitting the construction of a new stationary source (DNR, 1982). As required by NR 154.04(3), the submitted written NOI for stationary sources must contain: the applicant's name and address; a listing of all stationary sources; a map showing the location and layout; dates of construction and operation; and the estimated cost of the project. Additional information is required for direct sources in section NR 154.04(3).

1.2 Crandon Project Requirements

The Project is a new minor stationary source since each of its potential air emissions are less than 250 tons per year. A stationary source may consist of one or more pieces of process equipment, each of which is capable of emitting an air contaminant. According to statute section 144.30(23), stationary sources do not include motor vehicles or equipment capable of emitting an air contaminant while moving.

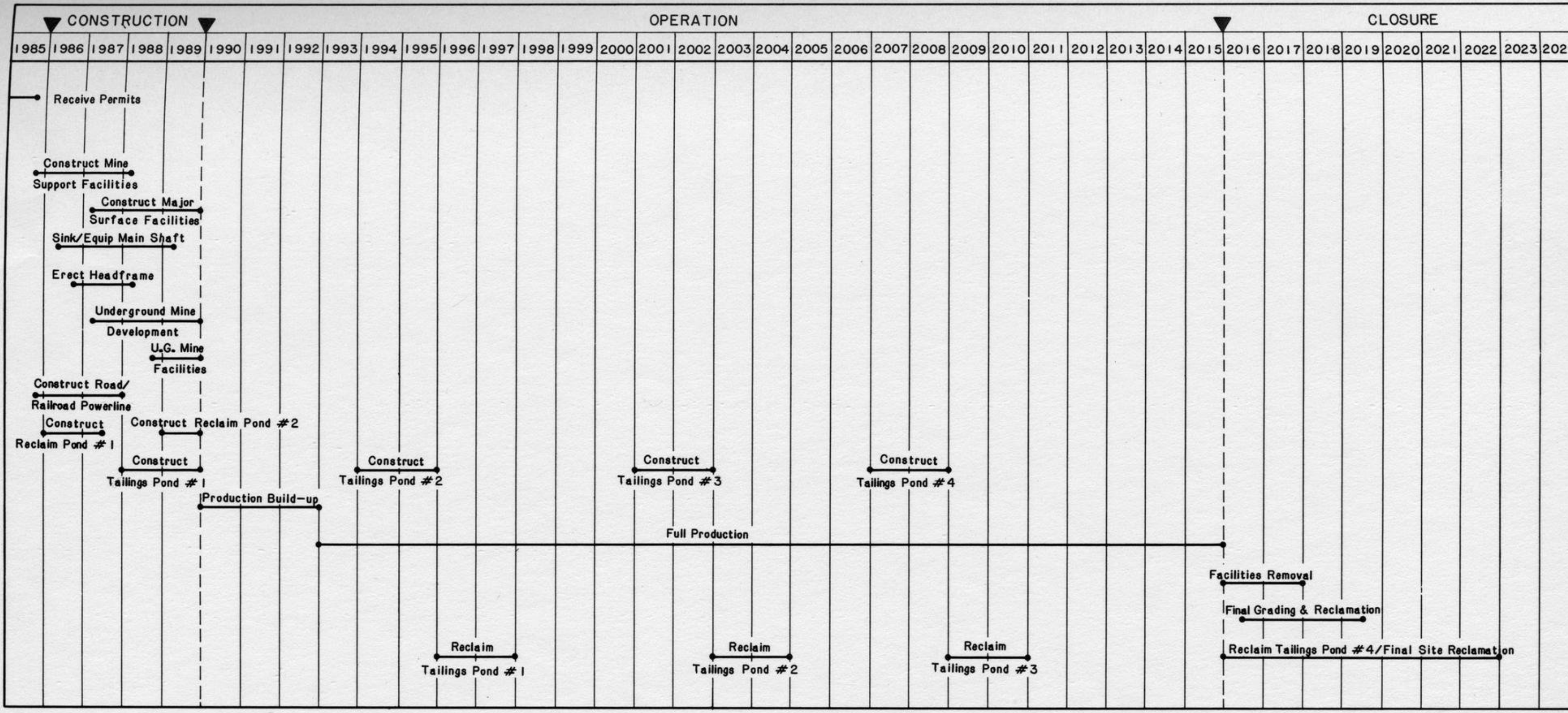
The following is the air quality permit application for the proposed Crandon Project:

Applicant:	Exxon Corporation c/o Exxon Minerals Company P. O. Box 813 Rhinelander, Wisconsin 54501 (715) 369-2800
Corporate Officer: (Attorney-in-fact for Exxon Corporation)	D. B. Achttien Vice-President, Project Development Exxon Minerals Company, A Division of Exxon Corporation P. O. Box 4508 Houston, Texas 77210 (713) 895-1137
Information Contact:	Technical Services Manager Exxon Minerals Company--Crandon Project P.O. Box 813 Rhinelander, Wisconsin 54501 (715) 369-2800
Corporate Officer Responsible for Operations:	Vice President, Operations Exxon Minerals Company, A Division of Exxon Corporation 1251 Avenue of the Americas New York, New York 10020 (212) 398-4831

Dates of Construction and Operation: See Figure 1-1

Estimated Total Cost of the Project: $885 Million (1982 $)

EXXON MINERALS COMPANY
CRANDON PROJECT
SCHEDULE



EXXON MINERALS COMPANY CRANDON PROJECT		
TITLE **DATES OF CONSTRUCTION AND OPERATION**		
SCALE NONE	STATE WISCONSIN	COUNTY FOREST
DRAWN BY S. J. Harvey	DATE 11/82	CHECKED BY [signature] DATE
APPROVED BY	DATE	APPROVED BY R P Hardt DATE 11-82
APPROVED BY	DATE	EXXON DATE
DRAWING NO **FIGURE 1 - 1**	SHEET ___ OF ___	REVISION NO.

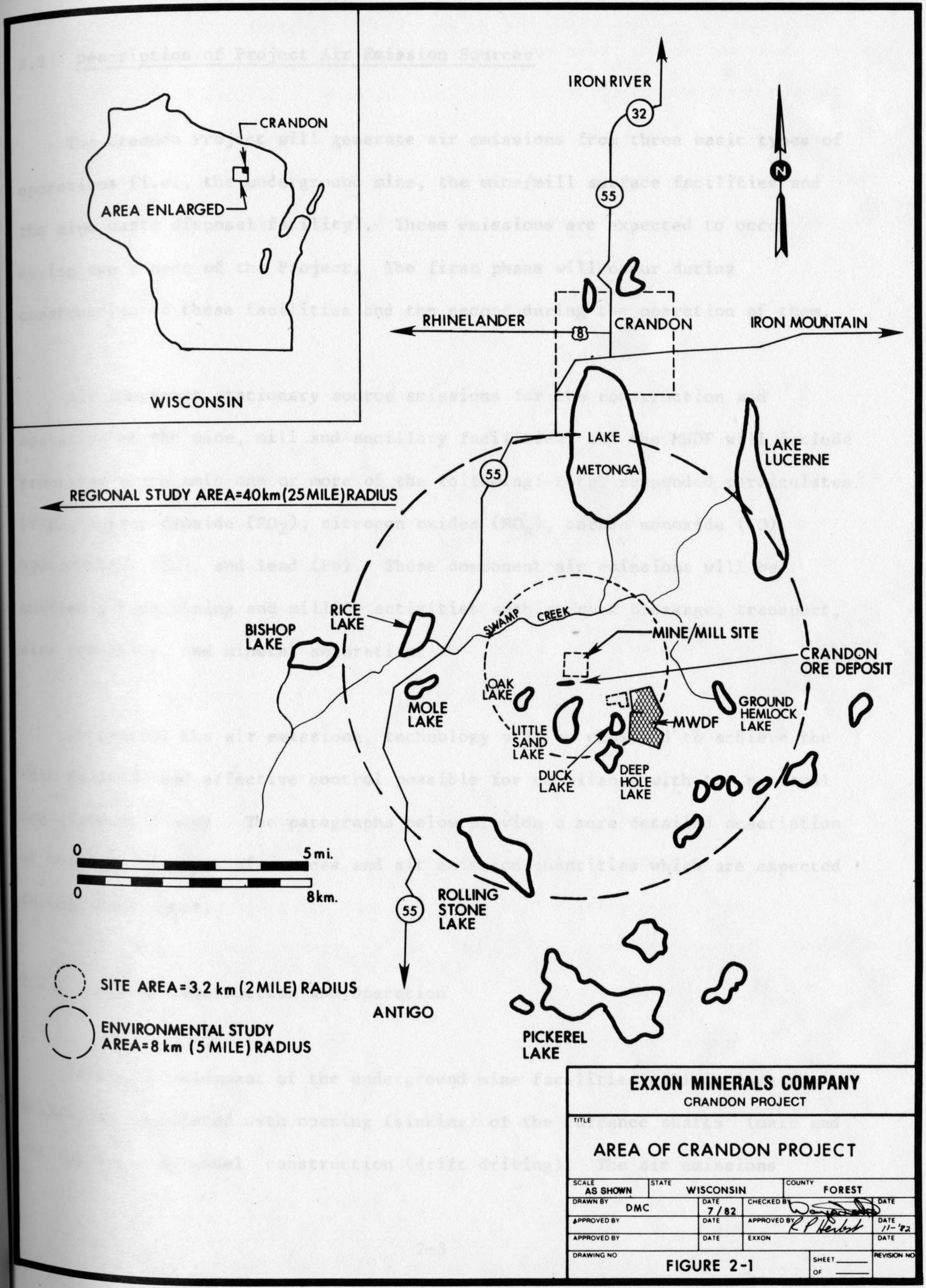
2.0 PROJECT FACILITY DESCRIPTION

Exxon Minerals Company (Exxon) is proposing development of a zinc(Zn)/copper(Cu)/lead(Pb) mine, mill and associated facilities (Crandon Project or Project) in Forest County, Wisconsin, approximately 8 km (5 miles) south of Crandon, Wisconsin. Figure 2-1 shows the location of the ore deposit and the Crandon Project. The ore deposit contains two types of ore and its recovery involves different concentrate processes with separate handling and storage. Components of the proposed Crandon Project include: mine operations, mill activities (i.e. ore handling, ore storage, ore crushing and the concentrator operation), ancillary units (e.g. offices, shops, warehouses, emergency generators) and the mine waste disposal facility (MWDF) operation.

The mill is designed to have a maximum ore processing capacity of 9,555 t (10,539 short tons) per day. While the mine would operate five days a week, mill operations would maintain a 24-hour, 7 day schedule. The mine waste disposal facility would be constructed as required to correspond with tailings production in the mill.

2.1 Description of Existing Air Emission Sources

There are no major air emission sources located in or near the Project environmental study area (Figure 2-1). The city of Crandon has several minor sources, none of which are close enough to the site area to influence its current ambient air quality.


CRANDON
AREA ENLARGED
WISCONSIN
IRON RIVER
32
55
RHINELANDER
8
CRANDON
IRON MOUNTAIN
LAKE
METONGA
LAKE
LUCERNE
55
REGIONAL STUDY AREA=40km (25 MILE) RADIUS
RICE
LAKE
BISHOP
LAKE
SWAMP
CREEK
MINE/MILL SITE
CRANDON
ORE DEPOSIT
OAK
LAKE
MOLE
LAKE
LITTLE
SAND
LAKE
MWDF
GROUND
HEMLOCK
LAKE
DUCK
LAKE
DEEP
HOLE
LAKE
0
5 mi.
0
8 km.
55
ROLLING
STONE
LAKE
SITE AREA=3.2 km (2 MILE) RADIUS
ENVIRONMENTAL STUDY
AREA=8 km (5 MILE) RADIUS
ANTIGO
PICKEREL
LAKE
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
AREA OF CRANDON PROJECT
SCALE AS SHOWN
STATE WISCONSIN
COUNTY FOREST
DRAWN BY DMC
DATE 7/82
CHECKED BY
APPROVED BY
DATE
APPROVED BY R P Herbst
DATE 11-'82
APPROVED BY
DATE
EXXON
DATE
DRAWING NO
FIGURE 2-1
SHEET
OF
REVISION NO

2.2 Description of Project Air Emission Sources

The Crandon Project will generate air emissions from three basic types of operations (i.e., the underground mine, the mine/mill surface facilities and the mine waste disposal facility). These emissions are expected to occur during two phases of the Project. The first phase will occur during construction of these facilities and the second during the operation of them.

Air component stationary source emissions for the construction and operation of the mine, mill and ancillary facilities, and the MWDF will include processes which emit one or more of the following: total suspended particulates (TSP), sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (HC), and lead (Pb). These component air emissions will be emitted during mining and milling activities such as rock breakage, transport, size reduction, and mineral separation.

To control the air emissions, technology will be employed to achieve the most reliable and effective control possible for compliance with the national and state standards. The paragraphs below provide a more detailed description of the specific type of sources and air emission quantities which are expected during the Project.

2.2.1 Mine - Construction and Operation

Initial development of the underground mine facilities will include the activities associated with opening (sinking) of the entrance shafts (main and air intake) and tunnel construction (drift driving). The air emissions generated in performing these tasks will originate from mine heating, mobile diesel vehicles, and construction blasting. Release of initial air emissions will occur from the construction activities during development of two entrance shafts and later the mine ventilation exhaust shafts (2) located at the western and eastern ends of the ore deposit. Maximum estimated source air emission rates at the generation location for mine construction are presented in Table 2.1.

Drilling and blasting will be the primary method used to loosen and reduce the size of rock for removal during development. Drilling activities will be conducted using water injection to the drill bit and will be virtually 100 percent effective in controlling total suspended particle (dust) emissions. The drilled holes will be charged with ammonium nitrate and fuel oil (ANFO). Blasting dust emissions will be reduced because of particle settling during its transport time in the mine, the humid underground environment, and the watering of loosened rock (muck) piles prior to handling. Muck pile wetting will be a standard operating procedure.

Mine air heating will be accomplished by directly burning natural gas in the intake air system as needed during freezing weather. Natural gas will be used because of its relative low cost, inherent clean burning properties and high efficiency. Control systems will be installed to insure maximum protection to personnel.

Diesel vehicles will be used for handling of rock and transporting personnel, equipment, and materials. Each diesel engine will employ a catalytic scrubber to reduce air emissions of NO_x and CO.

TABLE 2.1

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION OF THE MINE

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE CONSTRUCTION								
Drilling & Blasting	TSP	Residence settling and humid underground environment - 95%	76.1	(167.8)	141.1	(311.1)	5.8	(6.4)
	SO_2		10.3	(22.7)	19.1	(42.1)	1.7	(1.9)
	NO_x		82.4	(181.7)	152.8	(336.9)	13.7	(15.1)
	CO		350.2	(772.0)	649.4	(1432.0)	58.3	(64.3)
	Pb		1.43	(3.15)	2.66	(5.9)	0.1	(0.1)
Mine Air Heating	TSP	Use of clean burning natural gas	0.38	(0.84)	9.2	(20.3)	0.3	(0.4)
	SO_2		0.02	(0.05)	.55	(1.2)	0.02	(0.02)
	NO_x		4.6	(10.1)	110.3	(243.1)	4.1	(4.6)
	CO		0.77	(1.69)	18.4	(40.5)	0.7	(0.8)
	HC		0.31	(0.68)	7.4	(16.2)	0.3	(0.3)
Mine Mobile Vehicles	TSP	Clean burning Deutz engines with catalytic scrubbers	0.79	(1.73)*	15.4	(33.8)	4.6	(5.1)
	SO_2		2.22	(4.89)*	43.3	(95.4)	13.0	(14.4)
	NO_x		7.77	(17.1)*	151.4	(333.9)	45.6	(50.3)
	CO		0.14	(0.32)*	2.81	(6.18)	0.8	(0.9)
	HC		0.14	(0.31)*	2.75	(6.06)	0.8	(0.9)
TOTAL	TSP						10.7	(11.8)
	SO_2						14.7	(16.3)
	NO_x						63.4	(69.9)
	CO						59.8	(65.9)
	HC						1.1	(1.2)
	Pb						0.1	(0.1)

* These values do not occur at the same time as blasting and should not be included in hourly totals.
a. st/yr = short ton per year

During mine operations at full production: drilling/blasting; operation of diesel vehicles; and heating of the mine air during periods of freezing temperatures will generate the major air emissions.

During operation of the underground mine, drilling and blasting of rock are necessary to access the ore and allow subsequent removal. Generation of dust during drilling will be virtually 100 percent controlled with water injection to the drill bit. Blasting will release dust (TSP) from the fracturing of the rock and components of SO_2, NO_x, CO, and HC from detonation of ANFO. Dust from blasting is expected to be controlled to a minimum of 95 percent by the humid underground environment and the residence (local) gravity settling of particles because of the low air velocities in many areas of the mine. Estimated source air emission rates at the generation location during full production mine operations are presented in Table 2.2.

Another source of air emissions underground is operation of the diesel vehicles. These vehicles will be used for drilling, loading, and hauling of ore and waste rock. Other support vehicles will also be used as required to transport personnel and equipment. The primary tailpipe exhaust components of the mobile equipment will be TSP, SO_2, NO_x, CO, and HC. The source related values for these components are also presented in Table 2.2. These values are estimated source emissions as discharged from clean burning engines with catalytic scrubbers. The values listed do not include the control inherent in the humid mine atmosphere and the thousands of square feet of rock surface available for air contaminant capture and retention.

TABLE 2.2

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE OPERATIONS								
Drilling & Blasting	TSP	Residence settling and humid underground environment - 95%	310.0	(683.4)	372.0	(821.0)	8.2	(9.0)
	SO_2		4.2	(9.3)	50.0	(110.0)	2.4	(2.7)
	NO_x		33.6	(74.1)	420.0	(926.0)	19.3	(21.3)
	CO		142.8	(314.8)	1800.0	(3968.0)	82.0	(90.4)
	Pb		5.8	(12.9)	7.0	(15.4)	0.2	(0.2)
Mine Air Heating	TSP	Use of clean burning natural gas	0.77	(1.7)	18.4	(40.5)	0.69	(0.76)
	SO_2		0.045	(0.1)	1.1	(2.4)	0.04	(0.05)
	NO_x		9.2	(20.3)	220.0	(486.0)	8.3	(9.1)
	CO		0.61	(1.4)	14.7	(32.4)	0.55	(0.61)
	HC		1.5	(3.4)	36.8	(81.0)	1.4	(1.5)
Mine Mobile Vehicles	TSP	Clean burning engines catalytic scrubbers	1.2	(2.6)*	22.6	(49.8)	5.2	(5.7)
	SO_2		3.3	(7.2)*	63.6	(140.3)	14.6	(16.1)
	NO_x		11.4	(25.2)*	222.8	(491.2)	51.0	(56.2)
	CO		0.2	(0.46)*	4.0	(8.9)	0.9	(1.0)
	HC		0.2	(0.46)*	4.1	(9.1)	0.9	(1.0)
TOTAL	TSP						14.1	(15.5)
	SO_2						17.0	(18.8)
	NO_x						42.2	(46.5)
	CO						78.6	(86.7)
	HC						1.5	(1.6)
	Pb						0.2	(0.2)

* These values do not occur at the same time as blasting and should not be included in hourly totals.

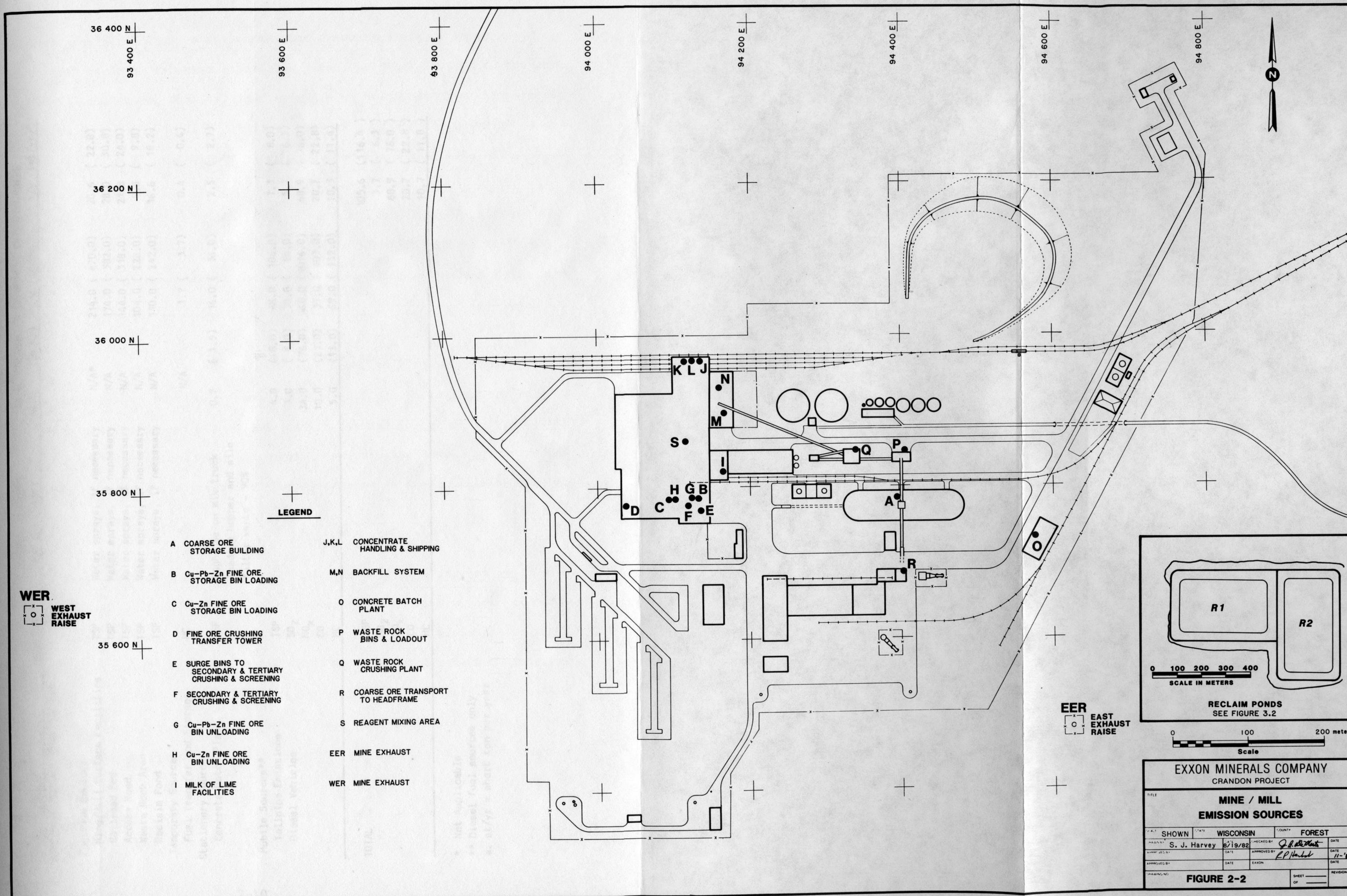
a. st/yr = short ton per year

Mine heating will also generate component emissions of TSP, SO_2, NO_x, CO, and HC via controlled combustion of natural gas for the intake air stream. Operation of this source will be necessary during periods in which heating of mine air is necessary to prevent freezing of water and service pipelines in the intake shafts. Natural gas will be used because it is cost-effective, clean burning and highly efficient.

