**BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS**

IN THE MATTER OF:	)	
	)	
	)	
REVISIONS TO WATER QUALITY	)	
STANDARDS FOR TOTAL DISSOLVED	)	R06-24
SOLIDS IN THE LOWER DES PLAINES RIVER	)	(Site Specific Rule - Water)
EXXONMOBIL OIL CORPORATION	)	
PROPOSED 35 ILL. ADM. CODE 303.445	)	

NOTICE OF FILING

To:

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Please take notice that on July 11, 2006, we filed with the Office of the Clerk of the Illinois Pollution Control Board via electronic mail the **POST-HEARING COMMENTS OF EXXONMOBIL OIL CORPORATION**, a copy of which is served upon you.

EXXONMOBIL OIL CORPORATION

By: _[signature]_
One of Its Attorneys

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POST-HEARING COMMENTS OF EXXONMOBIL OIL CORPORATION

On June 14, 2006, the Illinois Pollution Control Board (the "Board") held a hearing[1] regarding ExxonMobil Oil Corporation's ("ExxonMobil's") Petition for a Site Specific Rule Change, which would allow the discharge of Total Dissolved Solids ("TDS") from ExxonMobil's Joliet Refinery during the months of November through April in excess of levels allowed under the existing rules, 35 Ill. Admin. Code §§ 302.208(g) and 302.407. This Comment is submitted on behalf of ExxonMobil in further support of the proposed site specific rule and to address matters raised by the Board during the June 14, 2006 hearing.

I. INTRODUCTION

ExxonMobil owns and operates the Joliet Refinery, located in Channahon Township on a 1,300 acre tract of land in unincorporated Will County. The site is adjacent to Interstate 55 at the Arsenal Road exit, approximately 50 miles southwest of Chicago. On October 11, 2005, ExxonMobil, together with the United States Environmental Protection Agency ("U.S. EPA") and the States of Illinois, Louisiana, and Montana, executed a consent decree (the "Consent Decree") requiring ExxonMobil, among other things, to make modifications to the Joliet Refinery that reduce air emissions coming from the Refinery. Specifically, the Consent Decree

[1] Citations to the transcript from the June 14, 2006 hearing are noted as "Tr. at XX:XX").

Refinery that reduce air emissions coming from the Refinery. Specifically, the Consent Decree calls for the use of a wet gas scrubber and other equipment that will contribute additional sulfate and TDS to the Refinery's wastewater treatment system.

On February 7, 2006, after consulting with the Illinois Environmental Protection Agency (the "Agency") as to the proper course of action, ExxonMobil filed with the Board a Petition for a Site Specific Rule Change ("Petition"), pursuant to Sections 27 and 28 of the Illinois Environmental Protection Act (the "Act"), 415 ILCS 5/35, and Part 102 of the Illinois Administrative Code, 35 Ill. Admin. Code § 102.100 *et seq.*, seeking authorization to discharge Total Dissolved Solids ("TDS") from the Joliet Refinery during the months of November through April in excess of levels allowed under the existing rules, 35 Ill. Admin. Code §§ 302.208(g) and 302.407.

While not a "petitioner," the Agency supports the relief sought. ExxonMobil has satisfied the requirements of 35 Ill. Admin. Code § 102.210; the Agency concurs. As set forth more fully in the Petition and in the Testimony of Stacey K. Ford[2] and James E. Huff,[3] the requirements of the existing water quality standards are neither technically feasible nor economically reasonable as applied to the Refinery in light of the requirements under the Consent Decree. Additionally, the evidence developed by the Agency (Exhibits A-F), including the testimony of Bob Moshur and Scott Twait supports the requested rule as consistent with federal law and that it will not cause an adverse environmental impact.[4]

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[2] Citations to the Pre-filed Testimony of Stacey K. Ford are noted as "Ford Test. at p. XX"). The testimony was entered as Petitioner's Exhibit 11.

[3] Citations to the Pre-filed Testimony of James E. Huff are noted as "Huff Test. at p. XX"). The testimony was entered as Petitioner's Exhibit 12.

[4] The Agency submitted pre-filed testimony for Mr. Twait, and that testimony was read into the record at the June 14, 2006 hearing. Citations to Mr. Twait's testimony are noted as "Twait Test. at p. XX; Tr. at XX:XX." The Agency did not submit pre-filed testimony for Mr. Moshur, and

II. THE UNCONTESTED EVIDENCE IN THE RECORD DEMONSTRATES THAT THE RULE CHANGE SOUGHT SHOULD BE GRANTED UNDER ILLINOIS LAW AND IS CONSISTENT WITH FEDERAL LAW

Consent Decree. ExxonMobil recently settled alleged violations of the New Source Review program. (Ford Test. at p. 3). The resulting Consent Decree, among ExxonMobil, U.S. EPA, and the States of Illinois, Louisiana, and Montana, requires ExxonMobil to install pollution control equipment at the Refinery to reduce emissions of sulfur dioxide by over 95%, or over 24,000 tons per year, and to reduce nitrogen oxides by approximately 50%, or over 1800 tons per year. (*Id.*).

To meet the requirements under the Consent Decree, ExxonMobil will install a wet gas scrubber ("WGS") in the Fluidized Catalytic Cracking ("FCC") unit. (*Id.* at p. 4). It will also install a DESOX process to remove additional sulfur compounds. The WGS technology will cause increased levels of sulfate and TDS in the Refinery's treated wastewater stream. (*Id.*). The Agency has challenged neither the existence of ExxonMobil's obligations under the Consent Decree nor the technology used to satisfy those obligations.

Alternatives Are Not Technically Feasible Nor Economically Reasonable. ExxonMobil investigated several alternatives to the WGS technology to avoid releasing wastewater containing amounts of sulfates and TDS necessitating this site specific rulemaking. None of these alternatives are technically feasible, as technologies for removing sodium sulfate from a dilute aqueous stream are limited. Further, some alternatives, such as electrodialysis, have never been applied on the scale required at the Refinery. (Ford Test. at p. 7).

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his testimony was given in response to specific Board questions at the June 14, 2006 hearing. Mr. Moshur's testimony is referenced as a citation to the hearing transcript. *See* FN 1, *supra*.

Similarly, the alternatives are not economically feasible. Installation of an evaporization/crystallization system would require a capital expenditure of \$36 million to \$56 million, with an additional \$1 million per year in operating costs. (Ford Test. at pp. 6-8). Short-term episodic storage of wastewater prior to discharge would require removal and replacement of existing tankage, pumps, secondary containment, and associated piping at a capital cost of approximately \$13.2 million. (Ford Test. at p. 9). Moreover, there is no room on the refinery site for such storage.

In addition, although the Department of Commerce and Economic Opportunity ("DCEO") has the right to conduct an economic impact study, the Board had not received a response to its request that the DCEO do so. (Tr. at 7:12 - 9:12). The Board concluded that the DCEO had determined that such a study was unnecessary and declined to perform it. (*Id.*).

The Agency has not contested the technical and economic infeasibility of alternatives to the site-specific relief.

Environmental Impact. The increased TDS discharges from the Refinery allowed under this site specific rule will not have an adverse impact on the aquatic community in the Des Plaines River. (Huff. Test. at p. 7). The Agency also acknowledges that the increase in TDS standards will not be "of great consequence," (Tr. at 57:16-22), finding that toxicity studies have demonstrated that the proposed level of 1,686 mg/l "is well within the TDS toxicity threshold." (Twait Test. at p. 3, Tr. at 34:1 - 35:10). The Agency has also found that toxicity testing has shown that even the most sensitive, invertebrate species can "easily tolerate" the levels of TDS in the receiving waters of the river taking into account the proposed 1,686 mg/l under this rulemaking. (Twait Test. at p. 2, Tr. at 33:10 - 35:10). The Agency states that a TDS level of 3,000 mg/l would still be protective of aquatic life. (Twait Test. at p. 3; Tr. at 34:22 - 35:3).

The Agency is indeed planning to petition the Board to change the General Use standards for sulfates and to eliminate altogether the water quality General Use standards for TDS. (Twait Test. at p. 3; Tr. at 34:1-13). The Agency's anticipated proposal is based on science that has developed since the promulgation of the existing standard in 1972. (Twait Test. at p. 3; Tr. at 34:1 - 35:10). Recent investigations are showing that fish are not sensitive to TDS levels. (Tr. at 57:16-22). Indeed, the only reason for this proceeding is the fact that the Agency is not be able to promulgate the new water quality standards on a timeline that would allow ExxonMobil to make the modifications required under the Consent Decree. (Tr. at 68:8-22).

The Agency is currently conducting a Use Attainability Analysis for the Lower Des Plaines River to evaluate the Secondary Contact and Indigenous Aquatic Life water quality standards. (Tr. at 68:22-69:6). The change in the secondary water quality standards would be justified by the same science as the change in General Use standards, namely that toxicity testing shows that aquatic life would not be harmed by TDS levels at or even above the levels requested here. (Tr. at 74:12-75:10).

The Illinois Department of Natural Resources ("IDNR") was contacted to determine the presence of any threatened or endangered species that may be impacted by this site specific rule. (Tr. at 32:16-23). IDNR terminated the consultation process on December 19, 2005 with a finding that no threatened and endangered species or natural areas are affected. (*Id.*).

Federal Approval Appears Likely. The proposed TDS standard is consistent with federal law. IEPA consulted with U.S.EPA before this proceeding began; indeed that feedback was a major reason that a rule change petition was submitted. U.S. EPA is expected to approve this rule if adopted by the Board as proposed. *See* Agency Exhibit F.

III. EXXONMOBIL'S RESPONSE TO BOARD INQUIRIES

During the June 14, 2006 hearing, the Board requested additional information and/or clarification of issues. ExxonMobil respectfully submits the following responses to specific Board inquiries during the hearing.

Latitude/Longitude. The Board inquired about the proposed language for the site specific rule regarding the Refinery's latitude and longitude coordinates. ExxonMobil responds that the proper coordinates for the principal outfall from the Refinery are 41°25'20" North and 88°11'20" West. These coordinates are consistent with those contained in the Refinery's draft NPDES permit.