Underground air emissions listed in Table 2.2 will be emitted from two fixed locations at the ground surface; the west exhaust raise (WER) and the east exhaust raise (EER) (Figure 2-2). Releases at the WER and EER will be approximately equal. The control effects of the humid mine environment and the large areas of exposed rock surface were utilized for TSP and Pb calculations only. While control of other air emission components will occur, they were not assumed for the calculations because of their undocumented efficiencies. Therefore, air emission rates in Table 2.2 were estimated at the point of origin, and with the exception of TSP and Pb, do not include control provided by the mine environment.

2.2.2 Mill and Other Surface Facilities - Construction and Operation

Earth moving activities constitute the major source of air emissions during construction of the mill and other surface facilities. Minor air emissions result from vehicle travel, fuel transfer and storage, and concrete batch plant operation (Table 2.3).



36 400 N
93 400 E
93 600 E
93 800 E
94 000 E
94 200 E
94 400 E
94 600 E
94 800 E
36 200 N
36 000 N
35 800 N
35 600 N
N
K L J
N
M
S
I
Q
P
H G B
D
C
F
E
A
O
R
LEGEND
A COARSE ORE STORAGE BUILDING
B Cu-Pb-Zn FINE ORE STORAGE BIN LOADING
C Cu-Zn FINE ORE STORAGE BIN LOADING
D FINE ORE CRUSHING TRANSFER TOWER
E SURGE BINS TO SECONDARY & TERTIARY CRUSHING & SCREENING
F SECONDARY & TERTIARY CRUSHING & SCREENING
G Cu-Pb-Zn FINE ORE BIN UNLOADING
H Cu-Zn FINE ORE BIN UNLOADING
I MILK OF LIME FACILITIES
J,K,L CONCENTRATE HANDLING & SHIPPING
M,N BACKFILL SYSTEM
O CONCRETE BATCH PLANT
P WASTE ROCK BINS & LOADOUT
Q WASTE ROCK CRUSHING PLANT
R COARSE ORE TRANSPORT TO HEADFRAME
S REAGENT MIXING AREA
EER MINE EXHAUST
WER MINE EXHAUST
WER WEST EXHAUST RAISE
EER EAST EXHAUST RAISE
R1
R2
0 100 200 300 400
SCALE IN METERS
RECLAIM PONDS
SEE FIGURE 3.2
0 100 200 meters
Scale
EXXON MINERALS COMPANY
CRANDON PROJECT
MINE / MILL
EMISSION SOURCES
SHOWN
WISCONSIN
FOREST
S. J. Harvey
8/19/82
11-'82
FIGURE 2-2

TABLE 2.3

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION OF THE MINE/MILL SURFACE FACILITIES

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE/MILL SURFACE CONSTRUCTION								
Fugitive Sources								
Mine/Mill Surface Facilities	TSP	Water sprays, if necessary	N/A*		214.0	(470.0)	20.6	(22.8)
Railroad Bed	TSP	Water sprays, if necessary	N/A		174.0	(382.0)	28.0	(30.8)
Access Road	TSP	Water sprays, if necessary	N/A		144.0	(318.0)	21.8	(24.0)
Waste Rock Area	TSP	Water sprays, if necessary	N/A		104.0	(228.0)	8.8	(9.8)
Reclaim Pond	TSP	Water sprays, if necessary	N/A		110.0	(242.0)	16.6	(18.2)
Temporary Sources								
Fuel Transfer and Storage	HC		N/A		1.7	(3.7)	0.4	(0.4)
Stationary Source								
Concrete Batch Plant	TSP	Baghouse on mix truck loading hopper and silo filter vents - 90%	0.7	(1.5)	16.0	(36.0)	2.5	(2.7)
Mobile Sources**								
Tailpipe Emissions	TSP		4.0	(8.0)	48.0	(106.0)	7.3	(8.0)
Diesel Vehicles	SO_2		3.0	(6.0)	38.0	(84.0)	5.7	(6.3)
	NO_x		34.0	(76.0)	460.0	(1016.0)	68.9	(76.0)
	CO		10.0	(23.0)	37.0	(303.0)	20.7	(22.8)
	HC		5.0	(11.0)	69.0	(152.0)	10.3	(11.4)
TOTAL	TSP						105.6	(116.4)
	SO_2						5.7	(6.3)
	NO_x						68.9	(76.0)
	CO						20.7	(22.8)
	HC						10.7	(11.8)

* Not Applicable
** Diesel fuel sources only
a. st/yr = short ton per year

Wetting of in-plant roadways and excavation areas will be performed as required to control fugitive dust. Frequently traveled in-plant roads will be paved early in construction to minimize fugitive dust generation. In addition, trucks carrying crushed rock or fine particles will be covered or water sprayed as required when long distance transport is necessary.

Areas subject to cut and fill operations will be temporarily revegetated after final grading for soil stabilization and dust control. This activity will start during the first year and continue through completion of construction.

A batch plant will be located on-site to support concrete needs during mine/mill construction (O; Figure 2-2). Control of dust emissions from this facility will include a passive filter vent on the cement storage silo, and a filter on the cement weigh hopper. Aggregate used in the facility will be pre-washed and loading and discharge points vented to a baghouse type collector.

Potential air emissions will be controlled during operations by use of properly sized air cleaning equipment and a process facility design that incorporates minimum component emission levels (Table 2.4). Selection of baghouses and scrubbers to control TSP and Pb emissions from the mill and other surface operations was based upon the physical characteristics of the particulates. Baghouses were specified where the captured material was fine and could be returned directly to the process. Scrubbers were employed where the product would be recycled indirectly to the wet process. Baghouses located outside of a building will be provided with adequate dewpoint controls and

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE/MILL SURFACE FACILITIES

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE/MILL OPERATIONS								
Stationary Sources								
Coarse Ore Trans-	TSP	Wet scrubber - 99.5%	0.26	(0.57)	6.2	(13.7)	0.8	(0.9)
port to Headframe	Pb		0.01	(0.017)	0.19	(0.42)	0.02	(0.02)
Coarse Ore	TSP	Conveyor enclosure	0.26	(0.57)	6.2	(13.7)	0.8	(0.9)
Storage Building	Pb	wet scrubber - 99.5%	0.005	(0.011)	0.12	(0.26)	0.01	(0.01)
Surge Bins to	TSP	Passive bin filter -	0.64	(1.4)	12.5	(27.5)	3.2	(3.5)
Sec. & Tert.	Pb	90%	0.01	(0.03)	0.20	(0.43)	0.04	(0.04)
Crush. & Screening								
Sec. & Tert.	TSP	Conveyor enclosure	11.9	(26.2)	197.0	(435.0)	61.6	(67.9)
Crush. & Screening	Pb	wet scrubber - 99.4%	0.13	(0.29)	2.2	(4.85)	0.68	(0.75)
Fine Ore Crushing	TSP	Conveyor enclosure	0.16	(0.35)	3.1	(6.9)	0.8	(0.88)
Transfer Tower	Pb	wet scrubber - 99.5%	0.003	(0.007)	0.06	(0.14)	0.01	(0.01)
Cu-Pb-Zn Fine Ore	TSP	Conveyor enclosures	0.07	(0.15)	1.3	(2.9)	0.35	(0.39)
Bin Loading	Pb	wet scrubber - 99.4%	0.001	(0.002)	0.02	(0.04)	0.01	(0.01)
Cu-Zn Fine	TSP	Conveyor enclosures	0.06	(0.13)	1.1	(2.5)	0.29	(0.32)
Ore Bin Loading	Pb	wet scrubber - 99.4%	0.0001	(0.0002)	0.002	(0.004)	0.0005	(0.0006)
Cu-Pb-Zn Fine Ore	TSP	Conveyor enclosures	0.07	(0.15)	1.6	(3.6)	0.55	(0.61)
Bin Unloading	Pb	wet scrubbers - 99.4%	0.001	(0.002)	0.02	(0.05)	0.01	(0.011)
Cu-Zn Fine Ore	TSP	Conveyor enclosures	0.05	(0.11)	1.2	(2.6)	0.45	(0.50)
Bin Unloading	Pb	Wet scrubber - 99.4%	0.0001	(0.0002)	0.002	(0.005)	0.001	(0.001)

TABLE 2.4 (continued)

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
Milk of Lime Facilities	TSP	Conveyor enclosures wet scrubber - 98.6%	0.70	(1 .54)	4.9	(20.8)	1.3	(1.43)
Reagent Mixing Area	TSP	Wet scrubber - 98% Passive filters - 90%	0.08	(0.17))	1.8	(4.0)	0.63	(0.69)
Concentrate Handling and Shipping	TSP	Conveyor transfer enclosures	0.04	(0.08)	0.83	(1.82)	0.29	(0.32)
	Pb	wet scrubber (3) - 99.4%	0.001	(0.002)	0.02	(0.04)	0.006	(0.007)
Backfill System	TSP	Waste handling, baghouse - 99.6% Cement storage tank, passive filter - 90%	0.67	(1.48)	5.7	(12.5)	1.6	(1.8)
Waste Rock Bins and Loadout	TSP	Conveyor enclosures baghouse - 99.6% Capture efficiency - 95%	0.94	(2.07)	2.82	(6.21)	0.76	(0.84)
Waste Rock Crushing Plant	TSP	Conveyor baghouse - 99.5%	0.08	(0.17)	1.5	(3.22)	0.86	(0.94)
Concrete Batch Plant	TSP	Baghouse on mix truck loading hopper and silo filter vents - 90%	0.13	(0.28)	1.02	(2.2)	0.26	(0.29)
Mine/Mill Surface Facilities Heating	TSP	Use of clean burning natural gas	0.42	(0.92)	9.93	(21.9)	1.32	(1.46)
	SO_2		0.03	(0.06)	0.59	(1.3)	0.08	(0.09)
	NO_x		5.01	(11.04)	119.2	(262.8)	15.9	(17.5)
	CO		0.83	(1.84)	19.9	(43.8)	2.65	(2.92)
	HC		0.34	(0.74)	7.94	(17.5)	1.06	(1.17)
Fuel Trans. & Stor.	HC	Vapor balance on loading	N/A*		0.17	(0.38)	0.061	(0.067)
Bulk Storage Fac. Service Station	HC	systems - 95%	N/A		2.37	(5.23)	0.83	(0.91)

TABLE 2.4 (continued)

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
Emergency Diesel Generators	TSP	Emergency use only	6.5	(14.3)	156.0	(343.9)	N/A	
	SO_2		6.0	(13.2)	144.0	(317.5)	N/A	
	NO_x		90.2	(199.0)	2164.8	(4772.6)	N/A	
	CO		19.4	(42.8)	465.6	(1026.5)	N/A	
	HC		7.2	(15.9)	172.8	(381.0)	N/A	
Mobile Sources								
Vehicular Travel Plant Vehicle Exhaust	TSP	Federal vehicular emission standards		N/A	3.09	(6.81)	1.08	(1.19)
	SO_2			N/A	5.93	(13.08)	2.08	(2.29)
	NO_x			N/A	49.5	(109.1)	17.3	(19.1)
	CO			N/A	138.5	(305.4)	48.5	(53.4)
	HC			N/A	19.2	(42.3)	6.72	(7.40)
Vehicular Travel Employee Vehicles	TSP	Federal vehicular emission standards		N/A	0.68	(1.5)	0.24	(0.26)
	SO_2			N/A	0.26	(0.57)	0.10	(0.11)
	NO_x			N/A	9.2	(20.3)	3.2	(3.5)
	CO			N/A	73.8	(162.7)	25.9	(28.5)
	HC			N/A	9.6	(21.2)	3.4	(3.7)
Locomotive Exhaust Emissions	TSP		2.5	(5.5)	15.0	(33.1)	5.18	(5.70)
	SO_2		0.93	(2.1)	5.58	(12.3)	1.9	(2.0)
	NO_x		18.0	(39.7)	108.0	(238.0)	37.4	(41.2)
	CO		2.3	(5.1)	13.8	(30.4)	4.8	(5.3)
	HC		0.39	(0.86)	2.34	(5.16)	0.81	(0.89)
Fugitive Sources								
Total Road Dust Emissions	TSP	Paving		N/A	27.6	(60.9)	9.7	(10.7)
TOTAL	TSP						92.1	(101.5)
	SO_2						4.2	(4.6)
	NO_x						73.8	(81.4)
	CO						81.9	(90.2)
	HC						15.9	(17.5)
	Pb						0.8	(0.9)

* Not Applicable

a. st/yr = short ton per year

heaters to prevent bag blinding during varying climatic conditions. Similarly, scrubbers located outside of the building will be provided with heaters to assure continuous operation during freezing weather.

Ore handling and crushing, vehicle travel, and fuel transfer and storage constitute the major emission sources from other surface facility operations (Table 2.4). Other air emissions will originate from reagent and concentrate handling. All air emission sources will have reliable and effective controls (Table 2.4)

To contain dust, belt conveyors used to transport ore and waste rock will operate inside covered galleries, or will be housed within a building. Material transfer points will be completely enclosed and exhausted through appropriately-sized dust collection hoods and systems.

Baghouses or wet scrubbers will be used to control dust emissions from the fine ore storage bins (B, C, G, H), the crushed backfill waste rock storage tank (M, N) and waste rock surge bins(E, F), and the entire waste rock crushing plant (Q) (Figure 2-2). These baghouses and wet scrubbers will be of pulsed-air design, to allow bag cleaning during continuous operation. The dust collection efficiencies of these baghouses and wet scrubbers will exceed 99 percent. Collected dust from these devices will be recycled to the appropriate process. Passive bin filter vents will be used to control dust emissions from the fine ore crushing and screening surge bins, and from the backfill cement storage tank. In addition, wet scrubbers will be used to control dust emissions in the coarse ore storage bin areas, fine ore crushing and screening area, and fine ore bin discharge. These systems will consist of wet scrubbers with dust collection efficiencies exceeding 99 percent. Collected dust will be slurried and returned to the processing circuit. Flotation is a wet process and will not emit dust.

The controlled air emission rates presented in Table 2.4 for ore or waste rock handling and crushing are an order of magnitude less than the allowable emission rates established for NR 154 (Table 2.5). The largest controlled dust emission rate (from secondary and tertiary crushing and screening) constitutes 53 percent of the corresponding allowable emission rate (Table 2.5)

To minimize potential dust emissions from concentrate (zinc, copper, and lead) handling (J, K, L), dust collection systems will be used for each loadout circuit (Figure 2-2). A telescopic spout will be used to minimize material freefall during concentrate loadout. Each collection system will consist of ventilation hoods, ducting, and a wet scrubber to control dust emissions during concentrate loadout to railcars. These scrubbers will have a collection efficiency exceeding 99 percent (Table 2.5). All collected material will be returned to the process.

Burnt pebble lime will be stored and processed within a separate facility (I, Figure 2-2). To minimize potential dust emissions from this facility, dust collection hoods and ducting will be used to exhaust the inlet hopper, bucket elevator, storage bins, and slaked lime inlet conveyor through a wet scrubber. This scrubber will have a collection efficiency exceeding 98 percent.

TABLE 2.5

COMPARISON OF ESTIMATED STATIONARY SOURCE AIR EMISSION RATES WITH STATE OF WISCONSIN ALLOWABLE EMISSIONS (NR 154) FROM THE MINE/MILL SURFACE FACILITIES

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL EMISSION RATES kg/h	(lb/hr)	ALLOWABLE EMISSIONS kg/h	(lb/hr)
Stationary Sources						
Coarse Ore Transport to Headframe	TSP	Wet scrubber - 99.5%	0.26	(0.57)	24.0	(53.0)
	Pb		0.01	(0.017)		
Coarse Ore Storage Building	TSP	Conveyor enclosure	0.26	(0.57)	24.0	(53.0)
	Pb	wet scrubber - 99.5%	0.005	(0.011)		
Surge Bins to Sec. & Tert. Crush. & Screening	TSP	Passive bin filter -	0.64	(1.4)	17.2	(38.0)
	Pb	90%	0.01	(0.03)		
Sec. & Tert. Crush. & Screening	TSP	Conveyor enclosure	11.9	(26.2)	22.3	(49.0)
	Pb	wet scrubber - 99.4%	0.13	(0.29)		
Fine Ore Crushing Transfer Tower	TSP	Conveyor enclosure	0.16	(0.35)	22.3	(49.0)
	Pb	wet scrubber - 99.5%	0.003	(0.007)		
Cu-Pb-Zn Fine Ore Bin Loading	TSP	Conveyor enclosures	0.07	(0.15)	20.3	(44.7)
	Pb	wet scrubber - 99.4%	0.001	(0.002)		
Cu-Zn Fine Ore Bin Loading	TSP	Conveyor enclosures	0.06	(0.13)	19.6	(43.3)
	Pb	wet scrubber - 99.4%	0.0001	(0.0002)		
Cu-Pb-Zn Fine Ore Bin Unloading	TSP	Conveyor enclosures	0.07	(0.15)	18.9	(41.6)
	Pb	wet scrubbers - 99.4%	0.001	(0.002)		
Cu-Zn Fine Ore Bin Unloading	TSP	Conveyor enclosures	0.05	(0.11)	18.3	(40.3)
	Pb	wet scrubber - 99.4%	0.0001	(0.0002)		
Milk of Lime Facilities	TSP	Conveyor enclosures wet scrubber - 98.6%	0.70	(1.54)	15.0	(32.9)

TABLE 2.5 (continued)

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL EMISSION RATES kg/h	(lb/hr)	ALLOWABLE EMISSIONS kg/h	(lb/hr)
Reagent Mixing Area	TSP	Wet scrubber - 98% Passive filters - 90%	0.08	(0.17)		
Concentrate Handling and Shipping	TSP	Conveyor transfer enclosure	0.04	(0.08)	25.9	(57.1)
	Pb	wet scrubber (3) - 99.4%	0.001	(0.002)		
Backfill System	TSP	Waste handling baghouse - 99.6% Cement storage tank passive filter - 90%	0.67	(1.48)	18.1	(39.8)
Waste Rock Bins and Loadout	TSP	Conveyor enclosures baghouse - 99.6% Capture efficiency - 95%	0.94	(2.07)	24.2	(53.3)
Waste Rock Crushing Plant	TSP	Conveyor baghouse - 99.5%	0.08	(0.17)	17.8	(39.2)
Concrete Batch Plant	TSP	Baghouse on mix truck loading hopper and silo filter vents - 90%	0.13	(0.28)	10.9	(24.0)
Mine/Mill Surface Facilities Heating	TSP	Use of clean burning natural gas	0.42	(0.92)		
	SO_2		0.03	(0.06)		
	NO_x		5.01	(11.04)		
	CO		0.83	(1.84)		
	HC		0.34	(0.74)		
Fuel Trans. & Stor. Bulk Storage Fac.	HC	Vapor balance on loading systems - 95%	N/A*			
Service Station	HC		N/A			
Emergency Diesel Generators	TSP	Emergency use only	6.5	(14.3)		
	SO_2		6.0	(13.2)		
	NO_x		90.2	(199.0)		
	CO		19.4	(42.8)		
	HC		7.2	(15.9)		

* Not Applicable

Collected material will be returned to the process. Emissions from the milk of lime facility will be less than 5 percent of that allowed by NR 154 (Table 2.5).

A soda ash scrubber will be used to control SO_2 exhausted during handling. In addition, filtered vents and a wet scrubber will be used to control dust and fumes from the reagent mixing area (S, Figure 2-2). Slurry from the wet scrubber will be pumped to the tailing sump. A complete tabulation of emissions from the reagent mixing area is presented in Table 2.4.

Transfer and storage of fuels will occur primarily at the 189,266 L (50,000 gallon) bulk diesel storage tanks and at the fueling station. A vapor balance system will be used during storage tank loading to minimize hydrocarbon emissions. This will consist of a product line and ventilation line connected between tankcar or tanktruck and the storage tanks. The ventilation lines will exhaust the hydrocarbon vapors from the tank vents back to the tankcar or tanktruck.