Aerial Map. The Board requested that ExxonMobil provide a diagram, map, or photograph depicting the Des Plaines River and the locations of key points for purposes of this proceeding (*e.g.* the I-55 Bridge, the point of discharge from the Refinery, and the confluence of the Des Plaines and Illinois Rivers). An aerial photograph of the area surrounding the Refinery and depicting the key locations is submitted as Attachment 13 hereto.

Mixing Zone Study. The Board asked ExxonMobil witness James E. Huff to provide the mixing zone study entered into the record in a previous, unrelated proceeding. The mixing zone study, James E. Huff and Sean D. LaDieu, *Plume Study and Effluent Deviations Report*, April 21, 1997, is submitted as Attachment 14 hereto.

Incremental Impact. Another question concerned the incremental impact of just the ExxonMobil Refinery. Petitioner factored into its evidence the combined impact of this rule change with the variance issued by the Board to Citgo in PCB 05-85 (Variance - Water). The incremental contribution of ExxonMobil will be 11 mg/L sulfate and 16 mg/L TDS during the 7Q10 flow, at the I55 Bridge.

Temporary Storage. Temporary storage of wastewater containing elevated levels of TDS is not a viable alternative. (Ford Test. at p. 9; Tr. at 71:21-73:12). There is insufficient space within the refinery or the surrounding property owned by ExxonMobil to construct new storage tanks large enough to hold the wastewater prior to discharge. (*Id.*). The Board requested a schematic diagram or map showing the layout of the refinery and demonstrating the lack of space to construct or install temporary storage tanks. An annotated map of the refinery is submitted as Attachment 15 hereto.

WHEREFORE, ExxonMobil respectfully requests that the Board grant the proposed site specific rule.

Dated: July 11, 2006

Respectfully submitted,

By: ______________________________
One of the Attorneys for EXXONMOBIL OIL CORPORATION

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CERTIFICATE OF SERVICE

The undersigned, an attorney, certifies that I have served upon the individuals named on the attached Notice of Filing true and correct copies of the **POST-HEARING COMMENTS OF EXXONMOBIL OIL CORPORATION** via Federal Express, on July 11, 2006.

Elizabeth A. Leifel

ATTACHMENT 13

PLUME STUDY
and
EFFLUENT LIMIT
DERIVATIONS REPORT

MOBIL OIL CORPORATION
JOLIET REFINERY
JOLIET, ILLINOIS

Prepared by:

James E. Huff, P.E.
Sean D. LaDieu

April 21, 1997

HUFF & HUFF, INC.
ENVIRONMENTAL CONSULTANTS
LaGRANGE, ILLINOIS

ATTACHMENT 14

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1. INTRODUCTION

The Mobil Oil Corporation - Joliet Refinery (Mobil) operates a wastewater treatment plant (WWTP) for the treatment of process wastewater and in-plant surface run-off. The WWTP flowrate on average is approximately 1,900 gallons per minute (gpm) or 2.7 million gallons per day (mgd) and discharges to the Des Plaines River through Outfall 001. Mobil currently operates the WWTP under National Pollution Discharge Elimination System (NPDES) permit no. IL0002861.

The ammonia limits set forth in the NPDES permit are based on a variance for effluent limits. The variance allows a monthly average ammonia limit of 13 mg/l and a daily maximum limit of 26 mg/l. This was granted on March 3, 1994 and originally expired on March 3, 1998. The variance now expires on March 3, 1999 after a one year extension was granted to Mobil. Unless site specific relief is adopted before the current variance expires, the ammonia effluent limits will be reduced to the applicable Illinois effluent limits of 3.0 mg/l and 6.0 mg/l for the monthly average and daily maximum, respectively.

A plume study was conducted at Outfall 001 in order to determine the extent of mixing that occurs between the outfall and the Des Plaines River. The plume study included an evaluation of the mixing zone and the Zone of Initial Dilution (ZID). The report contained herein documents the procedures used for the study, results, and implications for future limits.

2. BACKGROUND

2.1 Mobil Oil Refinery WWTP

The Mobil refinery is located in Will County approximately 10 miles southwest of Joliet, Illinois, on the south side of the Des Plaines River just east of the Interstate 55 bridge. The location of the refinery is depicted on Figure 2-1 with the WWTP located on the north side of Arsenal Road. The WWTP is an activated sludge system that is preceded by an API oil/water separator system, a dissolved air flotation system, and equalization biological treatment units.

The existing NPDES permit for the refinery covers nine outfalls numbered as Outfall 001 through Outfall 009. Outfall 001 discharges the treated process wastewater to a manmade outfall channel depicted in Figure 2-1. Outfall 002 discharges non-contact cooling water from the plant into the same manmade outfall channel, as does Outfall 003 which discharges stormwater for the west storage basin. The remaining outfalls (004 through 009) are all stormwater runoff discharges.

2.2 Des Plaines River

The refinery WWTP discharges into the Des Plaines River upstream of the I-55 bridge at River Mile 278.5 (approximately). The Des Plaines River originates near Kenosha, Wisconsin and travels south and then southwest before merging with the Kankakee River near Channahon, Illinois, where the combined rivers become the Illinois River. The width of the Des Plaines River at the point of the refinery WWTP outfall is approximately 600 feet.

The Des Plaines River is designated as a Secondary Contact Water under 35 Ill. Adm. Code 303.441 from the confluence with the Chicago Sanitary and Ship Canal to the Interstate 55 bridge. The water quality standards for Secondary Contact Waters are set forth in 35 Ill. Adm. Code 302 Subpart D. The ammonia water quality standard for these waters is based upon the un-ionized portion of ammonia with the established limit being 0.1 mg/l.

2.3 Mixing Zone and Zone of Initial Dilution Regulations and Policies

The mixing zone and Zone of Initial Dilution (ZID) are components of the State's program to protect water quality within the vicinity of wastewater outfalls. The mixing zone defines an area within which the acute toxicity standard is to be met but the water quality standard may be exceeded. The water quality standards are to be met at the edge of the mixing zone. The ZID is a portion of the mixing zone and defines a boundary at which the acute toxicity standards are to be met. Both of these components are defined in 35 Ill. Adm. Code 302 as follows:

> " 'Mixing Zone' means a portion of the waters of the State identified as a region within which mixing is allowed pursuant to Section 302.102(d)."

> " 'ZID' or 'Zone of Initial Dilution' means a portion of a mixing zone, identified pursuant to Section 302.102(e), within which acute toxicity standards need not be met."

The concepts of the mixing zone and ZID are used to derive effluent limits protective of the receiving stream's water quality standard. Section 302.102 sets the allowable area for the mixing zone based upon the receiving stream dimensions. The area and volume within which mixing occurs is limited to 25% of the cross-sectional area and volume of the stream. In no case shall the mixing zone area be greater than 26 acres.

Title 35 Ill. Adm Code 302 defines the area allowed for the ZID as an area "within which effluent dispersion is immediate and rapid". The Illinois Environmental Protection Agency (IEPA) has issued a guidance document for mixing zones that states the acute standard (the ZID area) "must be met within 10% of the distance from the edge of the outfall to the edge of the regulatory mixing zone in any spatial direction".

The present study for Mobil was conducted to determine the available dilutional mixing available for Outfall 001. The study was conducted consistent with the regulations and policies described above.

3. FIELD RESULTS

3.1 Plume Study Sampling

Field sampling for the plume study was conducted on October 29, 1996. Mobil provided the boat and driver, the necessary sample bottles, and the laboratory analyses for the plume study evaluation. Sampling locations were determined using a total station surveying system to measure angle and distance.

The weather on the day of sampling was cold and rainy. The temperature during the day was between 45 and 50 degrees fahrenheit. The rain was intermittent with periods of heavy downpour. The rain did not influence the low flow stream conditions that existed during the study period.

3.2 Sampling Methods

Samples were analyzed for conductivity using a YSI Model 33 conductivity meter and temperature was measured with a Cole-Parmer Digi-Sense Type K Digital Thermometer. These two parameters were analyzed at the sample location. Mobil's laboratory analyzed the samples for ammonia, chlorides, and pH on the same day as collected. The rationale for the analyses conducted is as follows:

- Conductivity and Temperature - These parameters were analyzed in the field as a method for tracking the plume. The plume effluent temperature and conductivity are both normally higher than the receiving stream's.

- Chlorides - This parameter was chosen because it is a conservative pollutant. There is usually a large difference between river and effluent chloride levels and the analysis is fairly accurate.

- Ammonia - The intent of the plume study was primarily to determine the available dilution within the mixing zone as it relates to the ammonia levels in the effluent.

- pH - This parameter is easy to measure and is used in calculating un-ionized ammonia.

3.3 Sampling at Effluent Channel

The sampling for the Mobil plume study was conducted on October 29, 1996, a day with low flow river conditions. The United States Geological Survey operates a gaging station on the Des Plaines River at Riverside, Illinois. This station is located approximately 39 miles upstream of the Mobil discharge. The nearest downstream station is the USGS station in Marseilles, Illinois on the Illinois River located 32 miles from Mobil's outfall. The flow values for these two stations, including the day of sampling and the plant effluent flow are presented below:

USGS Monitoring Station	7Q10 Flow, cfs	Sampling Day Flow, October 29, 1996, cfs	Harmonic Mean Flow, cfs
Des Plaines River at Riverside	139	190 (October 28, 1996)	370
Illinois River at Marseilles	3,185	4,700 (October 28, 1996)	7,200
WWTP Effluent Flow	----	2.9	----

The sampling program began by determining the general location and direction of the plume and the depth of the plume. This was determined by measuring the background water conductivity and temperature, and comparing it to the effluent. Using the boat, the river was then traversed to locate the general shape of the plume by observing the conductivity and temperature measurements as they compared to background levels. The measurements made in the field are presented in Table 3-1.