Emissions during vehicle operation at the facility will occur primarily from vehicle exhaust and road friction (Table 2.4). There will be four types of vehicles capable of producing emissions. They are heavy-duty diesel powered vehicles, light-duty gasoline powered trucks (plant vehicles), light-duty gasoline powered automobiles (employee vehicles), and heavy-duty gasoline powered vehicles. Applicant owned vehicles used in the mine/mill will meet all local, state and federal exhaust and evaporative emission regulations.

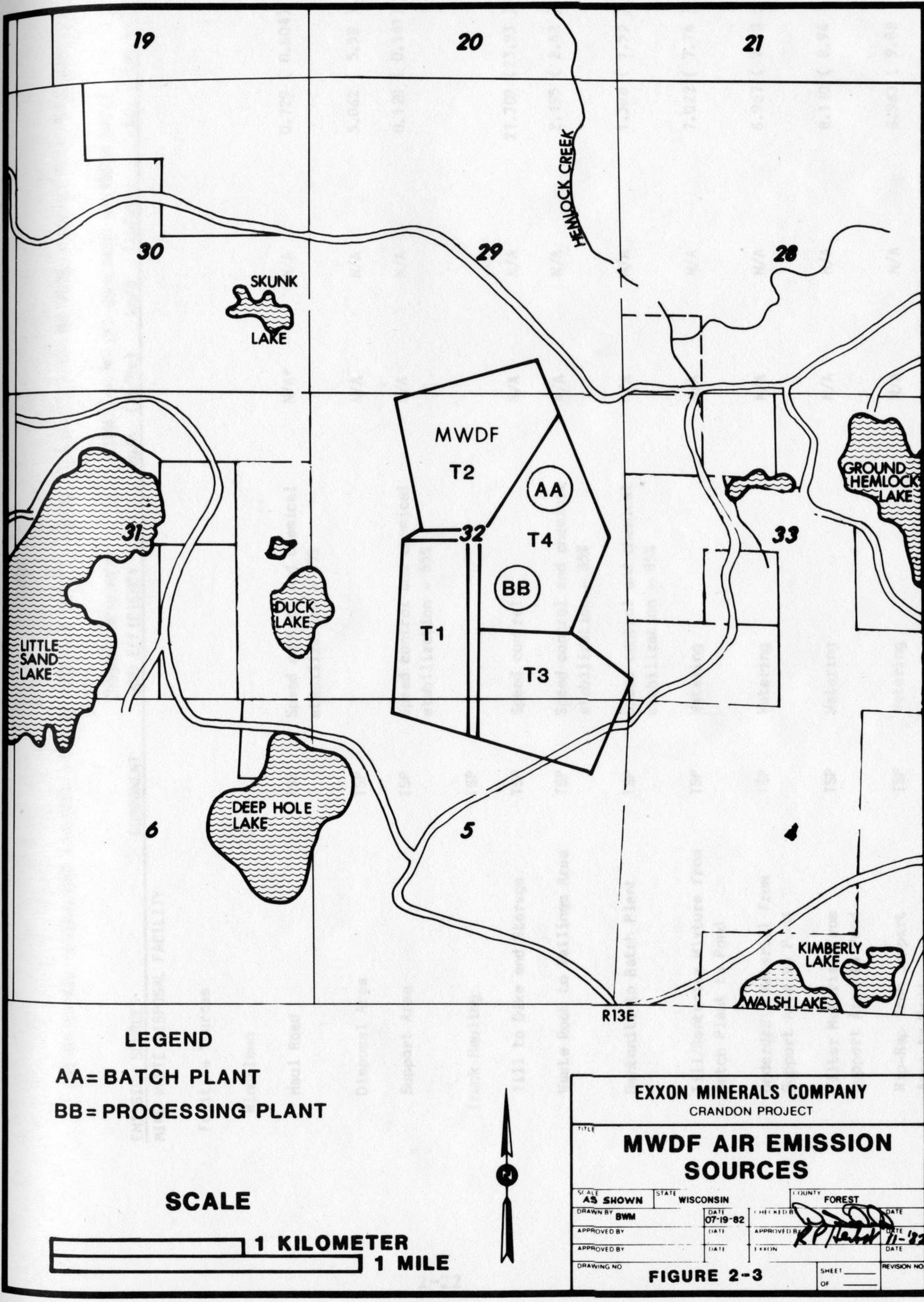
2.2.3 Mine Waste Disposal Facility - Construction and Operation

The primary air emission sources during development of the mine waste disposal facility are the vehicles used for excavation of the ponds and the transportation and handling of till and other materials used in pond construction. Minor stationary sources include the liner batch plant and soil processing plant operations (Figure 2-3).

Particulate emissions constitute the major air contaminant generated during MWDF construction (Table 2.6). Fugitive dust represents 96 percent of total particulate emissions.

The ponds will be excavated with scrapers and the normal compliment of support equipment (e.g. dozers, trucks). To reduce particulate emissions, disturbed areas will be sprinkled with water as required. After final grading of embankment slopes, temporary or permanent vegetation will be planted for soil stabilization and to reduce wind blown dust. Soil additives will be applied to haul roads, if necessary, to reduce generation of dust by vehicle tires. During construction, the outside embankments will be vegetated to reduce wind erosion.

Emission controls for the liner batch plant and soil processing plant will be similar to those used at the concrete batch plant at the mill. Where possible, unloading systems will be enclosed and emissions will be vented through filters to remove suspended particulates.


19
20
21
HEMLOCK CREEK
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28
SKUNK
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MWDF
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BB
T1
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DUCK LAKE
LITTLE SAND LAKE
GROUND HEMLOCK LAKE
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DEEP HOLE LAKE
6
5
4
KIMBERLY LAKE
WALSH LAKE
R13E
LEGEND
AA= BATCH PLANT
BB= PROCESSING PLANT
SCALE
1 KILOMETER
1 MILE
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
MWDF AIR EMISSION SOURCES
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STATE WISCONSIN
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FIGURE 2-3
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TABLE 2.6

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING CONSTRUCTION OF THE MINE WASTE DISPOSAL FACILITY

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h (lb/hr)	kg/d (lb/day)	t/y (st/yr)[a]
MINE WASTE DISPOSAL FACILITY					
Fugitive Sources					
Windblown					
Haul Road	TSP	Speed control and chemical stabilization - 85%	N/A*	N/A	0.729 (0.804)
Disposal Area	TSP		N/A	N/A	5.062 (5.58)
Support Area	TSP	Speed control and chemical stabilization - 85%	N/A	N/A	0.128 (0.141)
Truck Hauling	TSP				
Till to Dike and Storage	TSP	Speed control	N/A	N/A	21.709 (23.93)
Waste Rock to Tailings Area	TSP	Speed control and chemical stabilization - 85%	N/A	N/A	2.195 (2.42)
Bentonite to Batch Plant	TSP	Speed control and chemical stabilization - 85%	N/A	N/A	1.388 (1.53)
Till/Bentonite Mixture from Batch Plant to Pond	TSP	Watering	N/A	N/A	7.022 (7.74)
Underdrain Material from Support Area to Pond	TSP	Watering	N/A	N/A	6.967 (7.68)
Filter Material from Support Area to Pond	TSP	Watering	N/A	N/A	8.110 (8.94)
Rip-Rap from Support Area to Pond	TSP	Watering	N/A	N/A	8.963 (9.88)

TABLE 2.6 (continued)

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE WASTE DISPOSAL FACILITY								
Loading								
Pond Excavation with Scraper	TSP		N/A		N/A		252.53	(278.37)
Loading Till into Batch Plant and Processing Plant	TSP	Minimize drop height	N/A		N/A		4.87	(5.37)
Loading Underdrain Filter Material and Rip-Rap	TSP	Minimize drop height	N/A		N/A		8.72	(9.61)
Dumping								
Till and Bentonite Mixture in Pond	TSP		N/A		N/A		1.89	(2.08)
Waste Rock at Stockpile	TSP		N/A		N/A		1.12	(1.23)
Underdrain, Filter Material and Rip-Rap	TSP		N/A		N/A		6.48	(7.14)
Mobile Sources								
Tailpipe Emissions								
Diesel	TSP		8.93	(19.69)	116.02	(255.78)	12.52	(13.80)
	SO_2		7.03	(15.50)	91.40	(201.50)	9.86	(10.87)
	NO_x		85.33	(188.11)	1,109.20	(2445.37)	119.66	(131.90)
	CO		25.47	(56.15)	331.10	(729.95)	35.72	(39.37)
	HC		12.79	(28.20)	166.29	(366.60)	17.94	(19.77)

TABLE 2.6 (continued)

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
Gasoline	TSP	Catalytic converter	0.068	(0.149)	0.86	(1.9)	0.094	(0.104)
	SO_2	(on trucks)	0.009	(0.020)	0.12	(0.258)	0.013	(0.014)
	NO_x		0.180	(0.397)	2.34	(5.158)	0.252	(0.278)
	CO		0.827	(1.823)	10.75	(23.70)	1.159	(1.278)
	HC		0.132	(0.292)	1.72	(3.797)	0.186	(0.205)
TOTAL	TSP						350.5	(386.4)
	SO_2						9.9	(10.9)
	NO_x						119.9	(132.2)
	CO						36.9	(40.7)
	HC						18.1	(20.0)

* Not applicable

a. st/yr = short ton per year

The primary soui of air emissions from operation of the mine waste disposal facility will be wind erosion of the access road and pond embankments, as well as dust and vehicle exhaust emissions from maintenance and inspection vehicles traveling from the mill to the MWDF (Tables 2.6 and 2.7). The access road will be treated with a chemical stabilizer if necessary, which will reduce generation of fine particles by vehicular traffic. The interior of the ponds will be water saturated from discharge of tailing from the mill.

2.3 Summary of Air Emission Sources for Proposed Crandon Project

A summary of the estimated air emission rates from the construction and operation sources of the mine are presented in Tables 2.1 and 2.2. The majority of the air emissions resulting from the activities of mine development and ore production are predominately associated with blasting and operation of diesel vehicles. Blasting will occur predominately at the end of a normal mining shift, and emissions will be of short duration. Use of diesel vehicles will occur primarily during the 3 daily shifts for a normal 5 day week. Major air emission components will be carbon monoxide from blasting and nitrogen oxides from diesel vehicle operation.

A summary of the estimated air emission rates from the construction and operation sources associated with the mine/mill surface facilities are presented in Tables 2.3, 2.4, and 2.5. The construction phase will predominately generate TSP as fugitive dust and products of diesel

TABLE 2.7

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING OPERATION OF THE MINE WASTE DISPOSAL FACILITY

EMISSION SOURCE	COMPONENT	CONTROL MEASURES AND EFFICIENCY	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE WASTE DISPOSAL FACILITY OPERATION								
Stationary Sources								
Liner Batch Plant	TSP	Enclose dumping areas and vent to filters - 90%	N/A*		N/A		0.925	(1.02)
Soil Processing Plant	TSP	Emissions vented to bag-house - 99.6%	N/A		N/A		0.025	(0.028)
TOTAL	TSP						0.95	(1.047)

* Not Applicable

a. st/yr = short ton per year

combustion from mobile construction vehicles. The primary type of control will consist of watering areas undergoing construction activities. Operation of the mine/mill surface facilities will generate air emissions almost exclusively from stationary sources. The largest air emissions will occur from building heating during winter and from secondary and tertiary crushing and screening. Building heating will be accomplished with clean burning natural gas. Secondary and tertiary crushing and screening will utilize a wet scrubber which operates above a 99 percent collection efficiency to control emissions of TSP. Estimated emissions from this source will be approximately 53 percent of the amount allowed by NR 154 (Table 2.5)

Construction and operation of the MWDF will produce emissions similar to those encountered in any construction activity of this type and magnitude. Construction is estimated to generate air emissions as represented in Table 2.6. The principal component air emission will be fugitive dust (TSP). Escape of fugitive dust from the MWDF is minimized by its design configuration (i.e., the 15 m (50 feet) perimeter embankment). This embankment will offer maximum attenuation to wind dispersal and allow gravity settling of dust particles within the facility. Any dust blown beyond the embankments will also be rapidly attenuated by the surrounding vegetation. Operating the MWDF is estimated to produce very minor emissions of TSP from operation of the liner batch plant (Table 2.7). This emission source will be very small because of its size and type of controls.

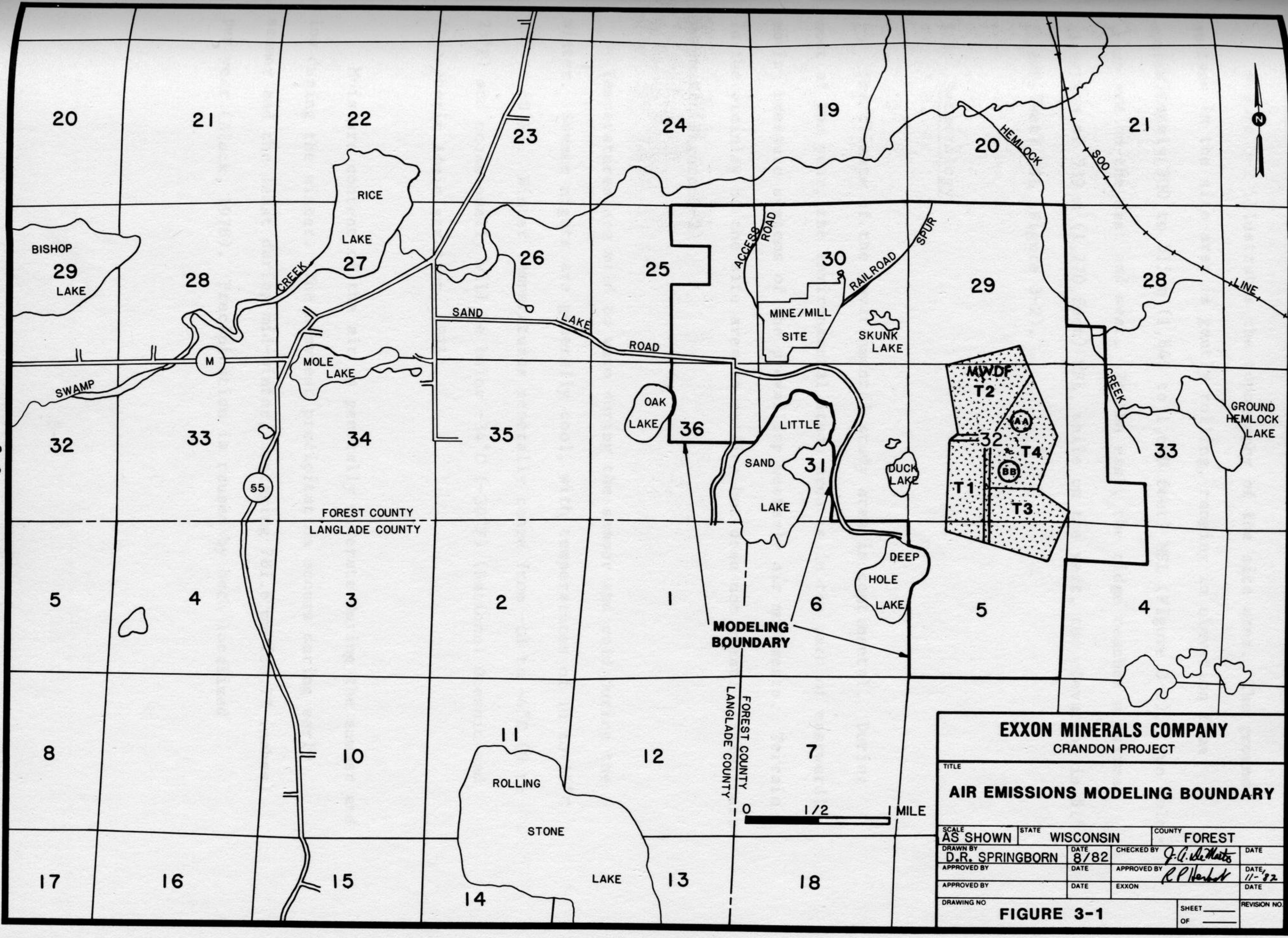
3.0 ENVIRONMENTAL STUDY AREA CHARACTERISTICS

The proposed Crandon Project will be developed approximately 5 miles south of Crandon in Forest County, Wisconsin. Figure 3-1 shows the location of the ore deposit, the mine/mill site, the mine waste disposal facility, and their relation to the air quality modeling boundary.

3.1 Topography

The environmental study area is located within the Northern Highlands physiographic province (Martin, 1965), a region of rolling terrain that reflects its glacial origins. Ground surface elevation in the environmental study area is from less than 472 m (1,550 feet) MSL near Rolling Stone Lake, approximately 5 km (3 miles) southwest, to more than 533 m (1,750 feet) MSL, approximately 8 km (5 miles) northwest of the ore deposit.

Topography in the environmental study area is characterized by a general southwest trend of the ridges and intervening valleys. This trend reflects the southwesterly advance of the most recent glacier, which reshaped the pre-existing topography. This southwest trend is especially apparent in the upland areas of the regional study area 8 to 16 km (5 to 10 miles) northwest of the ore deposit where elongated eliptical ridges or drumlins exhibit approximately 30 m (100 feet) of vertical elevation. The southwest trend is also apparent in the Swamp Creek valley and in the orientation of the ridges south of Mole Lake and immediately to the east and west of the mine/mill site.



BISHOP LAKE
RICE LAKE
CREEK
SWAMP
M
MOLE LAKE
SAND LAKE ROAD
55
ACCESS ROAD
MINE/MILL SITE
RAILROAD SPUR
SKUNK LAKE
HEMLOCK
SOO LINE
CREEK
OAK LAKE
LITTLE SAND LAKE
DUCK LAKE
DEEP HOLE LAKE
MWDF
T1
T2
T3
T4
AA
BB
GROUND HEMLOCK LAKE
FOREST COUNTY
LANGLADE COUNTY
MODELING BOUNDARY
ROLLING STONE LAKE
0 1/2 1 MILE
N
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
AIR EMISSIONS MODELING BOUNDARY
SCALE AS SHOWN
STATE WISCONSIN
COUNTY FOREST
DRAWN BY D.R. SPRINGBORN
DATE 8/82
CHECKED BY
APPROVED BY
DATE 11-'82
EXXON
DRAWING NO
FIGURE 3-1
SHEET
OF
REVISION NO.

Figure 3-2 illustrates the topography of the site area. The ground surface in the site area is gently rolling, ranging in elevation from approximately 500 to 515 m (1,640 to 1,690 feet) MSL (Figure 3-2). Two upland areas are on the east and west. To the east, the ridge reaches a maximum elevation of 539 m (1,770 feet) MSL, while on the west, the elevation is 515 m (1,690 feet) MSL (Figure 3-2).

3.2 Meteorology

The climate of the environmental study area is continental. During most of the year, the environmental study area is in the path of eastwardly moving pressure systems of the prevailing westerly air movements. Terrain in the vicinity of the site area is rolling but does not greatly inhibit air movement (Figure 3-2).

Temperatures are mild to warm during the summer and cold during the winter. Summer nights are generally cool, with temperatures of 10 to 16°C (50 to 60°F). Winter temperatures generally range from -18 to -4°C (0 to 25°F) and occasionally will be below -34°C (-30°F) (National Oceanic and Atmospheric Administration, 1974).

Moisture content of the air is generally moderate during the summer and low during the winter. The heaviest precipitation occurs during early summer and the least during mid-winter, averaging 781.6 mm (30.77 inches) per year (Black, 1978). Precipitation is caused by both localized

LEGEND

1650–ELEVATION IN FEET ABOVE MSL

MILE
0 .5 1

0 .5 1
KILOMETER

N

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
TOPOGRAPHY OF SITE AREA

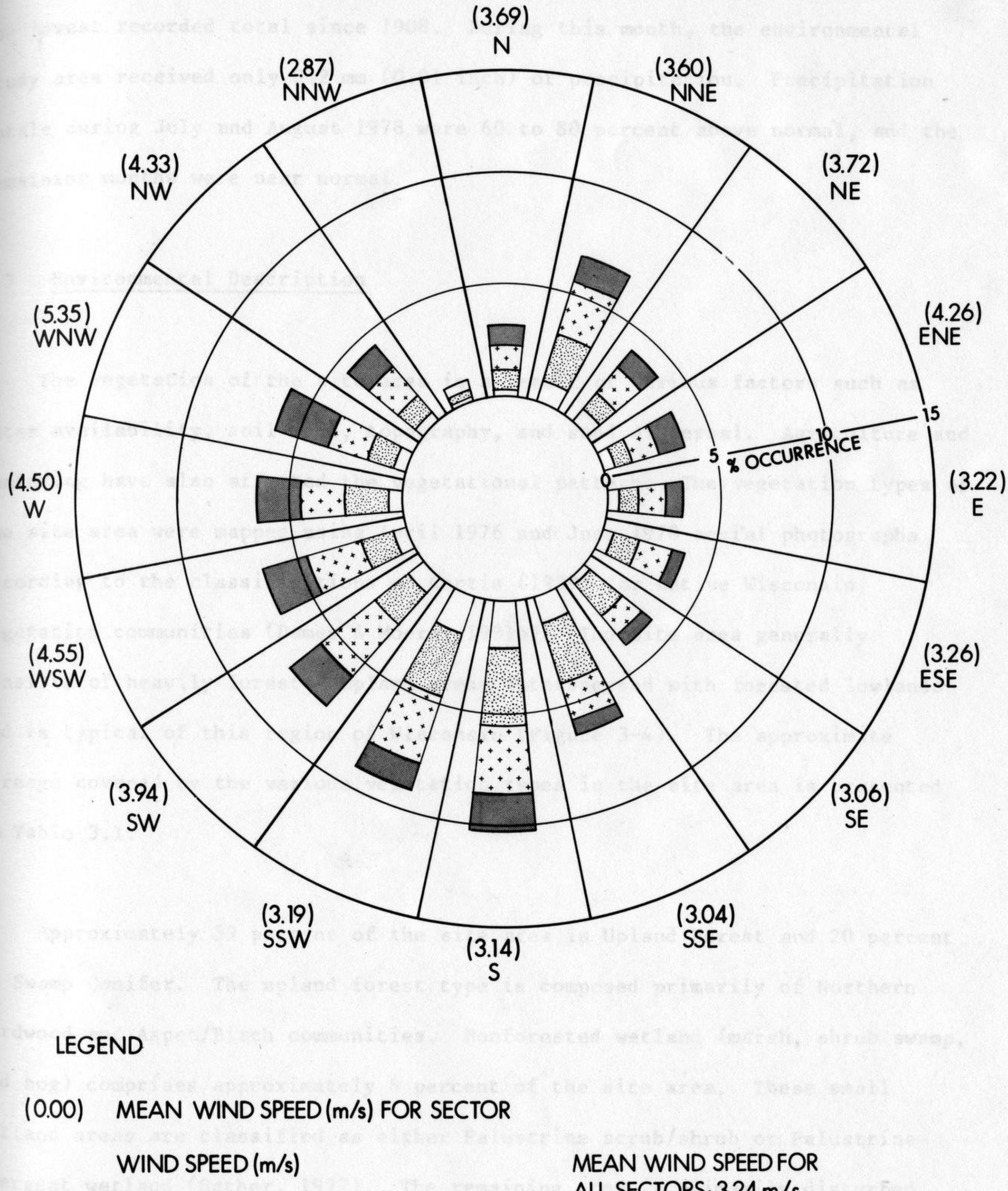
SCALE SHOWN	STATE WISCONSIN	COUNTY FOREST	
DRAWN BY BWM	DATE	CHECKED BY [signature]	DATE
APPROVED BY	DATE	APPROVED BY R P [signature]	DATE 11-'82
APPROVED BY	DATE	EXXON	DATE
DRAWING NO **FIGURE 3-2**		SHEET ___ OF ___	REVISION NO

thunderstorms and frontal systems during summer. During winter, precipitation, mostly in the form of snow, is caused exclusively by passing weather systems. The snow is usually quite light because of the lack of atmospheric moisture. Snowfall averages between 1016 and 1524 mm (40 and 60 inches) per year (Environmental Science Services Administration, 1968).