The conductivity at a depth of one foot near the mouth of the outfall channel measured 2,000 umhos/cm, while at a depth of three feet, the conductivity was 750 umhos/cm. Additional conductivity probing consistently showed the plume was spreading on the surface, indicating a "floating" plume. All samples were therefore collected at a depth of one foot.

TABLE 3-1

MIXING ZONE AND ZONE OF INITIAL DILUTION STUDY
FIELD MEASUREMENTS

Mobil Oil Refinery
Joliet, Illinois
October 29, 1996

Sample ID	Time	Conductivity, umhos	Temperature, deg F
Upstream Samples			
US 1	08:17	600	68.1
US 2	08:54	650	68.1
US 3	10:00	625	66.9
US 4	10:50	625	68.1
US 5	11:46	1600	67.6
US 6	12:09	1600	67.4
Effluent Channel Samples			
EC 1	08:20	1700	90.8
EC 2	08:56	1350	81.8
EC 3	09:31	1600	82.5
EC 4	10:07	1600	83.6
EC 5	10:53	1700	83.6
EC 6	11:51	2900	84.2
River Samples			
A1	08:25	1400	82.7
A2	08:30	1200	78.4
A3	08:32	1250	81.8
A4	08:34	1075	76.6
A5	08:36	775	70.5
A6	08:42	850	71.7
A7	08:44	800	71.4
A8	08:47	690	68.7
A9	08:51	700	68.1
B1	09:00	1100	77.1
B2	09:03	1200	76.8
B3	09:05	1400	78.9
B4	09:08	1150	76.1
B5	09:10	1050	74.4
B6	09:12	875	72.8
B7	09:15	850	72.1
B8	09:17	800	70.1
B9	09:20	750	69.2
C1	09:33	1075	73.4
C2	09:37	1300	78.6
C3	09:40	900	70.7
C4	09:43	900	71.9
C5	09:45	1250	79.1
C6	09:48	1050	77.7
C7	09:51	650	70.3
C8	09:55	650	67.8
D1	10:11	700	69.2
D2	10:15	750	69.9
D3	10:19	1200	75.7
D4	10:24	700	70.4
E3	11:08		
E4	11:06		
E5	11:02	900	68.9
E6	11:00	650	68.1
E7	10:56	750	67.6
F1	11:25	1250	65.6
F2	11:23	1200	70.1
F3	11:20	1100	65.6
F4	11:15	1000	68.5
F5	11:17	1000	68.7
G1	11:30	1200	65.1
G2	11:31	1600	67.6
G3	11:34	1600	68.1
G4	11:42	1650	65.6
H1	11:55	1600	67.1
I1	11:58	1700	66.1
I2	12:01	1600	67.4
I3	12:04	1400	67.6

File: f:/1doc/mobil/wrksht/plumdata.wk4

After the general direction and depth of the effluent plume was determined, samples were collected for analysis. Each sample location was labeled with an alpha-numeric character and then a numeric character. The alpha-numeric character increased in the downstream direction while the second numeric character increased with distance from the shoreline. Figure 3-1 depicts the sample locations.

3.4 Sampling Data

The sampling data for the measurements made at the sampling location, which include conductivity and temperature were presented in Table 3-1. The laboratory results for the parameters measured in the laboratory are presented in Table 3-2. These parameters include chlorides, pH, and ammonia. Table 3-3 presents the chlorides values and compares the results to levels measured in the samples collected from the upstream locations. These upstream samples were collected to determine background levels in the river. The chloride results were used to calculate the dilution ratios for the sample locations.

The dilution ratio is used to determine the degree of mixing that is occurring in the river. The ratio is determined by dividing the effluent value above background by the river sample value above background. Higher dilution ratios indicate more dilution as the difference between the effluent levels and the river levels is greater (the river level being lower than the effluent level). The background levels are subtracted from both the effluent sample and river sample to establish the background level as the baseline level. The dilution ratios for the chlorides have been calculated and are presented in Table 3-3.

The ammonia effluent levels on the day of sampling ranged from 0.00 mg/l to 0.16 mg/l. Four out of the six effluent samples collected were 0.00 mg/l. In comparison, the upstream samples ranged from 0.00 mg/l (3 out of 6 samples) to 0.28 mg/l. These levels were too low to produce results that would allow tracking of the ammonia plume at any degree of certainty, and therefore were not used for the plume delineation. The ammonia analytical results as they compare to background levels are included in Appendix A.

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* * * * * PC #2 * * * * *

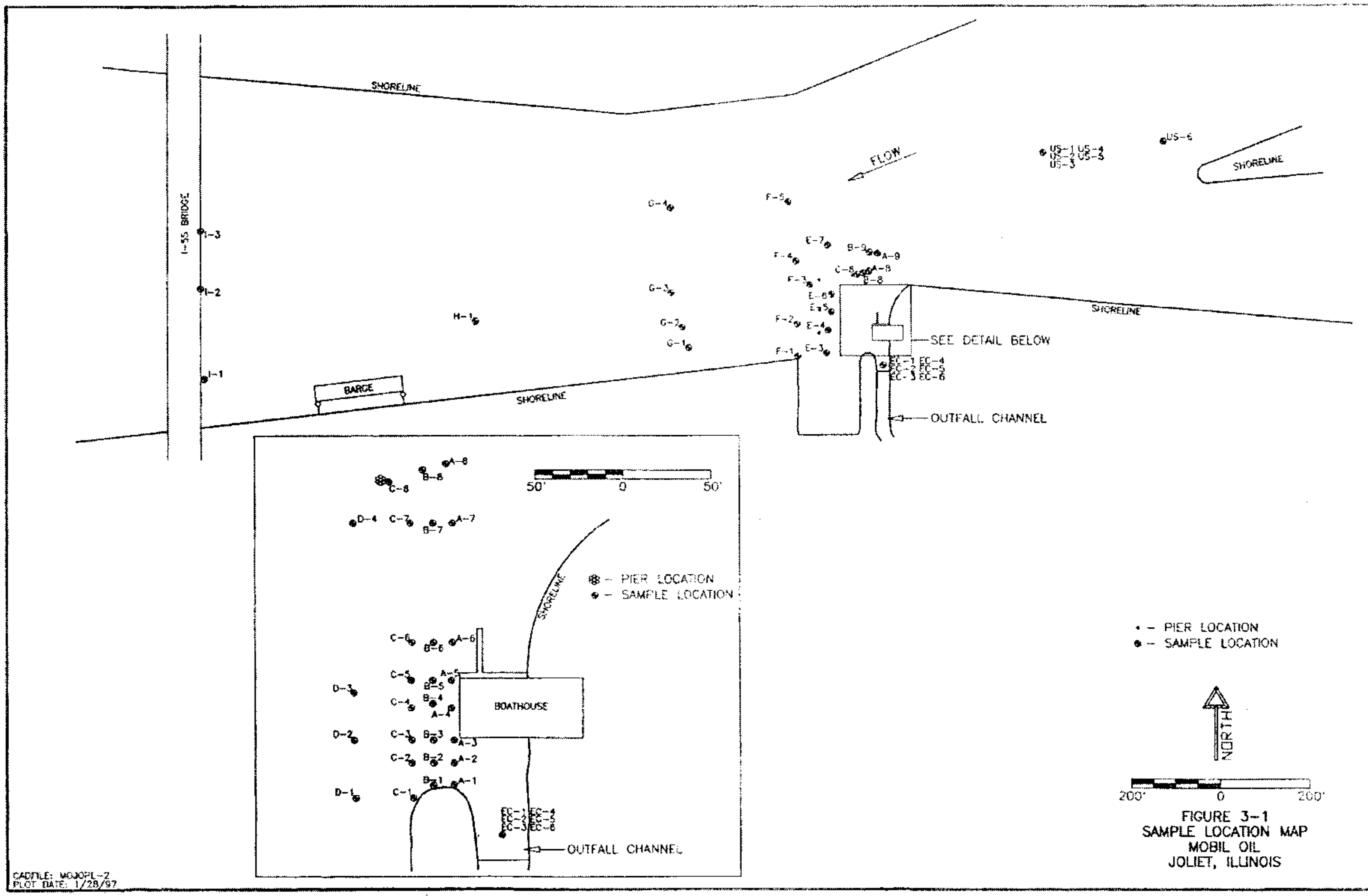

FIGURE 3-1
SAMPLE LOCATION MAP
MOBIL OIL
JOLIET, ILLINOIS

TABLE 3-2

MIXING ZONE AND ZONE OF INITIAL DILUTION STUDY
RAW DATA

Mobil Oil Refinery
Joliet, Illinois
October 29, 1996

Sample ID	Time	Chlorides, mg/l	pH, units	Ammonia, mg/l
Upstream Samples				
US 1	08:17	92	7.57	0.28
US 2	08:54	92	7.50	0.05
US 3	10:00	93	7.64	0.00
US 4	10:50	94	7.75	0.16
US 5	11:46	93	7.81	0.00
US 6	12:09	92	7.77	0.00
Effluent Channel Samples				
EC 1	08:20	270	8.09	0.16
EC 2	08:56	227	7.69	0.00
EC 3	09:31	277	8.09	0.00
EC 4	10:07	279	8.00	0.00
EC 5	10:53	313	8.11	0.00
EC 6	11:51	349	8.17	0.05
River Samples				
A1	08:25	228	7.79	0.05
A2	08:30	181	7.49	0.11
A3	08:32	197	7.35	0.00
A4	08:34	166	7.69	0.28
A5	08:36	105	7.65	0.22
A6	08:42	142	7.64	0.11
A7	08:44	121	7.55	0.11
A8	08:47	96	7.29	0.18
A9	08:51	103	7.41	0.28
B1	09:00	178	7.71	0.00
B2	09:03	204	7.73	0.00
B3	09:05	239	7.89	0.12
B4	09:08	184	7.69	0.00
B5	09:10	165	7.74	0.00
B6	09:12	153	7.73	0.00
B7	09:15	135	7.64	0.00
B8	09:17	146	7.67	0.16
B9	09:20	121	8.05	0.11
C1	09:33	174	7.87	0.12
C2	09:37	220	8.02	0.00
C3	09:40	143	7.80	0.00
C4	09:43	150	7.76	0.11
C5	09:45	218	7.93	0.16
C6	09:48	198	7.86	0.00
C7	09:51	133	7.52	0.05
C8	09:55	93	7.62	0.05
D1	10:11	106	7.75	0.00
D2	10:15	128	7.75	0.00
D3	10:19	205	7.90	0.00
D4	10:24	95	7.74	0.00
E3	11:08	120	7.67	0.00
E4	11:06	117	7.78	0.00
E5	11:02	101	7.70	0.16
E6	11:00	99	7.72	0.00
E7	10:56	110	7.73	0.00
F1	11:25	124	7.86	0.00
F2	11:23	148	7.85	0.22
F3	11:20	94	7.86	0.00
F4	11:15	93	7.79	0.00
F5	11:17	93	7.82	0.00
G1	11:30	102	7.75	0.22
G2	11:31	99	7.72	0.00
G3	11:34	94	7.82	0.00
G4	11:42	95	7.86	0.00
H1	11:55	105	7.74	0.05
I1	11:58	96	7.76	0.00
I2	12:01	94	7.76	0.00
I3	12:04	94	7.74	0.11