Wind roses from the data of the air monitoring program conducted in 1978 were used to depict the frequency of occurrence of wind direction and speed in each of 16 compass directions (Dames & Moore, 1981a). An annual wind rose for January through December 1978 is presented on Figure 3-3. The annual wind rose for 1978 indicates the predominant wind direction was from the south (10.3 percent of the time). South-southwest, southwest, and north-northeast were the next most frequently observed directions (9.0, 7.5, and 7.0 percent, respectively). West and northwest winds were almost equal in frequency to those from the north-northeast (Figure 3-3).

Mean wind speed ranged from 2.24 to 3.66 m/s (5.0 to 8.2 miles per hour) and averaged 3.24 m/s (7.2 miles per hour) for the 1978 calendar year. Calm wind (less than 0.45 m/s [1.0 mile per hour]) occurred 13.7 percent of the time in 1978, and was almost exclusively observed at night.

Precipitation at Nicolet College (Rhinelander, Wisconsin) during the 1978 calendar year totaled 747.7 mm (29.44 inches), which approximates the long-term (1908-1977 annual average of 781.6 mm (30.77 inches) (Black, 1978). The winter season (December 1977 through March 1978) was one of the driest on record, with the total precipitation in March (2.5 mm [0.10 inch] at Nicolet College) being



LEGEND

(0.00) MEAN WIND SPEED (m/s) FOR SECTOR

WIND SPEED (m/s)

> 5.0

3.0 - 5.0

1.5 - 3.0

0.0 - 1.5

MEAN WIND SPEED FOR ALL SECTORS: 3.24 m/s

EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE
ENVIRONMENTAL STUDY AREA WIND ROSE (ANNUAL, 1978)

SCALE NONE	STATE WISCONSIN			COUNTY FOREST	
DRAWN BY BWM	DATE 07/21/82	CHECKED BY		DATE	
APPROVED BY	DATE	APPROVED BY		DATE 11-'82	
APPROVED BY	DATE	EXXON		DATE	
DRAWING NO.	FIGURE 3-3		SHEET ____ OF ____	REVISION NO.	

the lowest recorded total since 1908. During this month, the environmental study area received only 0.2 mm (0.01 inch) of precipitation. Precipitation totals during July and August 1978 were 60 to 80 percent above normal, and the remaining months were near normal.

3.3 Environmental Description

The vegetation of the site area is a result of various factors such as water availability, soil type, topography, and seed dispersal. Agriculture and lumbering have also affected the vegetational pattern. The vegetation types of the site area were mapped using April 1976 and June 1978 aerial photographs according to the classifications of Curtis (1959) for native Wisconsin vegetation communities (Dames & Moore, 1981b). The site area generally consists of heavily forested upland areas interspersed with forested lowlands and is typical of this region of Wisconsin (Figure 3-4). The approximate acreage covered by the various vegetation types in the site area is presented in Table 3.1.

Approximately 59 percent of the site area is Upland Forest and 20 percent is Swamp Conifer. The upland forest type is composed primarily of Northern Hardwood and Aspen/Birch communities. Nonforested wetland (marsh, shrub swamp, and bog) comprises approximately 6 percent of the site area. These small wetland areas are classified as either Palustrine scrub/shrub or Palustrine emergent wetland (Sather, 1977). The remaining area is primarily disturbed land, agriculture, or water.

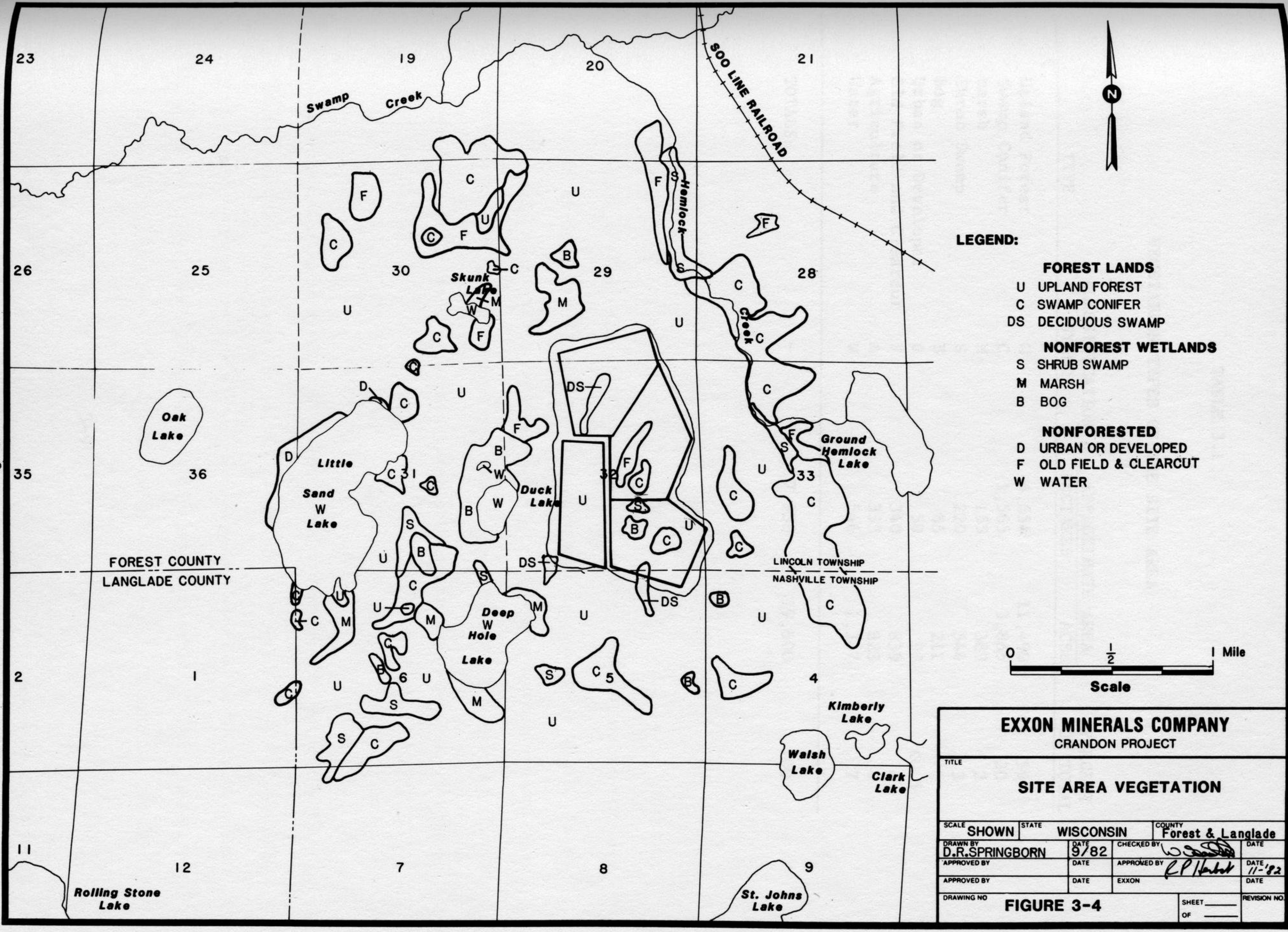

Swamp Creek
SOO LINE RAILROAD
Hemlock Creek
Skunk Lake
Oak Lake
Little Sand Lake
Duck Lake
Ground Hemlock Lake
Deep Hole Lake
Kimberly Lake
Walsh Lake
Clark Lake
St. Johns Lake
Rolling Stone Lake
FOREST COUNTY
LANGLADE COUNTY
LINCOLN TOWNSHIP
NASHVILLE TOWNSHIP
N
LEGEND:
FOREST LANDS
U UPLAND FOREST
C SWAMP CONIFER
DS DECIDUOUS SWAMP
NONFOREST WETLANDS
S SHRUB SWAMP
M MARSH
B BOG
NONFORESTED
D URBAN OR DEVELOPED
F OLD FIELD & CLEARCUT
W WATER
0 1/2 1 Mile
Scale
EXXON MINERALS COMPANY
CRANDON PROJECT
TITLE
SITE AREA VEGETATION
SCALE SHOWN
STATE WISCONSIN
COUNTY Forest & Langlade
DRAWN BY D.R.SPRINGBORN
DATE 9/82
CHECKED BY
DATE
APPROVED BY
DATE
APPROVED BY
DATE 11-'82
APPROVED BY
DATE
EXXON
DATE
DRAWING NO
FIGURE 3-4
SHEET
OF
REVISION NO.

TABLE 3.1

VEGETATION TYPES OF THE SITE AREA

TYPE	CLASSIFICATION SYMBOL	APPROXIMATE AREA HECTARES	ACRES	PERCENT OF TOTAL
Upland Forest	U	4,654	11,490	59
Swamp Conifer	C	1,565	3,865	20
Marsh	M	155	383	2
Shrub Swamp	S	220	544	3
Bog	B	85	211	1
Urban or Developed	D	50	98	<0.5
Old Field and Clearcut	F	340	839	4
Agriculture	A	333	823	4
Water	W	546	1,347	7
TOTALS	-	7,938	19,600	100

3.4 Current Air Quality Status

Total suspended particulate (TSP) concentrations were monitored at three stations during 1977 and 1978 (Dames & Moore, 1981a). At each station the sampler was operated for a 24-hour period every third calendar day in phase with the state-wide sampling schedule (every sixth day) established by the DNR.

The data from this sampling program are summarized in Table 3.2 for comparison to the Wisconsin Ambient Air Quality Standards. The highest 24-hour TSP concentrations at the three stations ranged from 65 to 99 ug/m^3, and the second highest 24-hour concentrations ranged from 61 to 77 ug/m^3. These concentrations are far below the Wisconsin primary and secondary standards of 260 and 150 ug/m^3, respectively. The geometric mean TSP concentrations ranged from 15.9 to 17.9 ug/m^3 at the three monitoring stations during the 12 months of concurrent monitoring in 1978. An additional 9 months of monitoring were performed at Station 1 (see section 4.2.3) in 1977. The TSP geometric mean for Station 1 was 16.6 ug/m^3. Geometric means at the stations are less than 24 percent of the primary annual standard of 75 ug/m^3.

The highest TSP concentrations occurred during spring and summer when agricultural operations were greatest. Total suspended particulate levels were lowest during periods of snow cover, when 24-hour concentrations were as low as 2 ug/m^3 (Dames & Moore, 1981a). Concentrations were similar at all three monitoring locations, with concurrent 24-hour concentrations often within 5 ug/m^3.

TABLE 3.2

TOTAL SUSPENDED PARTICULATE GEOMETRIC MEAN CONCENTRATIONS AT STATIONS 1, 2, and 3 (ug/m^3) (APRIL 1977 - DECEMBER 1978)

CALENDAR QUARTER	STATION 1	STATION 2	STATION 3
Apr. - Jun. 1977	20.6	_[a]	_ a
Jul. - Sep. 1977	18.6	_	_
Oct. - Dec. 1977	13.2	-	_
Jan. - Mar. 1978	11.5	11.1	11.6
Apr. - Jun. 1978	20.0	17.5	21.8
Jul. - Sep. 1978	18.8	19.1	20.9
Oct. - Dec. 1978	17.2	15.9	16.8

CONCENTRATIONS	STATION 1	STATION 2	STATION 3
Highest 24-Hour	99	65	74
Second Highest 24-Hour	77	61	73
Annual Geometric Mean[b]	16.6	15.9	17.9

WISCONSIN AMBIENT AIR QUALITY STANDARDS (WISCONSIN ADMINISTRATIVE CODE, 1975)	24-HOUR AVERAGE[c]	ANNUAL GEOMETRIC MEAN
Primary	260	75
Secondary	150	60

a. No data collected.
b. Calendar year 1978.
c. Not to be exceeded more than once per year.

Background levels of atmospheric SO_2 were also monitored at Station 1 (Dames & Moore, 1981a). None of the SO_2 samples indicated that ambient 24-hour SO_2 concentrations exceeded the lower limit of detection (25 ug/m^3). For consistency with the DNR data reporting procedures, all 24-hour SO_2 concentrations were reported as 0.5 of the lower limit of detection. All concentrations were far below the Wisconsin ambient 24-hour and annual SO_2 standards of 365 and 80 ug/m^3 (see Table 4.11), respectively (Wisconsin Administrative Code, 1975).

No measurements of other criteria pollutants were obtained for the environmental study area. Background concentrations of TSP and SO_2 indicate air quality of the environmental study area for these parameters is well below state and federal standards.

4.0 AIR QUALITY ASSESSMENT OF PROPOSED CRANDON PROJECT

Calculation of air contaminant emission rates for the Project includes all stationary source air emissions from the operating mine, mill, and mine waste disposal facility (Table 4.1). The Project stationary source air contaminant emission rates for TSP, SO_2, NO_x, CO, HC, and Pb are 102.6, 18.8, 104.2, 95.8, 3.9, and 1.0 tons per year, respectively. Since these air contaminant emission rates are below the 250 ton per year limit, the Project is exempt from the requirement to obtain a PSD permit.

The ambient air quality impact of the Project operations was assessed by performing a dispersion modeling analysis. The objective of the modeling anaysis was to demonstrate compliance with federal (National Ambient Air Quality Standards [NAAQS]) and state standards. Data bases and technical assumptions of the modeling analysis are discussed later.

4.1 Data Bases for Air Quality Evaluation

In an effort to predict the ambient air quality impact of the Project operations, a dispersion modeling analysis was performed. Data bases in the following areas were used: meteorology, existing air quality, the emission inventory, the emission factors, and calculated air emissions for the Project. In all cases the data used was the most currently accepted and available.

4.1.1 Meteorology and Air Quality

The data base used for the meteorological information consisted of the 1979 hourly surface observations from a privately operated monitoring location

TABLE 4.1

ESTIMATED AIR EMISSIONS FOR MODEL CALCULATIONS BY SPECIFIC STATIONARY SOURCES DURING OPERATION OF THE PROJECT

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MINE OPERATIONS							
Stationary Sources							
Drilling & Blasting	TSP	310.0	(683.4)	372.0	(821.0)	8.20	(9.00)
	SO_2	4.2	(9.3)	50.0	(110.0)	2.40	(2.70)
	NO_x	33.6	(74.1)	420.0	(926.0)	19.30	(21.30)
	CO	142.8	(314.8)	1800.0	(3968.0)	82.00	(90.40)
	Pb	5.8	(12.9)	7.0	(15.4)	0.15	(0.17)
Mine Air Heating	TSP	0.77	(1.7)	18.4	(40.5)	0.69	(0.76)
	SO_2	0.045	(.1)	1.1	(2.4)	0.04	(0.05)
	NO_x	9.20	(20.3)	220.0	(486.0)	8.30	(9.10)
	CO	1.50	(3.4)	36.8	(81.0)	1.40	(1.50)
	HC	0.61	(1.4)	14.7	(32.4)	0.55	(0.61)
Mine Mobile Vehicles Totals	TSP	1.2	(2.60)*	22.6	(49.8)	5.2	(5.7)
	SO_2	3.3	(7.20)*	63.6	(140.3)	14.6	(16.1)
	NO_x	11.4	(25.20)*	222.8	(491.2)	51.0	(56.2)
	CO	0.2	(0.46)*	4.1	(9.1)	0.9	(1.0)
	HC	0.2	(0.46)*	4.0	(8.9)	0.9	(1.0)
MINE TOTAL EMISSIONS	TSP	310.8	(685.1)	413.0	(910.5)	14.10	(15.50)
	SO_2	4.2	(9.3)	114.7	(252.9)	17.00	(18.80)
	NO_x	42.8	(94.4)	862.8	(1902.1)	78.60	(86.60)
	CO	144.3	(318.1)	1840.9	(4058.4)	84.30	(92.90)
	HC	0.6	(1.3)	18.7	(41.2)	1.50	(1.60)
	Pb	5.8	(12.8)	7.0	(15.4)	0.15	(0.17)
MILL OPERATIONS							
Stationary Sources							
Concentrate Handling and Shipping	TSP	0.0400	(0.080)	0.830	(1.82)	0.290	(0.320)
	Pb	0.0010	(0.002)	0.020	(0.04)	0.006	(0.007)

TABLE 4.1 (continued)

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
Coarse Ore	TSP	0.2600	(0.570)	6.200	(13.70)	0.80	(0.90)
Storage Building	Pb	0.0050	(0.011)	0.120	(0.26)	0.02	(0.01)
Coarse Ore Trans-	TSP	0.2600	(0.570)	6.200	(13.70)	0.80	(0.90)
port to Headframe	Pb	0.0100	(0.017)	0.190	(0.42)	0.02	(0.02)
Concrete Batch Plant	TSP	0.1300	(0.280)	1.020	(2.20)	0.26	(0.29)
Mine/Mill Surface	TSP	0.42	(0.92)	9.93	(21.9)	1.320	(1.46)
Facilities Heating	SO_2	0.03	(0.06)	0.59	(1.3)	0.080	(0.09)
	NO_x	5.01	(11.04)	119.20	(262.8)	15.900	(17.50)
	CO	0.83	(1.84)	19.90	(43.8)	2.650	(2.92)
	HC	0.34	(0.74)	7.94	(17.5)	1.060	(1.17)
Fuel Trans. & Stor.	HC	N/A[a]		0.17	(0.38)	0.061	(0.067)
Bulk Storage Fac. Service Station	HC	N/A		2.37	(5.23)	0.830	(0.91)
Emergency Diesel	TSP	6.5	(14.3)	156.0	(343.9)	N/A	
Generators	SO_2	6.0	(13.2)	144.0	(317.5)	N/A	
	NO_x	90.2	(199.0)	2164.8	(4772.6)	N/A	
	CO	1 9.4	(42.8)	465.6	(1026.5)	N/A	
	HC	7.2	(15.9)	172.8	(381.0)	N/A	

TABLE 4.1 (continued)

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h (lb/hr)	kg/d (lb/day)	t/y (st/yr)[a]
Backfill System	TSP	0.6700 (1.480)	5.700 (12.50)	1.600 (1.800)
Reagent Mixing Area	TSP	0.0800 (0.170)	1.800 (4.0)	0.63 (0.690)
Fine Ore Crushing Transfer Tower	TSP	0.1600 (0.350)	3.100 (6.80)	0.80 (0.880)
	Pb	0.0030 (0.007)	0.060 (0.14)	0.01 (0.020)
Cu-Zn Fine Ore Bin Loading	TSP	0.0600 (0.1300)	1.100 (2.50)	0.2900(0.320)
	Pb	0.0001 (0.0002)	0.002 (0.004)	0.0005(0.0006)
Cu-Zn Fine Ore Bin Unloading	TSP	0.0500 (0.1100)	1.200 (2.600)	0.45 (0.500)
	Pb	0.0001 (0.0002)	0.002 (0.005)	0.001 (0.001)
Cu-Pb-Zn Fine Ore Bin Unloading	TSP	0.0700 (0.150)	1.600 (3.600)	0.55 (0.610)
	Pb	0.0010 (0.002)	0.020 (0.050)	0.01 (0.011)
Cu-Pb-Zn Fine Ore Bin Loading	TSP	0.0700 (0.150)	1.300 (2.90)	0.35 (0.390)
	Pb	0.0010 (0.002)	0.020 (0.04)	0.01 (0.010)
Sec. & Tert. Crush. & Screening	TSP	11.9000 (26.200)	197.000 (435.00)	61.60 (67.900)
	Pb	0.1300 (0.290)	2.200 (4.85)	0.68 (0.750)
Surge Bins to Sec. & Tert. Crush. & Screening	TSP	0.6400 (1.400)	12.500 (27.50)	3.20 (3.50)
	Pb	0.0100 (0.030)	0.200 (0.43)	0.04 (0.04)
Milk of Lime Facilities	TSP	0.7000 (1.540)	4.900 (10.80)	1.30 (1.43)
Waste Rock Crushing Plant	TSP	0.0800 (0.170)	1.500 (3.22)	0.86 (0.94)
Waste Rock Bins and Loadout	TSP	0.9400 (2.070)	2.820 (6.21)	0.76 (0.84)

TABLE 4.1 (continued)

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]
MILL TOTAL EMISSIONS	TSP	23.00	(50.8)	414.7	(914.1)	75.9	(86.0)
	SO_2	6.03	(13.3)	144.6	(318.8)	0.1	(0.1)
	NO_x	95.21	(209.9)	2284.0	(5035.4)	15.9	(17.5)
	CO	20.23	(44.5)	485.5	(1070.3)	2.6	(2.9)
	HC	7.54	(16.6)	183.3	(404.1)	2.0	(2.2)
	Pb	0.16	(0.4)	2.8	(6.2)	0.8	(0.9)
MINE WASTE DISPOSAL FACILITY							
Stationary Sources							
Liner Batch Plant	TSP	N/A		N/A		0.925	(1.02)
Soil Processing Plant	TSP	N/A		N/A		0.025	(0.028)
MWDF TOTAL EMISSIONS	TSP	N/A		N/A		0.950	(1.05)

* These values do not occur at the same time as blasting and should not be included in hourly totals.

a. Not Applicable

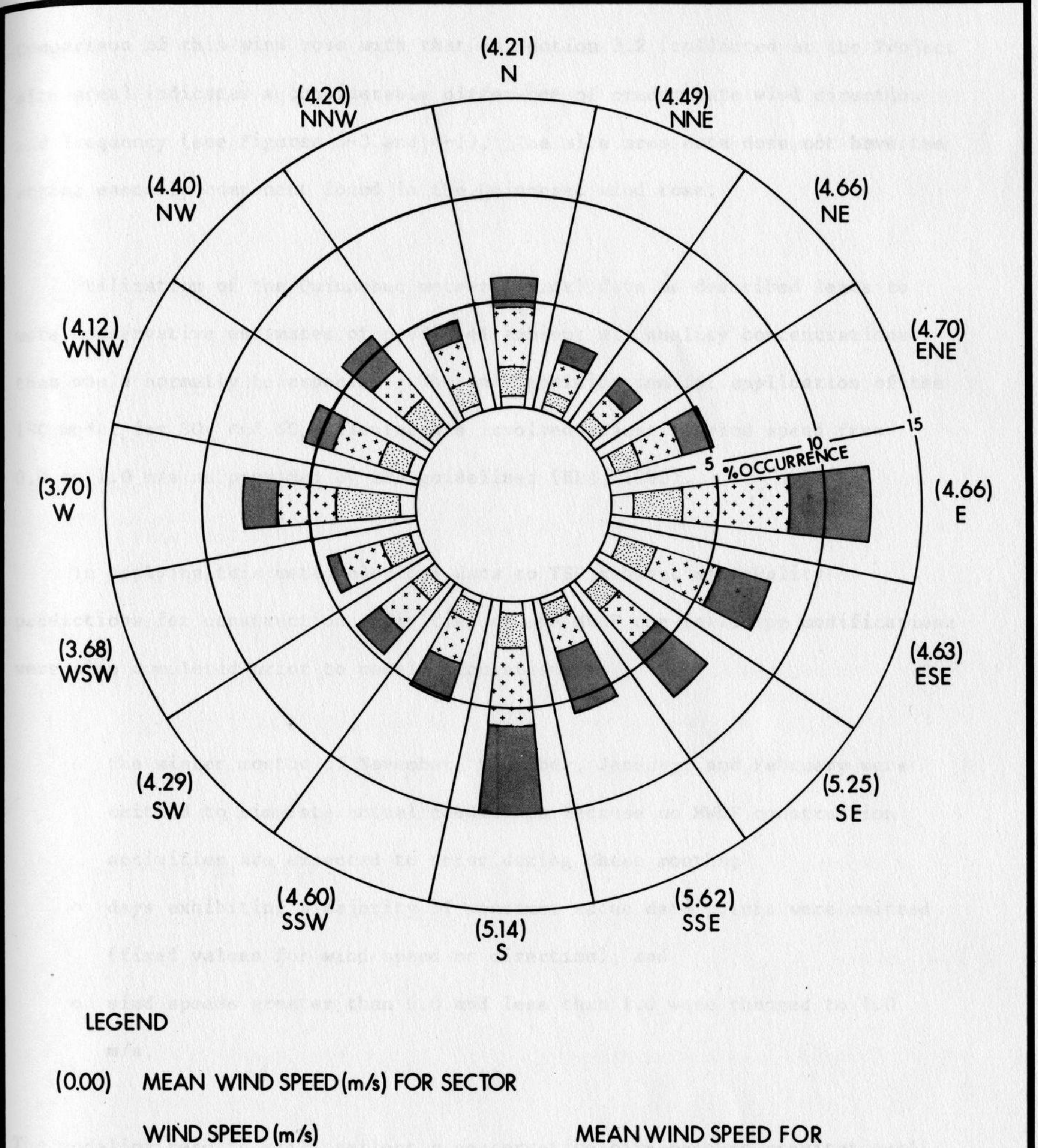
b. st/yr = short ton per year

near Quinnesec, Michigan, and the National Weather Service (NWS) upper air data from Green Bay Austin Strauble Airport (Appendix A). This data was used at the request of the DNR (DNR, 1982b).

Application of the Quinnesec meteorology data for predicting ambient air quality concentrations for the Project results in a conservative estimate of impact because the data contains many unusual meteorological conditions which cannot or are very unlikely to occur. This data contains the following:

- o extended periods of constant wind speed, temperature, and/or wind direction (one instance lasting 7 days);
- o wind speed values less than 1.0 m/s (processed meteorological data used for air quality dispersion analyses using UNAMAP models are designed by EPA to have no wind speeds less than 1.0 m/s);
- o nine consecutive hours of very unstable atmospheric conditions (stability class A) occurring during the night;
- o 24 consecutive hours of stability class 6 (very stable);
- o abrupt changes in atmospheric stability class (2 to 4 class categories) for adjacent hours;
- o numerous cases of stable classes E and F occurring during the day and unstable classes A through C occurring at night; and
- o approximately 35 hourly wind speeds had to be changed from 0.0 to 1.0 m/s to perform the calculations of the ISC model (see Section 4.2).

An annual wind rose (velocity/direction plot) was drawn of the Quinnesec meteorological data (Figure 4-1). The wind rose indicates predominate wind directions from the southeast and northeast quadrants for Quinnessec.



EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE QUINNESEC, MICHIGAN
ANNUAL WIND ROSE (1979)

SCALE NONE	STATE MICHIGAN		COUNTY	
DRAWN BY DMC	DATE 09/6/82	CHECKED BY [signature]		DATE
APPROVED BY	DATE	APPROVED BY [signature]		DATE 11-'82
APPROVED BY	DATE	EXXON		DATE
DRAWING NO	FIGURE 4-1		SHEET ___ OF ___	REVISION NO.

Comparison of this wind rose with that in Section 3.2 (collected at the Project site area) indicates a considerable difference of predominate wind direction and frequency (see Figures 3-3 and 4-1). The site area data does not have the strong easterly component found in the Quinnesec wind rose.

Utilization of the Quinnesec meteorological data as described leads to more conservative estimates of predicted ambient air quality concentrations than would normally be expected. The only modification for application of the ISC model for SO_2 and NO_x calculations involved adjusting wind speed from 0.0 to 1.0 m/s as provided by EPA guidelines (EPA, 1980).

In applying this meteorological data to TSP ambient air quality predictions for construction activities of the MWDF the following modifications were also completed prior to model calculations:

- o the winter months of November, December, January, and February were omitted to simulate actual conditions because no MWDF construction activities are expected to occur during these months;
- o days exhibiting a majority of constant value data points were omitted (fixed values for wind speed or direction); and
- o wind speeds greater than 0.0 and less than 1.0 were changed to 1.0 m/s.

The modeling results still reflect a conservative bias because gravitational settling of fugitive air emissions was not used and no adjustments were included for the embankment heights.

Ambient air quality monitoring data were used to estimate the background concentration of TSP, SO_2, and NO_2 in the site area. These extrapolated values were then added to the estimated ambient air concentrations by the modeling.

In 1978, Dames & Moore conducted an ambient air quality monitoring program in the Project site area which included three separate installations for the collection of total suspended particulates (TSP) and one installation for sampling SO_2. In applying this data, the highest, second highest 24-hour TSP concentration at the three locations was 77 ug/m^3 and the highest of the annual geometric means from the three sampling locations was 17.9 ug/m^3. During this particular year of sampling, ambient SO_2 concentrations did not exceed the minimum detectable limit of (25 ug/m^3) of the SO_2 analyzer (Dames & Moore, 1981a). As a result, a conservative background concentration of 25 ug/m^3 for all averaging periods in which an NAAQS exists (3-hour, 24-hour, and annual average) was used for ambient air quality for SO_2. Since this monitoring program did not include sampling for ambient NO_2 concentrations, a DNR estimated annual average of 19.4 ug/m^3 was used from data obtained at a NO_2 monitoring location in Sheboygan County, Wisconsin (DNR, 1982c).

4.1.2 Emission Factors and Inventory

Air emission estimates were calculated for each source of the Project. Air emission sources, factors and estimated rates can be found in Tables 4.2 through 4.7. The values in these tables represent the anticipated production mode controlled (where applicable) air emission rates. The air emissions for all sources were estimated on an hourly, daily, and yearly basis whenever possible. The tables include construction and operation activities for the mine, mine/mill surface facilities, and MWDF.

4.1.3 Calculated Air Emissions for Proposed Crandon Project

Calculation procedures for all the air emission rates presented in Tables 4.2 through 4.7 are provided in Appendix B. Figure 4-2 is a schematic flow diagram of the processes occurring during operations.

The control equipment for the processes in Tables 4.2 through 4.7 will provide control efficiencies as good or better than those listed. The manufacturer and model of equipment will be similar to those identified in Table 4.8.

TABLE 4.2

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE CONSTRUCTION

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR[b]		PROCESS RATE
MINE CONSTRUCTION										
Stationary Source										
Drilling & Blasting	TSP	76.1	(167.8)	141.1	(311.1)	5.8	(6.4)	.05	kg/t	ROCK:
	SO_2	10.3	(22.7)	19.1	(42.1)	1.7	(1.9)	1.0	kg/t	30,439 t/h; 56,445 t/d; 2,329,951 t/y
	NO_x	82.4	(181.7)	152.8	(336.9)	13.7	(15.1)	8.0	kg/t	
	CO	350.2	(772.0)	649.4	(143.2)	58.3	(64.3)	34.0	kg/t	ANFO:
	Pb	1.43	(3.15)	2.66	(5.9)	.11	(.12)	.00094	kg/t	10.3 t/h; 19.1 t/d; 1,715.001 t/y
Mine Air Heating[c]	TSP	.38	(.84)	9.2	(20.3)	.3	(.4)	10.0	$lb/10^6\ ft^3$	$.0844x10^4 ft^3/hr$; $2.03x10^6 ft^3/day$; $7.6x10^7 ft^3/yr$
	SO_2	.02	(.05)	.55	(1.2)	.02	(.02)	.6	$lb/10^6\ ft^3$	
	NO_x	4.6	(10.1)	110.3	(243.1)	4.1	(4.6)	120.0	$lb/10^6\ ft^3$	
	CO	.77	(1.69)	18.4	(40.5)	.7	(.8)	20.0	$lb/10^6\ ft^3$	
	HC	.31	(.68)	7.4	(16.2)	.3	(.3)	8.0	$lb/10^6\ ft^3$	
Mine Mobile Equipment[d]	TSP	.79	(1.73)	15.4	(33.8)	4.6	(5.1)	11.0	$lb/10^3 gal$	
	SO_2	2.22	(4.89)	43.3	(95.4)	13.0	(14.4)	31.0	$lb/10^3 gal$	157.8 gal/hr; 3,076.7 gal/day; 926,398 gal/yr
	NO_x	7.77	(17.1)	151.4	(333.9)	45.6	(50.3)	108.5	$lb/10^3 gal$	
	CO	.14	(.32)	2.81	(6.18)	.8	(.9)	2.0	$lb/10^3 gal$	
	HC	.14	(.31)	2.75	(6.06)	.8	(.9)	1.97	$lb/10^3 gal$	

a. st/yr = short ton per year

b. All emission factors are based on the EPA Emission Factors Source "AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. At standard conditions

d. Mine mobile equipment emission factors based on report titled "Emission Control of a Deutz F6L-714 diesel engine, derated for underground use, by application of water/oil fuel emulsions" by A. Lawson, E. W. Simmons, and M. Piett, March 30, 1979.

TABLE 4.3

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE OPERATION

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR[b]		PROCESS RATE
MINE OPERATIONS										
Stationary Source										
Drilling & Blasting	TSP	310.0	(683.4)	372.0	(821.0)	8.2	(9.0)	0.05	kg/t	Rock 124,120 t/hr; 148,952 t/d;
	SO_2	4.2	(9.3)	50.0	(110.0)	2.4	(2.7)	1.0	kg/t	3,276,000 t/y
	NO_x	33.6	(74.1)	420.0	(926.0)	19.3	(21.3)	8.0	kg/t	
	CO	142.8	(314.8)	1800.0	(3968.0)	82.0	(90.4)	34.0	kg/t	ANFO 42 t/h; 47.9 t/d;
	Pb	5.8	(12.9)	7.0	(15.4)	.15	(.17)	0.00094	kg/t	2,411 t/y
Mine Air Heating[c]	TSP	.77	(1.7)	18.4	(40.5)	.69	(.76)	10.0	$lb/10^6 ft^3$	$1.7 \times 10^5 ft^3/hr$; $4.1 \times 10^6 ft^3/day$;
	SO_2	.045	(.1)	1.1	(2.4)	.04	(.05)	0.6	$lb/10^6 ft^3$	$1.52 \times 10^8 ft^3/yr$
	NO_x	9.2	(20.3)	220.0	(486.0)	8.3	(9.1)	120.0	$lb/10^6 ft^3$	
	CO	1.5	(3.4)	36.8	(81.0)	1.4	(1.5)	20.0	$lb/10^6 ft^3$	
	HC	.61	(1.4)	14.7	(32.4)	.55	(.61)	8.0	$lb/10^6 ft^3$	
Mine Mobile Equipment[d]	TSP	1.2	(2.6)	22.6	(49.8)	5.2	(5.7)	11.0	$lbs/10^3 gal$	232 gal/hr; 4527 gal/day;
	SO_2	3.3	(7.2)	63.6	(140.3)	14.6	(16.1)	31.0	$lbs/10^3 gal$	$1.036 \times 10^6 gal/yr$
	NO_x	11.4	(25.2)	222.8	(491.2)	51.0	(56.2)	108.0	$lbs/10^3 gal$	
	CO	.2	(.46)	4.1	(9.1)	.9	(1.0)	2.0	$lbs/10^3 gal$	
	HC	.2	(.46)	4.0	(8.9)	.9	(1.0)	1.97	$lbs/10^3 gal$	

a. st/yr = short ton per year.

b. All emission factors are based on the EPA Emission Factors Source "AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. At standard conditions

d. Mine mobile equipment emission factors based on report titled "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.

TABLE 4.4

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE/MILL SURFACE FACILITIES CONSTRUCTION

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR [b]	PROCESS RATE
MINE/MILL CONSTRUCTION									
Fugitive Sources									
Mine/Mill Surface Facilities	TSP	N/A[c]		214.0	(470.0)	20.6	(22.8)	0.0555 st/acre/month	91.4 acres
Railroad Bed	TSP	N/A		174.0	(382.0)	28.0	(30.8)	0.0555 st/arce/month	74.1 acres
Access Road	TSP	N/A		144.0	(318.0)	21.8	(24.0)	0.0555 st/acre/month	61.8 acres
Waste Rock Area	TSP	N/A		104.0	(228.0)	8.8	(9.8)	0.0555 st/acre/month	44.5 acres
Reclaim Pond	TSP	N/A		110.0	(242.0)	16.6	(18.2)	0.0555 st/acre/month	46.9 acres
Temporary Sources									
Fuel Transfer & Storage	HC	N/A		1.7	(3.7)	0.4	(0.4)	AP-42, Section 4.3	Peak Consumption Diesel - 6000 gal/day (winter) - 8700 gal/day (summer) Gasoline - 140 gal/day (winter)
Concrete Batch Plant	TSP	0.7	(1.5)	16.0	(36.0)	2.5	(2.7)	0.02 lb/yd^3	75 yd^3/hr
Mobile Sources[d]									
Diesel Vehicles Tailpipe Emissions	TSP	4.0	(8.0)	48.0	(106.0)	7.3	(8.0)	39.35 lb/10^{3}gal	Peak Consumption Diesel - 2700 gal/day
	SO_2	3.0	(6.0)	38.0	(84.0)	5.7	(6.3)	31.0 lb/10^{3}gal	
	NO_x	34.0	(76.0)	460.0	(1016.0)	68.9	(76.0)	376.2 lb/10^{3}gal	
	CO	10.0	(23.0)	37.0	(303.0)	20.7	(22.8)	112.3 lb/10^{3}gal	
	HC	5.0	(11.0)	69.0	(152.0)	10.3	(11.4)	56.4 lb/10^{3}gal	

a. st/yr = short ton per year

b. All emission factors are based on the EPA Emission Factors Source "AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. Not Applicable

d. Gasoline vehicles tailpipe emissions were included in MDWF Construction

TABLE 4.5

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE/MILL SURFACE FACILITIES OPERATION

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
MILL OPERATIONS									
Stationary Sources									
Coarse Ore Transport to Headframe	TSP	.26	(.57)	6.2	(13.7)	.8	(.9)	.05 kg/t	1030 t/h
	Pb	.01	(.017)	.19	(.42)	.02	(.02)		
Coarse Ore Storage Building	TSP	.26	(.57)	6.2	(13.7)	.8	(.9)	.05 kg/t	1030 t/h
	Pb	.005	(.011)	.12	(.26)	.01	(.01)		
Surge Bins to Sec. & Tert. Crush. & Screening	TSP	.64	(1.4)	12.5	(27.5)	3.2	(3.5)	.05 kg/t	127 t/h
	Pb	.01	(.03)	.20	(.43)	.04	(.04)		
Sec. & Tert. Crush. & Screening	TSP	11.9	(26.2)	197.0	(435.0)	61.6	(67.9)	3.2 kg/t	620 t/h
	Pb	.13	(.29)	2.2	(4.85)	.68	(.75)		
Fine Ore Crushing Transfer Tower	TSP	.16	(.35)	3.1	(6.9)	.8	(.88)	.05 kg/t	620 t/h
	Pb	.003	(.007)	.06	(.14)	.01	(.01)		
Cu-Pb-Zn Fine Ore Bin Loading	TSP	.07	(.15)	1.3	(2.9)	.35	(.39)	.05 kg/t	341 t/h
	Pb	.001	(.002)	.02	(.04)	.01	(.01)		
Cu-Zn Fine Ore Bin Loading	TSP	.06	(.13)	1.1	(2.5)	.29	(.32)	.05 kg/t	279 t/h
	Pb	.0001	(.0002)	.002	(.004)	.0005	(.0006)		
Cu-Pb-Zn Fine Ore Bin Unloading	TSP	.07	(.15)	1.6	(3.6)	.55	(.61)	.05 kg/t	219 t/h
	Pb	.001	(.002)	.02	(.05)	.01	(.011)		
Cu-Zn Fine Ore Bin Unloading	TSP	.05	(.11)	1.2	(2.6)	.45	(.50)	.05 kg/t	179 t/h
	Pb	.0001	(.0002)	.002	(.005)	.001	(.001)		
Milk of Lime Facilities	TSP	.70	(1.54)	4.9	(10.8))	1.3	(1.43)	1.0 kg/t	50 t/h
Reagent Mixing Area	TSP	.08	(.17)	1.8	(4.0))	.63	(.69)	3.0 kg/t	24.3 t/h
Concentrate Handling and Shipping	TSP	.04	(.08)	.83	(1.82)	.29	(.32)	.01 kg/t	Cu - 471 t/d
	Pb	.001	(.002)	.02	(.04)	.006	(.007)		Pb - 72 t/d
									Zn - 1025 t/d
Backfill System	TSP	.67	(1.48)	5.7	(12.5)	1.6	(1.8)	.02 kg/t	150 t/h
								.12 kg/t	53.9 t/h
Waste Rock Bins and Loadout	TSP	.94	(2.07)	2.82	(6.21)	.76	(.84)	.033kg/t	1020 t/h

TABLE 4.5 (continued)