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TABLE 3-3

CHLORIDE DILUTION RATIOS

Mobil Oil Refinery
Joliet, Illinois
October 29, 1996

Sample ID	Time	Chlorides, mg/l Upstream	Effluent	River	River Above Background	Dilution Ratio
US 1	08:17	92				
EC 1	08:20		270			
A1	08:25			228	136	1.2
A2	08:30	Avg. Upstream=	Avg. Effluent =	181	89	1.8
A3	08:32	92	249	197	105	1.5
A4	08:34			166	74	2.1
A5	08:36			105	13	12.1
A6	08:42			142	50	3.1
A7	08:44			121	29	5.4
A8	08:47			96	4	39.3
A9	08:51			103	11	14.3
US 2	08:54	92				
EC 2	08:56		227			
B1	09:00			178	85	1.9
B2	09:03	Avg. Upstream=	Avg. Effluent =	204	111	1.4
B3	09:05	93	252	239	146	1.1
B4	09:08			184	91	1.7
B5	09:10			165	72	2.2
B6	09:12			153	60	2.7
B7	09:15			135	42	3.8
B8	09:17			146	53	3.0
B9	09:20			121	28	5.7
EC 3	09:31		277			
C1	09:33			174	81	2.3
C2	09:37		Avg. Effluent =	220	127	1.5
C3	09:40		278	143	50	3.7
C4	09:43			150	57	3.2
C5	09:45			218	125	1.5
C6	09:48			198	105	1.8
C7	09:51			133	40	4.6
C8	09:55			93	0	at background
US 3	10:00	93				
EC 4	10:07		279			
D1	10:11			106	12	16.8
D2	10:15	Avg. Upstream=	Avg. Effluent =	128	34	5.9
D3	10:19	94	296	205	111	1.8
D4	10:24			95	1	202.0
US 4	10:50	94				
EC 5	10:53		313			
E7	10:56			110	16	14.8
E6	11:00	Avg. Upstream=	Avg. Effluent =	99	5	47.4
E5	11:02	94	331	101	7	33.9
E4	11:06			117	23	10.3
E3	11:08			120	26	9.1
F4	11:15			93	0	at background
F5	11:17			93	0	at background
F3	11:20			94	0	at background
F2	11:23			148	54	4.4
F1	11:25			124	30	7.9
G1	11:30			102	8	29.6
G2	11:31			99	5	47.4
G3	11:34			94	0	at background
G4	11:42			95	1	237.0
US 5	11:46	93				
EC 6	11:51		349			
H1	11:55			105	12	21.3
I1	11:58	Avg. Upstream=	Avg. Effluent =	96	3	85.3
I2	12:01	93	349	94	1	256.0
I3	12:04			94	1	256.0
US 6	12:09	92				

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$$\text{Dilution Ratio} \quad \frac{\text{Effluent Value Above Background}}{\text{River Sample Value Above Background}} = \frac{\text{Effluent Avg. - Background Avg.}}{\text{River Sample - Background Avg.}}$$

4. MIXING ZONE AND ZID DETERMINATION

4.1 Mixing Zone Size

The mixing zone size is limited to 25% of the cross-sectional area of the stream. The Des Plaines River at the Mobil outfall channel is approximately 600 feet wide. The river is dredged in the area of the Mobil Oil outfall channel, making the bottom of the river fairly level. The mixing zone width is therefore limited to a width of 150 feet (25% of 600 feet). The surface area of the mixing zone is limited to 26 acres. The maximum length of the mixing zone allowed to Mobil is therefore 7,500 feet or approximately 1.4 miles.