EMISSION SOURCE	CONTAMINANT	TOTAL CONTAMINANT EMISSION RATES kg/h (lb/hr)	kg/d (lb/day)	t/yr (st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
MILL OPERATIONS (CONT.)						
Mobile Sources						
Vehicular Travel	TSP	N/A[c]	3.09 (6.81)	1.08 (1.19)	AP-42, Section 3.1	L.D. - Gasoline Trk 39 hr/day
Plant Vehicle	SO_2	N/A	5.93 (13.08)	2.08 (2.29)		H.D. - Gasoline Trk 103 hr/day
Exhaust	NO_x	N/A	49.5 (109.1)	17.3 (19.1)		H.D. - Diesel Trk 13 hr/day
	CO	N/A	138.5 (305.4)	48.5 (53.4)		All driven at 19.6 mi/hr
	HC	N/A	19.2 (42.3)	6.72 (7.40)		
Vehicular Travel	TSP	N/A	.68 (1.5)	.24 (.26)	.34 g/mi	L.D. Gasoline Vehicles
Employee Vehicles	SO_2	N/A	.26 (.57)	.10 (.11)	.13 g/mi	2,000 mi/day
	NO_x	N/A	9.2 (20.3)	3.2 (3.5)	4.55 g/mi	19.6 mi/day
	CO	N/A	73.8 (162.7)	25.9 (28.5)	36.9 g/mi	
	HC	N/A	9.6 (21.2)	3.4 (3.7)	4.78 g/mi	
Locomotive	TSP	2.5 (5.5)	15.0 (33.1)	5.18 (5.70)	5.5 lb/hr	2072 hr/yr
Exhaust Emissions	SO_2	.93 (2.1)	5.58 (12.3)	1.9 (2.1)	2.1 lb/hr	
	NO_x	18.0 (39.7)	108.0 (238.0)	37.4 (41.2)	39.7 lb/hr	
	CO	2.3 (5.1)	13.8 (30.4)	4.8 (5.3)	5.1 lb/hr	
	HC	.39 (.86)	2.34 (5.16)	.81 (.89)	.86 lb/hr	
Fugitive Sources						
Total Road Dust Emissions	TSP	N/A	27.6 (60.9)	9.7 (10.7)	Dust - .012 lb/vehicle mi; Tire Wear - .00044 lb/vehicle mi	5308 mi

TABLE 4.5 (continued)

EMISSION SOURCE	COMPONENT	kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
		TOTAL CONTROLLED COMPONENT EMISSION RATES							
MILL OPERATIONS (CONT.)									
Waste Rock Crushing Plant	TSP	.08	(.17)	1.5	(3.22)	.86	(.94)	.1 kg/t	150.0 t/h
Concrete Batch Plant	TSP	.13	(.28)	1.02	(2.2)	.26	(.29)	.118 kg/t	85.7 t/h
Mine/Mill Surface Facilities Heating	TSP	.42	(.92)	9.93	(21.9)	1.32	(1.46)	10.0 $lb/10^6 ft^3$	$9.2 \times 10^4 ft^3/hr$;
	SO_2	.03	(.06)	.59	(1.3)	.08	(.09)	.6 $lb/10^6 ft^3$	$2.2 \times 10^6 ft^3/day$;
	NO_x	5.01	(11.04)	119.2	(262.8)	15.9	(17.5)	120.0 $lb/10^6 ft^3$	$8.2 \times 10^7 ft^3/yr$
	CO	.83	(1.84)	19.9	(43.8)	2.65	(2.92)	20.0 $lb/10^6 ft^3$	
	HC	.34	(.74)	7.94	(17.5)	1.06	(1.17)	8.0 $lb/10^6 ft^3$	
Fuel Trans. & Stor.	HC	N/A		.17	(.38)	.061	(.067)	AP-42, Section 4.3	Peak Consumption
Bulk Storage Fac. Service Station	HC	N/A		2.37	(5.23)	.83	(.91)		Diesel - 6,000 gal/day Gasoline - 500 gal/day
Emergency Diesel Generators	TSP	6.5	(14.3)	156.0	(343.9)	N/A		1.34 g/kwh	2 - 2000 kw Units
	SO_2	6.0	(13.2)	144.0	(317.5)	N/A		1.25 g/kwh	and 1 - 800 kw Unit
	NO_x	90.2	(199.0)	2164.8	(4772.6)	N/A		18.8 g/kwh	Emergency Use Only
	CO	19.4	(42.8)	465.6	(1026.5)	N/A		4.06 g/kwh	
	HC	7.2	(15.9)	172.8	(381.0)	N/A		1.5 g/kwn	

a. st/yr = short ton per year

b. All emission factors are based on the EPA Emission Factors Source "AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. Not Applicable

TABLE 4.6

ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE WASTE DISPOSAL FACILITY CONSTRUCTION

EMISSION SOURCE	CONTAMINANT	TOTAL CONTAMINANT EMISSION RATES kg/h (lb/hr)	kg/d (lb/day)	t/y (st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
MINE WASTE DISPOSAL FACILITY						
Fugitive Sources						
Windblown						
Haul Road	TSP	N/A[c]	N/A	0.729 (0.804)	0.3325 st/acre/year	16.12 acres
Disposal Area	TSP	N/A	N/A	5.062 (5.58)	0.0469 st/acre/year	119 acres
Support Area	TSP	N/A	N/A	0.128 (0.141)	0.0469 st/acre/year	20 acres
Truck Hauling	TSP					
Till to Dike and Storage	TSP	N/A	N/A	21.709 (23.93)	1.36 lb/vehicle mi	35,162 mi/y
Waste Rock to Tailings Area	TSP	N/A	N/A	2.195 (2.42)	4.083 lb/vehicle mi	7,915 mi/y
Bentonite to Batch Plant	TSP	N/A	N/A	1.388 (1.53)	4.083 lb/vehicle mi	4,995 mi/y
Till/Bentonite Mix from Batch Plant to Pond	TSP	N/A	N/A	7.022 (7.74)	2.0416 lb/vehicle mi	7,575 mi/y
Underdrain Mat. from Support Area to Pond	TSP	N/A	N/A	6.967 (7.68)	2.0416 lb/vehicle mi	7,521 mi/y
Filter Material from Support Area to Pond	TSP	N/A	N/A	8.110 (8.94)	2.0416 lb/vehicle mi	8,762 mi/y
Rip-Rap from Sup. Area to Pond	TSP	N/A	N/A	8.963 (9.88)	2.0416 lb/vehicle mi	9,679 mi/y
Loading						
Pond Excavation with Scraper	TSP	N/A	N/A	252.53 (278.37)	0.38 lb/yd^3	1,465,104 yd^3/yr
Loading Till into Batch Plant and Processing Plant	TSP	N/A	N/A	4.87 (5.37)	0.037 lb/st	139,381 st/yr
Loading Underdrain Filter Material & Rip-Rap	TSP	N/A	N/A	8.72 (9.61)	0.037 lb/st	519,232 st/yr
Dumping						
Till and Bentonite Mixture in Pond	TSP	N/A	N/A	1.89 (2.08)	0.0275 lb/st	151,500 st/yr
Waste Rock at Stockpile	TSP	N/A	N/A	1.12 (1.23)	0.0275 lb/st	89,300 st/yr
Underdrain, Filter Material and Rip-Rap	TSP	N/A	N/A	6.48 (7.14)	0.0275 lb/st	519,232 st/yr

TABLE 4.6 (continued)

EMISSION SOURCE	CONTAMINANT	TOTAL CONTAMINANT EMISSION RATES kg/h	(lb/hr)	kg/d	(lb/day)	t/y	(st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
MINE WASTE DISPOSAL FACILITY (CONT.)									
Mobile Equipment									
Tailpipe Emissions									
									Peak Consumption
Diesel-In Pit	TSP	8.93	(19.69)	116.02	(255.78)	12.52	(13.80)	39.35 $lb/10^3 gal$	500 gal/hr max.
	SO_2	7.03	(15.50)	91.40	(201.50)	9.86	(10.87)	31.0 $lb/10^3 gal$	500 gal/hr max.
	NO_x	85.33	(188.11)	1,109.20	(2445.37)	119.66	(131.90)	376.21 $lb/10^3 gal$	500 gal/hr max.
	CO	25.47	(56.15)	331.10	(729.95)	35.72	(39.37)	112.3 $lb/10^3 gal$	500 gal/hr max.
	HC	12.79	(28.20)	166.29	(366.60)	17.94	(19.77)	56.4 $lb/10^3 gal$	500 gal/hr max.
Gasoline-Haul Road	TSP	0.068	(0.149)	0.86	(1.9)	0.094	(0.104)	14.89 $lb/10^3 gal$	10 gal/hr max.
	SO_2	0.009	(0.020)	0.12	(0.258)	0.013	(0.014)	1.91 $lb/10^3 gal$	10 gal/hr max.
	NO_x	0.180	(0.397)	2.34	(5.158)	0.252	(0.278)	39.68 $lb/10^3 gal$	10 gal/hr max.
	CO	0.827	(1.823)	10.75	(23.70)	1.159	(1.278)	182.32 $lb/10^3 gal$	10 gal/hr max.
	HC	0.132	(0.292)	1.72	(3.797)	0.186	(0.205)	29.21 $lb/10^3 gal$	10 gal/hr max.

a. st/yr = short ton per year

b. All emission factors are based on the EPA Emission Factors Source"AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. Not Applicable

TABLE 4.7

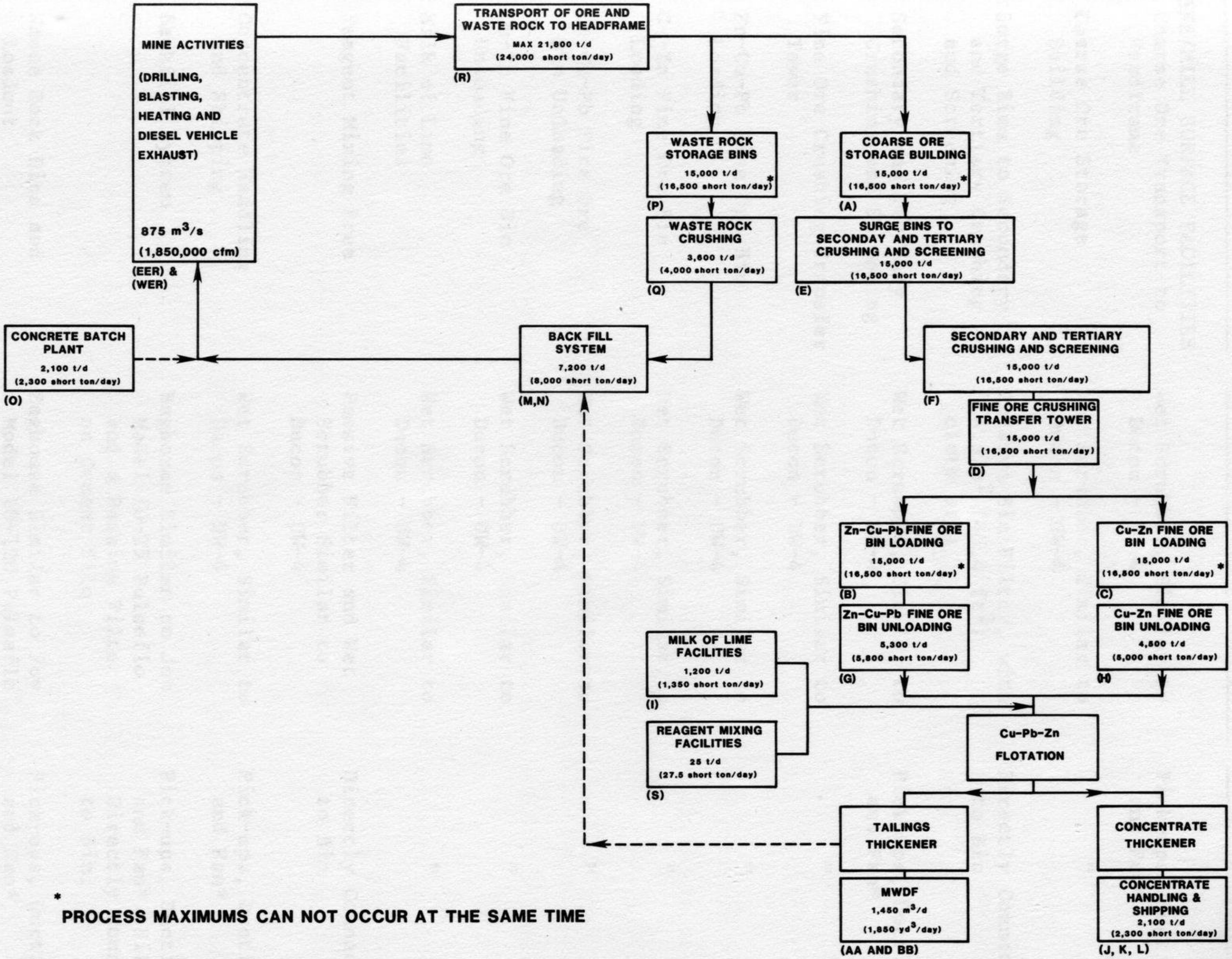
ESTIMATED AIR CONTAMINANT EMISSION RATES BY SPECIFIC SOURCES DURING MINE WASTE DISPOSAL FACILITY OPERATION

EMISSION SOURCE	COMPONENT	TOTAL CONTROLLED COMPONENT EMISSION RATES kg/h (lb/hr)	kg/d (lb/day)	t/y (st/yr)[a]	EMISSION FACTOR[b]	PROCESS RATE
MINE WASTE DISPOSAL FACILITY						
Stationary Sources						
Liner Batch Plant	TSP	N/A[c]	N/A	0.925 (1.02)	0.2 lb/yd^3	102,020 yd^3/yr.
Soil Processing Plant	TSP	N/A	N/A	0.025 (0.028)	0.1 lb/st	139,380 st/yr

a. st/yr = short tons per year

b. All emission factors are based on the EPA Emission Factors Source "AP-42, Supplement 12, April 1981 and earlier" unless specified.

c. Not Applicable



* PROCESS MAXIMUMS CAN NOT OCCUR AT THE SAME TIME

EMISSION SOURCE LOCATIONS SEE FIGURES 2-2 and 2-3 FOR DESCRIPTION AND LOCATION

EXXON MINERALS COMPANY
CRANDON PROJECT

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

NONE | WISCONSIN | FOREST
DRAWN BY BWM | DATE 07-19-82 | DATE 11-82

FIGURE 4-2

TABLE 4.8

MANUFACTURER AND MODEL NUMBERS OF POLLUTION CONTROL EQUIPMENT

Process	Pollution Control Equipment	System
MINE/MILL SURFACE FACILITIES		
Coarse Ore Transport to Headframe	Wet Scrubber, Similar to Ducon - UW-4	Pick-ups, Ducting and Fan*
Coarse Ore Storage Building	Wet Scrubber, Similar to Ducon - UW-4	"
Surge Bins to Secondary and Tertiary Crushing and Screening	Passive Bin Filter, with 4.5 m^2 (48.4 ft^2) cloth area	Directly Connected to Bin
Secondary and Tertiary Crushing and Screening	Wet Scrubber, Similar to Ducon - UW-4	Pick-ups, Ducting and Fan*
Fine Ore Crushing Transfer Tower	Wet Scrubber, Similar to Ducon - UW-4	"
Zn-Cu-Pb Fine Ore Bin Loading	Wet Scrubber, Similar to Ducon - UW-4	"
Cu-Zn Fine Ore Bin Loading	Wet Scrubber, Similar to Ducon - UW-4	"
Zn-Cu-Pb Fine Ore Bin Unloading	Wet Scrubber, Similar to Ducon - UW-4	"
Cu-Zn Fine Ore Bin Unloading	Wet Scrubber, Similar to Ducon - UW-4	"
Milk of Lime Facilities	Wet Scrubber, Similar to Ducon - UW-4	"
Reagent Mixing Area	Passive Filter and Wet Scrubber Similar to Ducon - UW-4	Directly Connected to Bin
Concentrate Handling and Shipping	Wet Scrubber, Similar to Ducon - UW-4	Pick-ups, Ducting and Fan*
Backfill System	Baghouse Similar to Joy Model 10-25 Pulseflo and a Passive Filter on Cement Silo	Pick-ups, Ducting and Fan*. Filter Directly Connected to Bin.
Waste Rock Bins and Loadout	Baghouse Similar to Joy Model 10-120 Pulseflo and Water Sprays on Loadout.	Pick-ups, Ducting, and Fan*

Table 4.8 (continued)

Process	Pollution Control Equipment	System
MINE/MILL SURFACE FACILITIES		
Waste Rock Crushing Plant	Baghouse Similar to Joy Model 10-300 Pulseflo	Pick-ups, Ducting and Fan*
Concrete Batch Plant	Baghouse Similar to Joy Model 10-49 Pulseflo Passive Filter on Cement Silo	Pick-ups, Ducting and Fan*. Filter Directly Connected to Bin.
Fuel Transfer and Storage. Bulk Storage Facility.	Vapor Balance System	Hoses for Vent Connections
MINE WASTE DISPOSAL FACILITY		
Liner Batch Plant	Passive Filter	Directly Connected to Bin.
Soil Processing Plant	Baghouse Similar to Joy Model 10-49 Pulseflo	Pick-ups, Ducting and Fan*.

* All Design of Pick-ups and Ducting, will be in Accordance with Industrial Ventilation Guidelines of the American Conference of Governmental Industrial Hygienists (1976).

Air Qu^lity Modeling

4.2.1 Methodology

The EPA Industrial Source Complex (ISC) model was used to predict the potential air quality effects of the Project. The model calculation procedure is based on the steady state Gaussian Plume concept (Bowers, Bjorklund, and Chenev, 1979). This model is recommended by the EPA for assessing the impact of fugitive particulate emissions and aerodynamic downwash effects.

The main ISC model consists of two programs: a short-term model (ISCST) and a long-term model (ISCLT). The ISCST program uses an hourly meteorological data base, while the ISCLT incorporates a sector-averaged program using a frequency of occurrence based on categories of wind speed, wind direction and atmospheric stability. The ISCLT model was used only to assess NO_x impacts, since only annual average standards exist for this air contaminant. Estimation of ambient CO concentrations was determined by a direct ratio to SO_2 concentration results. Both the ISCST and ISCLT programs were used to:

- o estimate effects of plume rise from momentum and buoyancy as a function of downwind distance for stack emissions (Briggs, 1971; 1975);
- o estimate effects created by building wakes (Huber and Synder, 1976; Huber, 1977);
- o maintain separation of individual stationary point and area sources for input and output; and
- o estimate concentrations for 1-hour to annual averages.

The assumptions and calculations utilized were as follows:

- o horizontal wind field - assumed to be steady-state (constant and uniform) within each hour;
- o vertical wind field - assumed to equal zero;
- o horizontal dispersion - was based on the semi-empirical Gaussian Plume. Hourly stability classes were determined internally by the Turner procedure. Turner's rural dispersion coefficients were used;
- o vertical dispersion - was based on the semi-empirical Gaussian Plume. Hourly stability classes were determined internally and Turner's rural dispersion coefficients were used; and
- o no adjustments were made for terrain topography because of the gradual changes present in the Project site area.

The ISCST and ISCLT models used the following formula for estimation of the respective air component ambient concentrations.

ISCST MODEL

INDUSTRIAL SOURCE COMPLEX SHORT TERM

GROUND-LEVEL CONCENTRATION FOR STACK AND AREA SOURCES

$$\chi\{x,y\} = \frac{KQ_A x_o}{\sqrt{2\pi}\,\bar{u}\{h\}\,\sigma_z}\{\text{Vertical Term}\}\left(\text{erf}\left(\frac{x'_o/2+y}{\sqrt{2}\,\sigma_y}\right) + \text{erf}\left(\frac{x'_o/2-y}{\sqrt{2}\,\sigma_y}\right)\right)\{\text{Decay Term}\}$$

x = HOURLY DOWNWIND DISTANCE CO-ORDINATE

y = HOURLY CROSSWIND DISTANCE CO-ORDINATE

x_o = LENGTH OF ONE SIDE OF SQUARE AREA

K = CONSTANT ≈ 7 Q = EMISSION RATE

$\bar{u}$ = MEAN WIND SPEED

h = EFFECTIVE STACK HEIGHT OF SOURCE

$\sigma_{z,k}$ = STANDARD DEVIATION OF THE VERTICAL CONCENTRATION (m) FOR THE K^{th} STABILITY CATEGORY

The model calculations for annual mean and short-term (3-hour and 24-hour) ground level air pollutant concentrations were performed with the ISC dispersion models using one year of meteorological data (previously described). This data consisted of surface observations from Quinnesec, Michigan and upper air data from Green Bay, Wisconsin. The stationary point source air emission rates used are found in Table 4.1. Actual input of emission rates from this table used the ton/yr estimates for TSP (when available), and lb/hr estimates for SO_2, and NO_2 (NO_x) (when available).

Stationary source stack emissions (point) were modeled with horizontal discharge from structure walls, exceptions were: vertical discharge from the mine exhausts (east exhaust raise [EER] and west exhaust raise [WER]) and secondary and tertiary crushing and screening. All stack parameters are presented in Table 4.9.

Area source inputs were used to represent emissions from: the mine/mill surface structure heating (1 square area = 400 m [1310 feet] per side), MWDF construction (2 square areas = 800 m [2625 feet] per side), and the haul road from the mine/mill site to the MWDF (3 square areas = 400 m [1310 feet] per side). These areas were assumed to have an effective plume height of 3.0 m (10 feet) except the mine/mill surface structure heating which was assumed to emit from a height of 15.0 m (50 feet).

The meteorological data as input contained many conservative features such as the unrealistic occurrences of constant wind speeds, temperatures and/or wind directions for periods up to 7 consecutive days. Also numerous occurrences of

TABLE 4.9

STACK PARAMETERS FOR MINE/MILL AIR EMISSION SOURCES

	EMISSION SOURCE	STACK OR RELEASE HEIGHT (m)	EXIT DIAMETER (m)	VOLUME FLOW RATE (m^3/s)	EXIT TEMPERATURE (°K)
J,K,L[a]	Concentrate handling and shipping	18.0	0.34	1.65	294.3
M,N	Backfill system	38.0	0.24	0.94	294.3
S	Reagent mixing area	15.2	0.34	1.70	294.3
	Fine ore crushing transfer tower	10.5	0.79	9.44	294.3
C	Cu-Zn fine ore storage bin loading	36.8	0.76	8.94	294.3
H	Cu-Zn fine ore bin unloading	34.0	0.88	12.58	294.3
G	Zn-Cu-Pb fine ore bin unloading	34.0	0.82	11.16	294.3
B	Zn-Cu-Pb fine ore storage bin loading	36.8	0.70	7.83	294.3
F	Sec. and tert. crushing and screening	40.5	1.19	23.10	294.3
E	Surge bins to sec. and tert. crushing and screening	2.4	0.61	5.32	294.3
I	Milk of lime facilities	17.0	0.70	7.79	294.3
Q	Waste rock crushing plant	34.0	1.04	17.33	294.3
P	Waste rock bins and loadout	28.0	0.64	6.77	294.3
A	Coarse ore storage building	27.0	0.91	13.26	294.3
R	Coarse ore transport to headframe	20.5	0.91	13.26	294.3
O	Concrete batch plant	8.0	0.43	1.77	294.3
EER	Mine exhaust shaft	3.7	6.71	436.6	294.3
WER	Mine exhaust shaft	3.7	6.71	436.6	294.3

[a]See Figure 2-2.

stability Classes E and F during the day and unstable Classes A through C at night. Therefore, use of meteorological data containing these conditions would predict conservatively high ambient air concentrations.

The air emissions data used also had the conservative assumption that all air emission rates were occurring for 24-hours per day, 365 days per year. This is obviously not the case for construction activities occurring only during daylight hours and as weather allows (i.e. precipitation and winter conditions). The mine and mill heating also occurs only during the winter when needed.

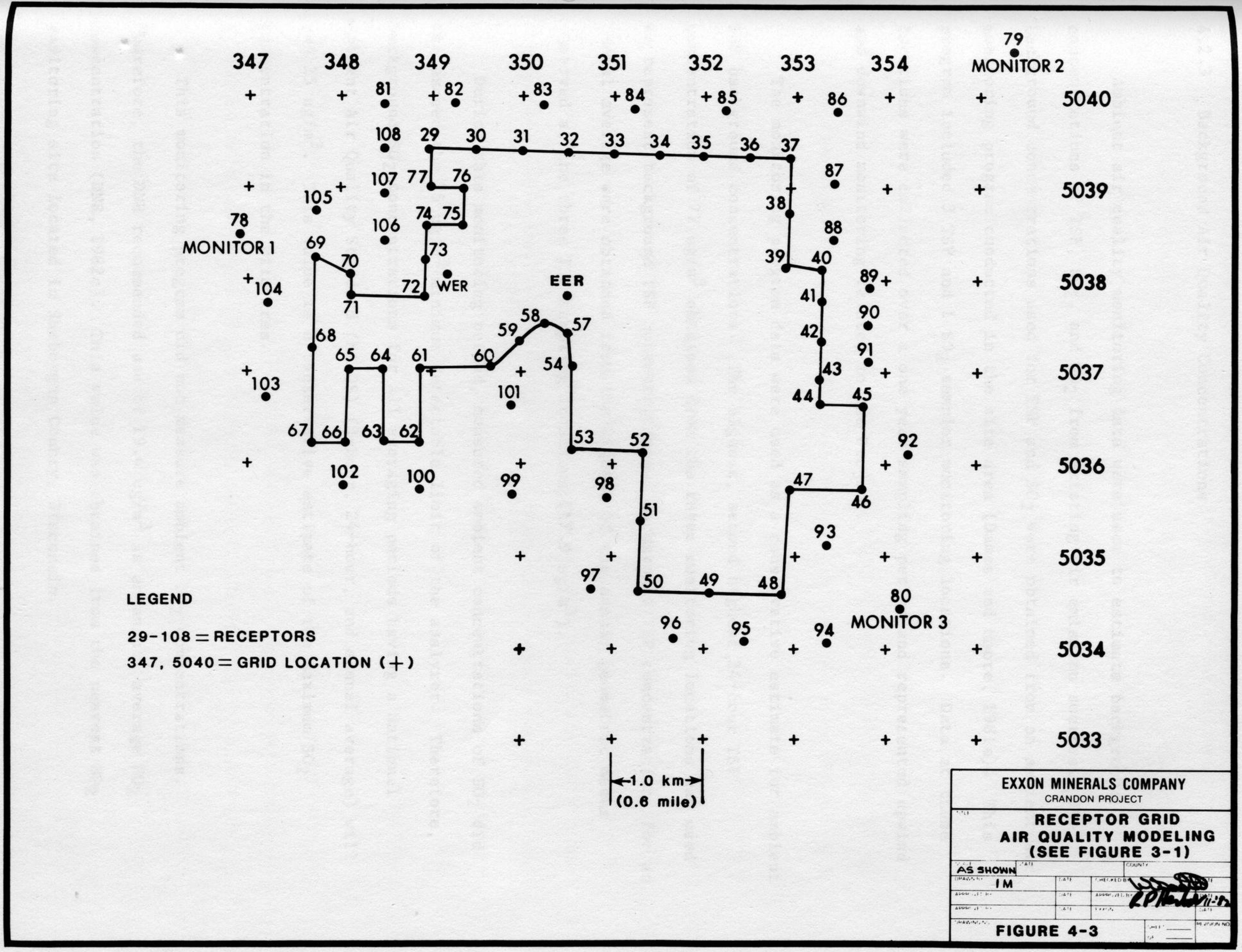
4.2.2 Dispersion Model Description

The use of the ISC model for determining ambient air concentrations as a result of the Project emissions was conservative because of the inability of the model to predict effects from sources that emit from a location below surrounding grade elevations (i.e. such as the actual conditions present during construction of the MWDF 15 m [50 feet] embankments). The embankments will also reduce the air emission concentrations leaving the MWDF by shielding the dispersing winds as well as providing a retention barrier for gravitational settling of the particles. A similar barrier is provided by a north-south trending ridge located immediately to the west and east of the MWDF. Also, the attenuation effects provided by the vegetation surrounding the MWDF will reduce the transport of particles during the construction and operational activities at the facility. All of these mitigating factors are beneficial aspects reducing air emission concentrations which are not accounted for by the ISC model.

Air emission rates modeled for the MWDF did not include the effects from gravity settling of particulate matter (TSP). Size distributions for gravitational settling rates were also omitted from the model calculations. The fugitive dust source emissions generated during construction and operation activities will definitely be reduced resulting in minimal effect, if any, beyond the MWDF embankments.

In an effort to more closely approximate the more realistic effects of these factors on predicted ambient air concentrations and to reduce the conservatisms provided in the ISC model calculations, estimated uncontrolled air emissions from the MWDF were reduced by 50 percent as per the EPA guidance for watering efficiency (EPA, 1981). In addition, those days containing obvious errors in the meteorology data were excluded from the model calculations. These changes were necessary to more accurately represent conditions to be predicted for the air emissions from the MWDF.

A dense receptor grid containing 80 locations was selected and used to identify the maximum predicted air quality impact from the Project. Receptors were located along the air emissions modeling (modeling) boundary, approximately 500 m (1,650 feet) beyond the modeling boundary, and at the locations of the ambient air quality monitors. Receptors farther than 500 m (1,650 feet) from the modeling boundary were not necessary, since the Project air emission sources have short stacks with release heights below building roof levels and the area sources for fugitive dust emissions are from near ground surface. For these reasons, maximum air emission concentrations from the Project sources will occur in close proximity to their point of origin with minimal effects beyond the modeling boundary. The actual receptor grid is presented on Figure 4.3



RECEPTOR GRID
AIR QUALITY MODELING
(SEE FIGURE 3-1)

FIGURE 4-3

4.2.3 Background Air Quality Concentrations

Ambient air quality monitoring data were used to estimate background concentrations of TSP, SO_2, and NO_2 from existing air emission sources. The background concentrations used for TSP and SO_2 were obtained from an ambient air monitoring program conducted in the site area (Dames and Moore, 1981a). This program included 3 TSP and 1 SO_2 sampler monitoring locations. Data at these locations were collected over a one year sampling period and represented upwind and downwind monitoring related to the Project.

The monitoring program data were used as a conservative estimate for ambient TSP background concentrations. The highest, second highest 24-hour TSP concentration of 77 ug/m^3 obtained from the three monitoring locations was used to represent background TSP concentrations. Background TSP concentrations for an annual average were obtained from the highest of the annual geometric means observed at the three TSP sampling locations (17.9 ug/m^3).

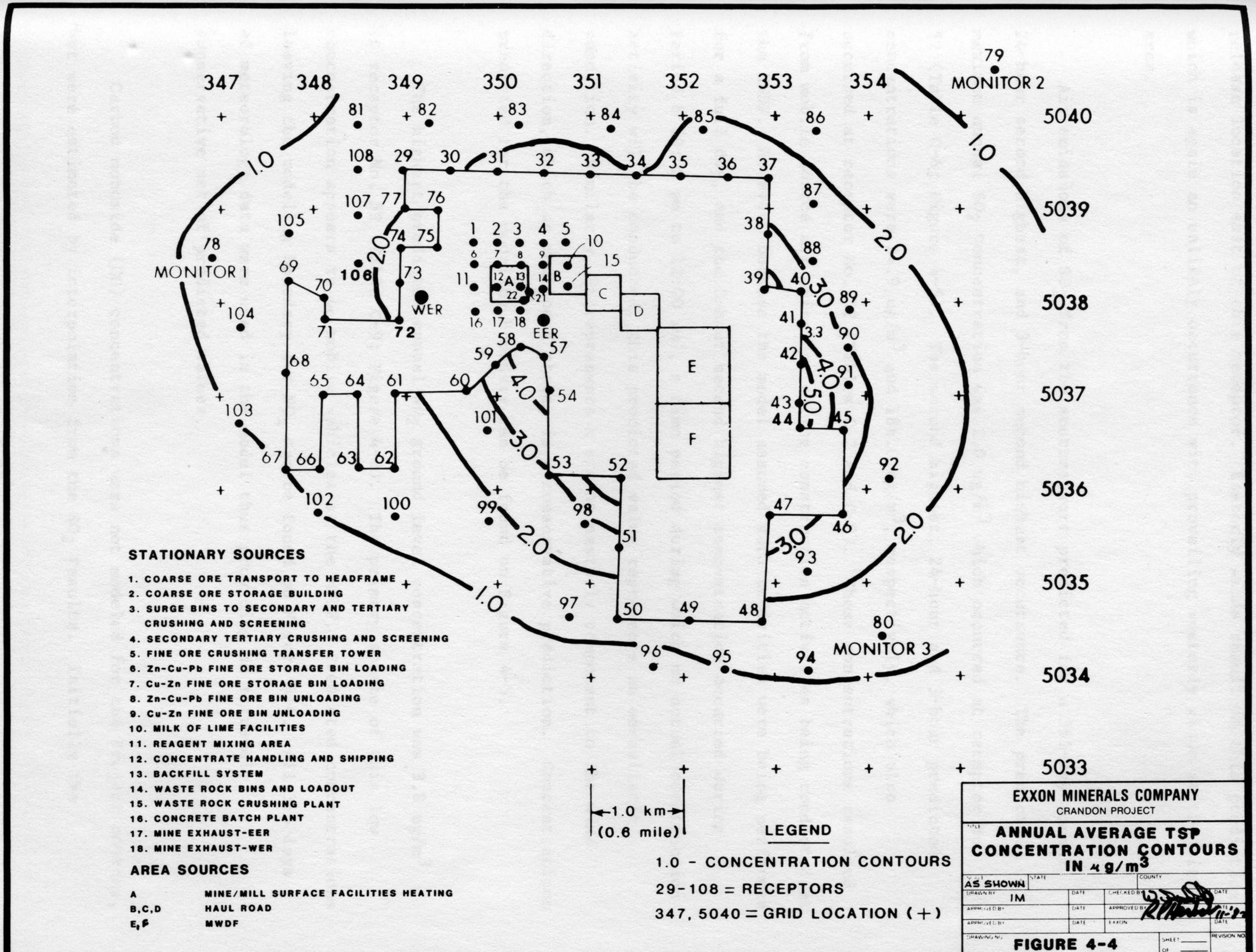
During this monitoring period, measured ambient concentrations of SO_2 did not exceed the 25 ug/m^3 minimum detectable limit of the analyzer. Therefore, background SO_2 concentrations for all averaging periods having a National Ambient Air Quality Standard (NAAQS) (3-hour, 24-hour, and annual average) will use 25 ug/m^3. This value is a conservative estimate of the maximum SO_2 concentration in the site area.

This monitoring program did not measure ambient NO_2 concentrations. Therefore, the DNR recommended use of 19.4 ug/m^3 as an annual average NO_2 concentration (DNR, 1982c). This value was obtained from the nearest NO_2 monitoring site located in Sheboygan County, Wisconsin.

4.2.4 Project Related Air Quality Concentrations

The three primary air emissions modeled were TSP, SO_2, and NO_x. Results obtained from the modeling conservatively predicted the ambient concentrations produced by sources (stationary and mobile) of the Project on adjacent adjoining areas from the modeling boundary (see Appendix C).

Air emissions of TSP leaving the modeling boundary were estimated for an annual and 24-hour second highest occurrence. Winter days (November 1 through February 28) were excluded for the MWDF to reflect days in which winter weather precludes construction activities at this facility. The maximum annual TSP concentration from all sources for the remaining 224 days of activity was 5.6 ug/m^3 experienced at receptor No. 44 (Table C-3; Figure 4-4). The second highest 24-hour concentration for these days was 35.7 ug/m^3 at receptor No. 52 (Table C-4). This receptor (52) is downwind of easterly winds (i.e., west of MWDF). This predicted TSP concentration occurred on Day 230 and was a result of construction activities at the MWDF. This value is conservative as it represents an easterly wind direction and velocity never recorded during the site area monitoring program. The Quinnesec meteorological data has a strong easterly component not likely to be found at the MWDF. In addition, the modeling of the fugitive dust concentrations from air emission sources did not include the effects of gravitational settling. Thus, the predicted 35.7 ug/m^3 TSP concentration is very conservative. The highest 24-hour average from stationary sources (excluding the MWDF) was 15 ug/m^3 (Table C-5) at receptor No. 75, which has no additive effect on any other receptors. Approximately one-half of this concentration was attributed to the secondary and tertiary crushing and screening which has its

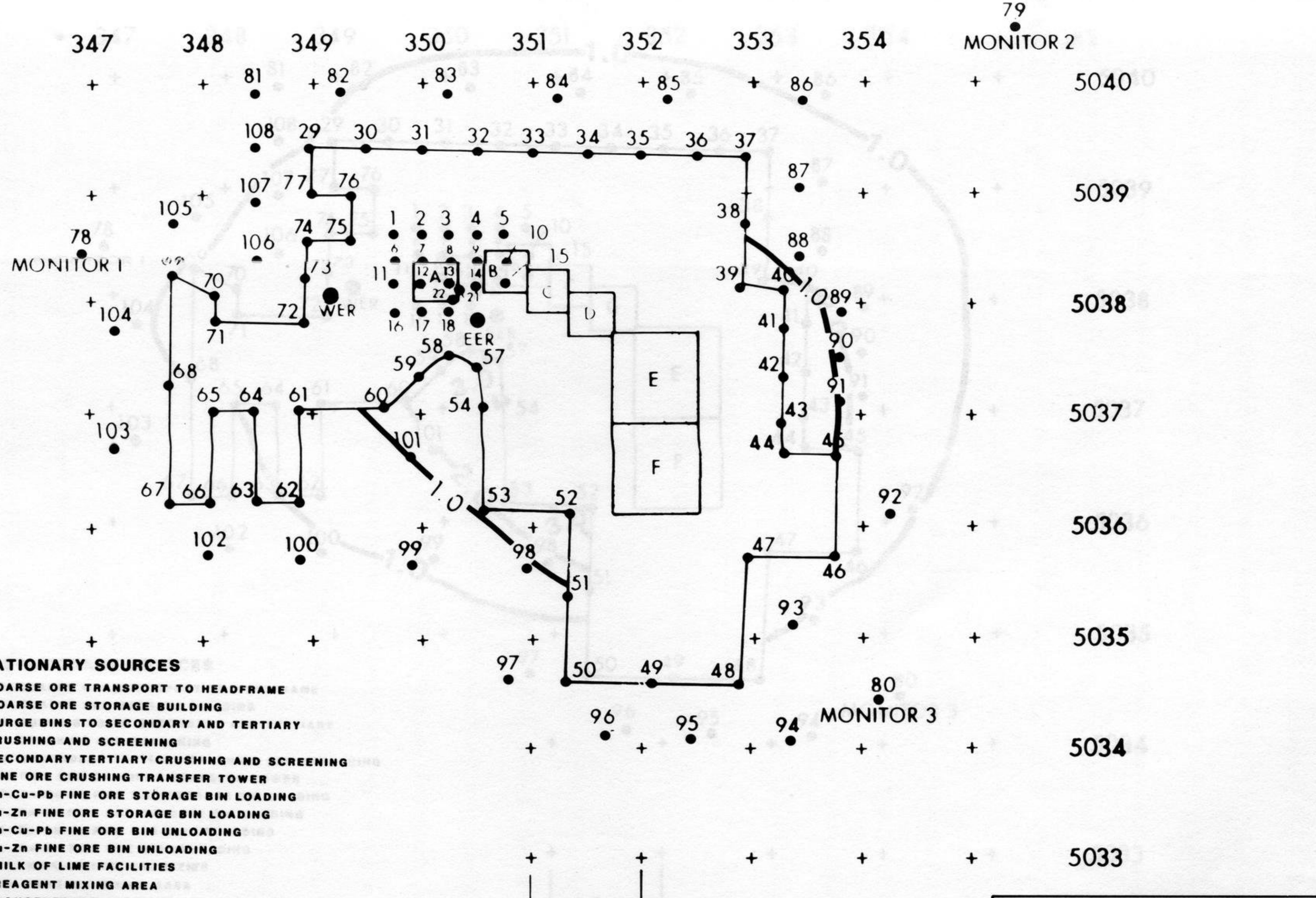

347 348 349 350 351 352 353 354
5040 5039 5038 5037 5036 5035 5034 5033
MONITOR 1
MONITOR 2
MONITOR 3
WER
EER
STATIONARY SOURCES
1. COARSE ORE TRANSPORT TO HEADFRAME
2. COARSE ORE STORAGE BUILDING
3. SURGE BINS TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
4. SECONDARY TERTIARY CRUSHING AND SCREENING
5. FINE ORE CRUSHING TRANSFER TOWER
6. Zn-Cu-Pb FINE ORE STORAGE BIN LOADING
7. Cu-Zn FINE ORE STORAGE BIN LOADING
8. Zn-Cu-Pb FINE ORE BIN UNLOADING
9. Cu-Zn FINE ORE BIN UNLOADING
10. MILK OF LIME FACILITIES
11. REAGENT MIXING AREA
12. CONCENTRATE HANDLING AND SHIPPING
13. BACKFILL SYSTEM
14. WASTE ROCK BINS AND LOADOUT
15. WASTE ROCK CRUSHING PLANT
16. CONCRETE BATCH PLANT
17. MINE EXHAUST-EER
18. MINE EXHAUST-WER
AREA SOURCES
A MINE/MILL SURFACE FACILITIES HEATING
B,C,D HAUL ROAD
E,F MWDF
1.0 km
(0.6 mile)
LEGEND
1.0 - CONCENTRATION CONTOURS
29-108 = RECEPTORS
347, 5040 = GRID LOCATION (+)
EXXON MINERALS COMPANY
CRANDON PROJECT
ANNUAL AVERAGE TSP CONCENTRATION CONTOURS IN µg/m3
AS SHOWN
IM
FIGURE 4-4

release location east of this receptor. Easterly winds result in this prediction which is again an unlikely occurrence with prevailing westerly winds at the site area.

Air emissions of SO_2 from the sources were predicted for a 365-day annual, 24-hour second highest, and 3-hour second highest occurrence. The predicted maximum annual SO_2 concentration was 2.0 ug/m^3 which occurred at receptor No. 52 (Table C-6; Figure 4-5). The second highest, 24-hour and 3-hour predicted concentrations were 24.9 ug/m^3 and 186.0 ug/m^3, respectively, which also occurred at receptor No. 52 (Tables C-7 and C-8). These concentrations resulted from mobile source air emissions during construction activities being conducted at the MWDF. However, because the model assumed such activities were being performed for a full day, and the 3-hour second highest concentration occurred during Period 8 (9:00 pm to 12:00 am), a time period during which no actual construction activity will be conducted, this predicted value represents an unrealistic condition. Similarly, it represents a strong easterly component to the wind direction, which as mentioned above, is a conservative prediction. Concentrations predicted for the modeling boundary can be found on Figure 4-5.

The highest predicted annual NO_2 ground level concentration was 3.8 ug/m^3 at receptor No. 52 (Table C-9; Figure 4-6). The primary source of this low concentration appears to be mobile vehicles at the MWDF. Predicted concentrations leaving the modeling boundary for NO_x can be found on Figure 4-6. All 365 days of meteorology data were used in the model thus providing an extremely conservative set of predicted values.

Carbon monoxide (CO) concentrations were not modeled for the Project sources, but were estimated by interpolation from the SO_2 results. Initially the



STATIONARY SOURCES

1. COARSE ORE TRANSPORT TO HEADFRAME
2. COARSE ORE STORAGE BUILDING
3. SURGE BINS TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
4. SECONDARY TERTIARY CRUSHING AND SCREENING
5. FINE ORE CRUSHING TRANSFER TOWER
6. Zn-Cu-Pb FINE ORE STORAGE BIN LOADING
7. Cu-Zn FINE ORE STORAGE BIN LOADING
8. Zn-Cu-Pb FINE ORE BIN UNLOADING
9. Cu-Zn FINE ORE BIN UNLOADING
10. MILK OF LIME FACILITIES
11. REAGENT MIXING AREA
12. CONCENTRATE HANDLING AND SHIPPING
13. BACKFILL SYSTEM
14. WASTE ROCK BINS AND LOADOUT
15. WASTE ROCK CRUSHING PLANT
16. CONCRETE BATCH PLANT
17. MINE EXHAUST-EER
18. MINE EXHAUST-WER

AREA SOURCES

A	MINE/MILL SURFACE FACILITIES HEATING
B,C,D	HAUL ROAD
E,F	MWDF

LEGEND

-1.0 - CONCENTRATION CONTOURS

29-108 = RECEPTORS

347, 5040 = GRID LOCATION (+)

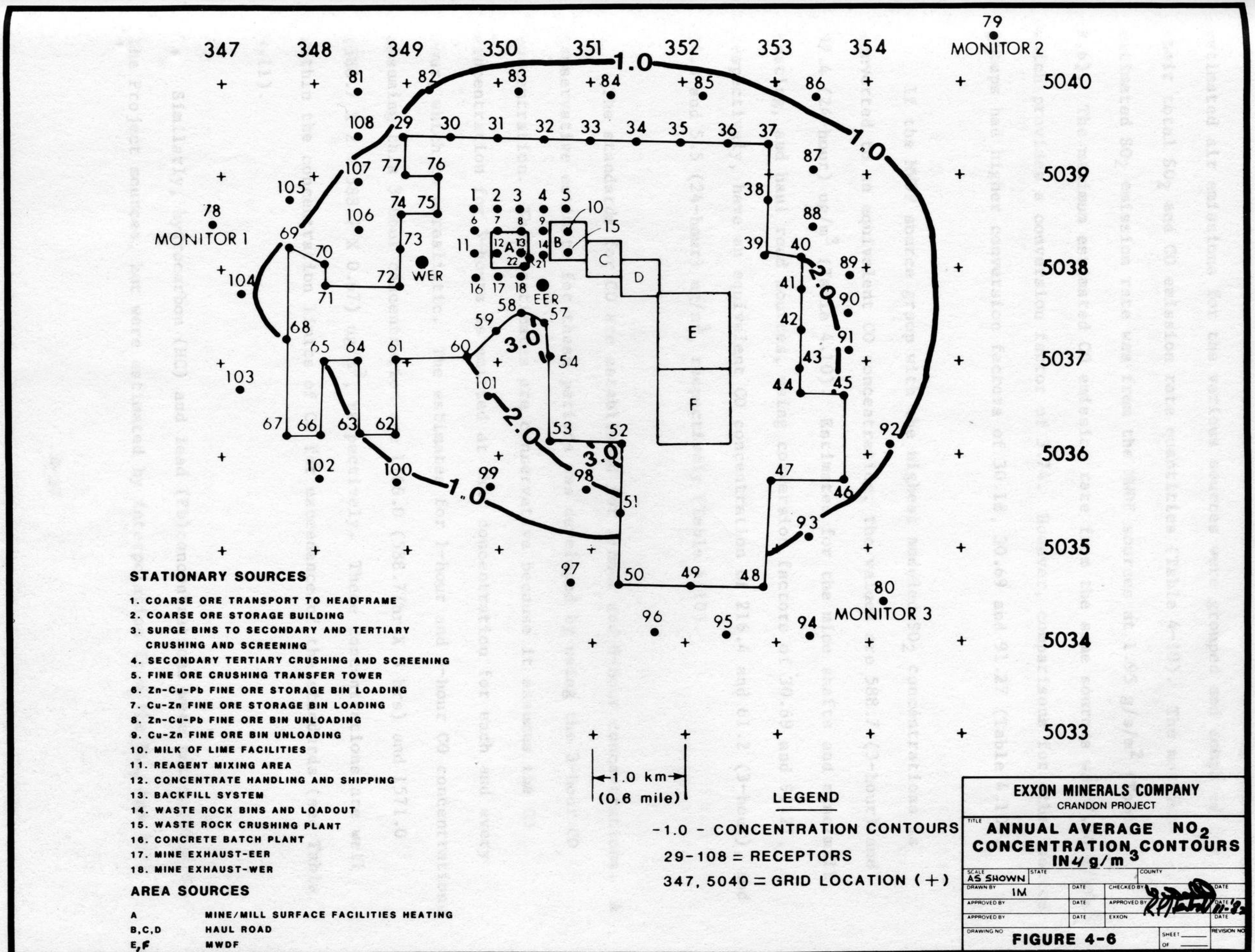
EXXON MINERALS COMPANY
CRANDON PROJECT

TITLE: ANNUAL AVERAGE SO_2 CONCENTRATION CONTOURS IN $\mu g/m^3$

SCALE: AS SHOWN | STATE | COUNTY
DRAWN BY: IM | DATE | CHECKED BY
APPROVED BY | DATE | APPROVED BY
APPROVED BY | DATE | EXXON | DATE
DRAWING NO

FIGURE 4-5

SHEET ___ OF ___ | REVISION NO


347 348 349 350 351 352 353 354
5040 5039 5038 5037 5036 5035 5034 5033
MONITOR 1
MONITOR 2
MONITOR 3
WER
EER
1.0
2.0
3.0
STATIONARY SOURCES
1. COARSE ORE TRANSPORT TO HEADFRAME
2. COARSE ORE STORAGE BUILDING
3. SURGE BINS TO SECONDARY AND TERTIARY CRUSHING AND SCREENING
4. SECONDARY TERTIARY CRUSHING AND SCREENING
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6. Zn-Cu-Pb FINE ORE STORAGE BIN LOADING
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17. MINE EXHAUST-EER
18. MINE EXHAUST-WER
AREA SOURCES
A MINE/MILL SURFACE FACILITIES HEATING
B,C,D HAUL ROAD
E,F MWDF
1.0 km
(0.6 mile)
LEGEND
-1.0 - CONCENTRATION CONTOURS
29-108 = RECEPTORS
347, 5040 = GRID LOCATION (+)
EXXON MINERALS COMPANY
CRANDON PROJECT
ANNUAL AVERAGE NO2 CONCENTRATION CONTOURS IN µg/m3
SCALE AS SHOWN
DRAWN BY IM
FIGURE 4-6

estimated air emissions for the various sources were grouped and compared for their total SO_2 and CO emission rate quantities (Table 4-10). The maximum estimated SO_2 emission rate was from the MWDF sources at 1.95 g/s/m^2 (Table 4.6). The maximum estimated CO emission rate from the same sources was 7.30 g/s/m^2 which provides a conversion factor of 3.74. However, comparisons for other source groups had higher conversion factors of 30.18, 30.69 and 91.27 (Table 4.10).

If the MWDF source group with the highest modeled SO_2 concentrations is converted to an equivalent CO concentration, the values are 588.7 (3-hour) and 92.4 (24-hour) ug/m^3 (Table 4.10). Estimates for the mine shafts and mine/mill heating, and haul road sources, using conversion factors of 30.69 and 91.27, respectively, have an equivalent CO concentration of 216.4 and 61.2 (3-hour), and 54.3 and 5.5 (24-hour) ug/m^3, respectively (Table 4.10).

The standards for CO are established for 1-hour and 8-hour concentrations. A conservative estimate for these periods was developed by using the 3-hour CO concentration. These estimates are conservative because it assumes the CO concentration for 3-hours is emitted at that concentration for each and every hour, which is unrealistic. The estimates for 1-hour and 8-hour CO concentrations assuming this 3-hour concentration are 1766.0 (588.7/hr X 3 hrs) and 1571.0 (588.7 X 2 + 588.7 X 0.67) ug/m^3, respectively. These concentrations are well within the concentration limits of CO for exceedance of the standards (see Table 4.11).

Similarly, hydrocarbon (HC) and lead (Pb)concentrations were not modeled for the Project sources, but were estimated by interpolation from the NO_x and TSP

TABLE 4.10

INTERPOLATED CO CONCENTRATIONS FROM THE MODELED SO_2 CONCENTRATIONS OF THE PROJECT

Source Group		Air Emissions Rate (g/s) SO_2	CO	Conversion Factor
Mine Shafts		1.33	40.08	30.18
Mine/Mill Heating		0.008	0.23	30.69
MWDF		1.95[b]	7.30[b]	3.74
Haul Road		0.003	0.23	91.27
		Concentrations (ug/m^3)		
		SO_2[a]	CO	
Mine Shafts and Mine/Mill Heating	(3-hour)	7.05	216.4	
	(24-hour)	1.77	54.3	
MWDF	(3-hour)	157.4	588.7	
	(24-hour)	24.7	92.4	
Haul Road	(3-hour)	0.67	61.2	
	(24-hour)	0.06	5.5	

a. high-second highest value calculated.

b. g/s/m^2

results, respectively. These estimates are conservately biased because of the assumptions that the relationships are linear, (i.e., there is actually less HC and Pb emitted than directly proportional to the respective NO_x and TSP concentrations), there is no reactive mechanisms for these air contaminants, and the use of the highest emission rates and modeled concentrations for NO_x and TSP were used.

Hydrocarbon (HC) emissions from the Project will be released from heating the mine and mine/mill surface facilities, operation of diesel and gasoline vehicles, and from handling and storage of liquid fuels for these vehicles. The estimated ambient concentrations can be conservatively compared with modeled SO_2 (3-hour) and annual SO_2 and NO_x quantities, and their relation with emission rates from NO_x sources. This estimating procedure was used because HC emission rates are more accurately related to those of NO_x than to SO_2, but the model calculations do not derive a 3-hour NO_x concentration. NO_x and SO_2 modeled concentrations can be compared from their emission rates. In addition to the previously mentioned reasons, this estimate is also conservative because it assumes that all NO_x emission sources have an HC component (i.e., which is unrealistic).

The maximum annual NO_x stationary and mobile source emissions from operation of the mine, mine/mill surface facilities; and construction of the MWDF are 46.5 (Table 2.2), 81.4 (Table 2.4), and 132.2 (Table 2.6) short tons per year, respectively. Annual HC emissions from these sources are 1.6, 17.5, and 20.0 short tons per year, respectively. Therefore, estimated total annual air emissions are 260.0 and 39.1 short tons per year for NO_x and HC, respectively.

Estimated annual HC emissions are approximately 15 percent of NO_x concentrations.

The standard for HC (160 ug/m^3) is established for a 3-hour maximum concentration. The modeled calculations for NO_x do not include a 3-hour prediction so that comparison between SO_2 and NO_x concentrations were also required prior to interpolation for estimated HC concentrations. The modeled maximum annual average SO_2 and NO_x concentrations were 2.0 and 3.8 ug/m^3, respectively, at receptor No. 52. Therefore, the estimated annual average NO_x concentrations are 190 percent higher than SO_2. The modeled highest maximum average 3-hour SO_2 concentration is 186.0 ug/m^3. The estimated highest maximum average 3-hour NO_x concentration would be 353.4 ug/m^3. Estimated HC emissions are approximately 15 percent of NO_x concentrations indicating a calculated maximum average 3-hour HC concentration of 53.01 ug/m^3.

Lead emissions from the Project will be released as small particles and as a result the estimated ambient concentrations can be conservatively compared with modeled TSP quantities. This estimate is conservative because of the above reasons as well as the assumption that all TSP emission sources have a lead component (which is unrealistic), and that these ambient concentrations are at a maximum for the complete time period.

The maximum annual TSP stationary source emissions during operation are from the mine and mine/mill surface facilities. The values are 15.5 and 101.5 short tons per year for the mine (Table 2.2) and mine/mill surface facilities (Table 2.4), respectively. Lead emissions from these sources are 0.2 and 0.9 short tons per year, respectively. Therefore, total estimated air emissions are 1.1 and

117.0 short tons per year for Pb and TSP, respectively. Estimated Pb emissions are 0.94 percent of TSP concentrations. The modeled stationary source maximum 24-hour average TSP concentration was 15.0 ug/m^3 at receptor No. 75. The estimated maximum 24-hour average lead concentration would be 0.14 ug/m^3 (15.0 x 0.0094) at this receptor.

The primary and secondary standard for lead is 1.5 ug/m^3 for a 3-month (90 day) average concentration. Therefore, the estimated maximum 3-month average lead concentration at receptor No. 75 would be 0.14 ug/m^3. This conservatively estimated concentration is less than 10 percent of the standard (see Table 4.11).

4.2.5 Comparison with Applicable Ambient Air Quality Standards

The predicted ambient air concentrations presented in section 4.2.4 must now include the previously discussed background concentrations to show the estimated impact on ambient air quality standards. Comparison was made with the National Ambient Air Quality Primary and Secondary Standards and are presented in Table 4.11. As indicated, for the estimated Project air emissions, all ambient state and federal air quality standards will be attained during construction and operation.

4.2.6 Net Air Quality Effects

The net air quality effects predicted for construction and operation of the Project will be minimal. Areas of interest related to the predicted ambient air quality discussed in this report include: vegetation and soils, animals, environmental health and safety, and visibility.

TABLE 4.11

COMPARISON OF STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS WITH ISC MODEL PREDICTED CONCENTRATIONS FOR THE PROJECT AT THE MODELING BOUNDARY

(All concentrations in ug/m^3)[a]

	PREDICTED CONCENTRATION FROM CRANDON PROJECT	BACKGROUND CONCENTRATION	SUMMED CONCENTRATION	PRIMARY NAAQS	SECONDARY NAAQS
SULFUR DIOXIDE (SO_2)					
Annual	0.1[b] (2.0)[c]	25.0	25.1 (27.0)[c]	80	--
24-Hour	1.8 (24.9)	25.0	26.8 (49.9)	365	--
3-Hour	7.0 (186.0)	25.0	32.0 (211.0)	--	1,300
PARTICULATE MATTER (TSP)					
Annual	5.6	17.9	23.5	75	60
24-Hour	35.7	77.0	112.7	260	150
NITROGEN DIOXIDE (NO_2)					
Annual	3.8	19.4	23.2	100	100
CARBON MONOXIDE (CO)					
8-Hour	1571	N/A[d]	1571	10,000	10,000
1-Hour	1766	N/A	1766	40,000	40,000
HYDROCARBONS (HC)					
3-Hour	53.0	N/A	53.0	160	160
LEAD (Pb)					
3-Month Average	0.14	N/A	0.14	1.5	1.5

a. All short-term limits (24-hour and less) can be exceeded once a year.

b. Stationary sources only (see Tables C-10, C-11 and C-12).

c. Includes temporary mobile source emissions.

d. Not applicable.

4.2.6.1 Vegetation and Soils

The predicted ambient air quality around the Project will meet all state and federal standards. As a result, no deleterious effects are projected to occur to either the vegetation or soils of the site area. Some dusting will occur to vegetation species nearest the Project major construction and operational activities. However, since the vegetation acts as a filter, no harmful effects are expected and precipitation events will wash the vegetation regularly. Air emissions other than dust are of such minor concentrations that no effects on the vegetation or soils is predicted.

4.2.6.2 Animals

Animal populations such as large mammals (i.e. deer, bear), with the exception of birds, will be largely restricted from the property by fencing. Therefore, animal species will not be exposed to ambient air emission concentrations considered to be harmful. No deleterious effects are projected to occur to animal populations of the site area.

4.2.6.3 Environmental Health and Safety

As shown in sections 4.2.5, federal and state standards will not be exceeded by air emissions from the Project. To assure maximum protection to the health and safety of employees, all applicable regulations of state and federal regulatory agencies will be attained by the Project.

4.2.6.4 Visibility

Some activities performed as part of the Project construction and operation will be visible from off-site locations. The emissions visible from the Project are expected to be in the air vented from the mine exhaust shafts (EER and WER), especially immediately following explosive detonations. These occurrences (blasting) will be of short duration (15 minutes) and on an infrequent basis.

The mine air exhausted during periods of extremely cold weather will also be visible beyond the property boundary. The primary visible component will be water vapor resulting from the saturated air leaving the mine. In all cases, the vented air should not have an objectionable color and odor and its visibility will be restricted to the immediate areas surrounding the property boundary.

5.0 SUMMARY AND CONCLUSIONS

Exxon Minerals Company is proposing development of the Crandon Project approximately 8 km (5 miles) south of Crandon, Forest County, Wisconsin. Components of the Project include: mine operations, mill activities, ancillary units (i.e. offices, warehouses) and the mine waste disposal facility. While the mine would operate five days a week, mill operations would maintain a 24-hour, 7-day schedule.

There are no major air emission sources located within 25 miles of the Project facilities. Project air emissions will include TSP, SO_2, NO_x, CO, HC, and Pb. Calculation of air emission rates for these parameters from Project stationary sources were 102.6, 18.8, 104.2, 95.8, 3.9, and 1.0 tons per year, respectively. Since the estimated air emission rates are below the 250 ton per year limit, the Project is exempt from the requirement to obtain a PSD permit. The Crandon Project will be a new minor stationary source.

Total suspended particulate (TSP) and SO_2 concentrations were monitored for the Project during 1978. The highest 24-hour TSP concentrations ranged from 65 to 99 ug/m^3 and the second highest 24-hour concentrations ranged from 61 to 77 ug/m^3. The geometric mean TSP concentrations ranged from 15.9 to 17.9 ug/m^3. None of the SO_2 samples collected during the monitoring program indicated that ambient 24-hour SO_2 concentrations exceeded the lower limit of detection (25 ug/m^3). Background concentrations of TSP and SO_2 indicate air quality for the Project site area is within state and federal standards.

The ambient air quality impact of the Project operations was assessed by performing a dispersion modeling analysis for TSP, SO_2 and NO_x concentrations. The objective of the modeling analysis was to demonstrate compliance with the federal and state ambient air quality standards. The EPA Industrial Source Complex (ISC) model was used to predict the potential air quality effects. The model calculation procedure is based on the steady state Gaussian Plume concept and is recommended by the EPA for assessing fugitive particulate emissions.

The model calculations for annual mean and short-term (3-hour and 24-hour) ground level air pollutant concentrations were performed with the ISC model using one year of meteorological data. This data consisted of surface observations from Quinnesec, Michigan (1979) and upper air data from Green Bay, Wisconsin. Actual input of Crandon Project air emission rates used the ton/yr estimate for TSP and lb/hr estimates for SO_2 and NO_x.

The Quinnesec meteorology data required modification prior to its use for modeling. Application of this data for predicting ambient air quality concentrations is conservative because the data contains many unusual meteorological conditions which cannot or are very unlikely to occur. They included extended periods of constant wind speed, temperature, and/or wind direction; wind speed values less than 1.0 m/s; and abrupt, unstable and/or continuous atmospheric conditions for adjacent hours which are unlikely. The annual wind rose for Quinnesec indicated a predominant wind direction from the east, whereas the Project site area monitoring data shows a southwesterly direction. Utilization of the Quinnesec meteorological data leads to a conservative estimate of predicted ambient air quality concentrations.

A dense receptor grid containing 80 locations was selected and used to identify the maximum predicted air quality impact from the Project. These receptors were located along the modeling property boundary, approximately 500 m (1,650 feet) beyond this boundary, and at the locations of the air quality monitors used for the Project in 1978. Receptors farther than 500 m (1,650 feet) were not necessary since the proposed air emissions are from sources having short stacks with release heights below building roof levels and area sources of fugitive dust emissions are from near ground surface. For these reasons, maximum air emission concentrations from the Project sources will occur in close proximity to their point of origin with minimal concentrations beyond the modeling boundary.

Air emissions of TSP leaving the modeling property boundary were estimated for an annual and 24-hour second highest occurrence. The maximum annual TSP concentration from all sources was 5.6 ug/m^3. The second highest 24-hour concentration for these days was 35.7 ug/m^3 at receptor No. 52. The TSP concentration at recepter No. 52 was downwind of easterly winds to the MWDF. This value is conservative as it represents an easterly wind direction and at a velocity never recorded during the monitoring program.

Air emissions of SO_2 from the Project sources were predicted for the annual, 24-hour and 3-hour second highest occurrence. The predicted maximum SO_2 concentrations were 2.0, 24.9, and 186.0 ug/m^3 for annual, 24-hour and 3-hours, respectively.

The highest predicted annual NO_x ground level concentration was 3.8 ug/m^3. The primary sources of this low concentration were mobile vehicles.

Carbon monoxide (CO) concentrations were interpolated from the SO_2 modeling results with appropriate conversion factors. The highest estimated CO concentrations were 588.7 and 92.4 ug/m^3 for 3-hour and 24-hour calculations, respectively. These values converted to 1766 and 1571 ug/m^3 on a 1-hour and 8-hour basis, respectively.

Similarly, hydrocarbon (HC) and lead (Pb) concentrations were not modeled for the Project sources, but were estimated by interpolation from the NO_x and TSP results, respectively. Estimated annual HC emissions are approximately 15 percent of NO_x concentrations. The calculated maximum average 3-hour HC concentration is 53.01 ug/m^3.

Lead emissions from the Project will be released as small particles and as a result the estimated ambient concentrations can be conservatively compared with modeled TSP quantities. Estimated Pb emissions are 0.94 percent of TSP concentrations. The estimated maximum 3-month average lead concentration is 0.14 ug/m^3.

The predicted ambient air quality around the Project will meet all state and federal standards. The net air quality effects predicted for construction and operation of the Project are minimal. As a result, no deleterious effects are projected to occur to either the soil, vegetation, or animals (including humans). Because state and federal standards will be attained, the Project will maintain the air quality for the area.

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