Figure 4-1 depicts the chloride plume generated from plotting the dilution ratios. Based upon the chloride dilution ratios, the minimum dilution achieved at the edge of the mixing zone is 21:1. This is the dilution ratio determined from the sample results of sample H1 collected 150 feet from the shoreline. This is the maximum width allowed and is within the main flow pattern of the plume.

4.2 ZID Size

The ZID size is limited to 10% of the mixing zone in any spatial direction. The mixing zone width is 150 feet wide at the outfall location. The ZID would therefore be limited to 15 feet wide, and based upon the IEPA interpretation, also limited to 15 feet in length. This area would be immediately outside the outfall channel.

Figure 4-2 depicts the area outside the outfall channel along with the chloride dilution ratios. The terminus of the effluent channel is defined as the end of the boathouse, as everything to this point is manmade for purposes of the effluent discharge. The 15 foot by 15 foot area allowed for the ZID is depicted in Figure 4-2 and delineated by the sample points A-1, A-2, B-1, and B-2. The minimum mixing achieved within this area is 1.4:1, as determined by the sample collected at B-2.

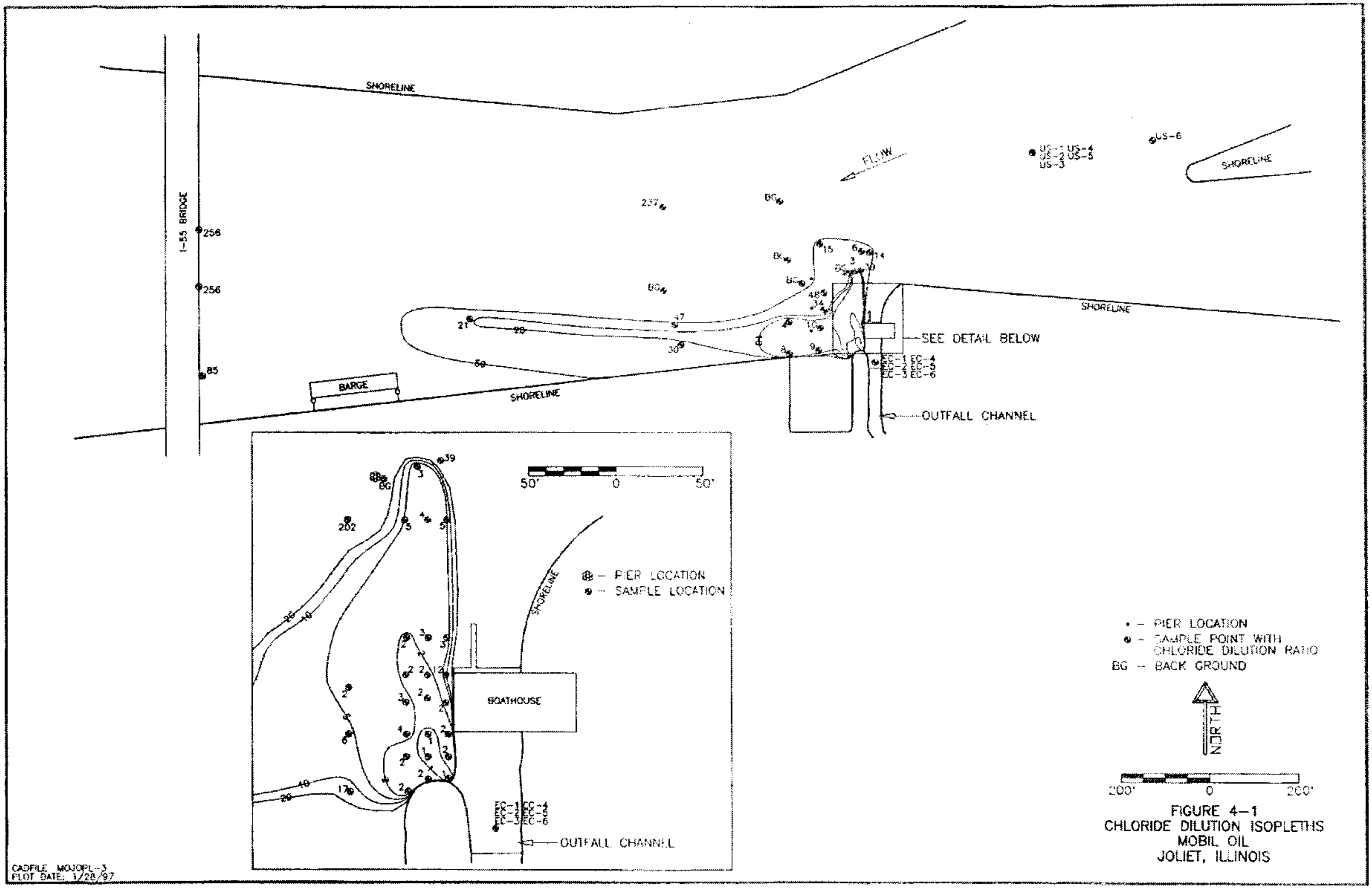

FIGURE 4–1
CHLORIDE DILUTION ISOPLETHS
MOBIL OIL
JOLIET, ILLINOIS

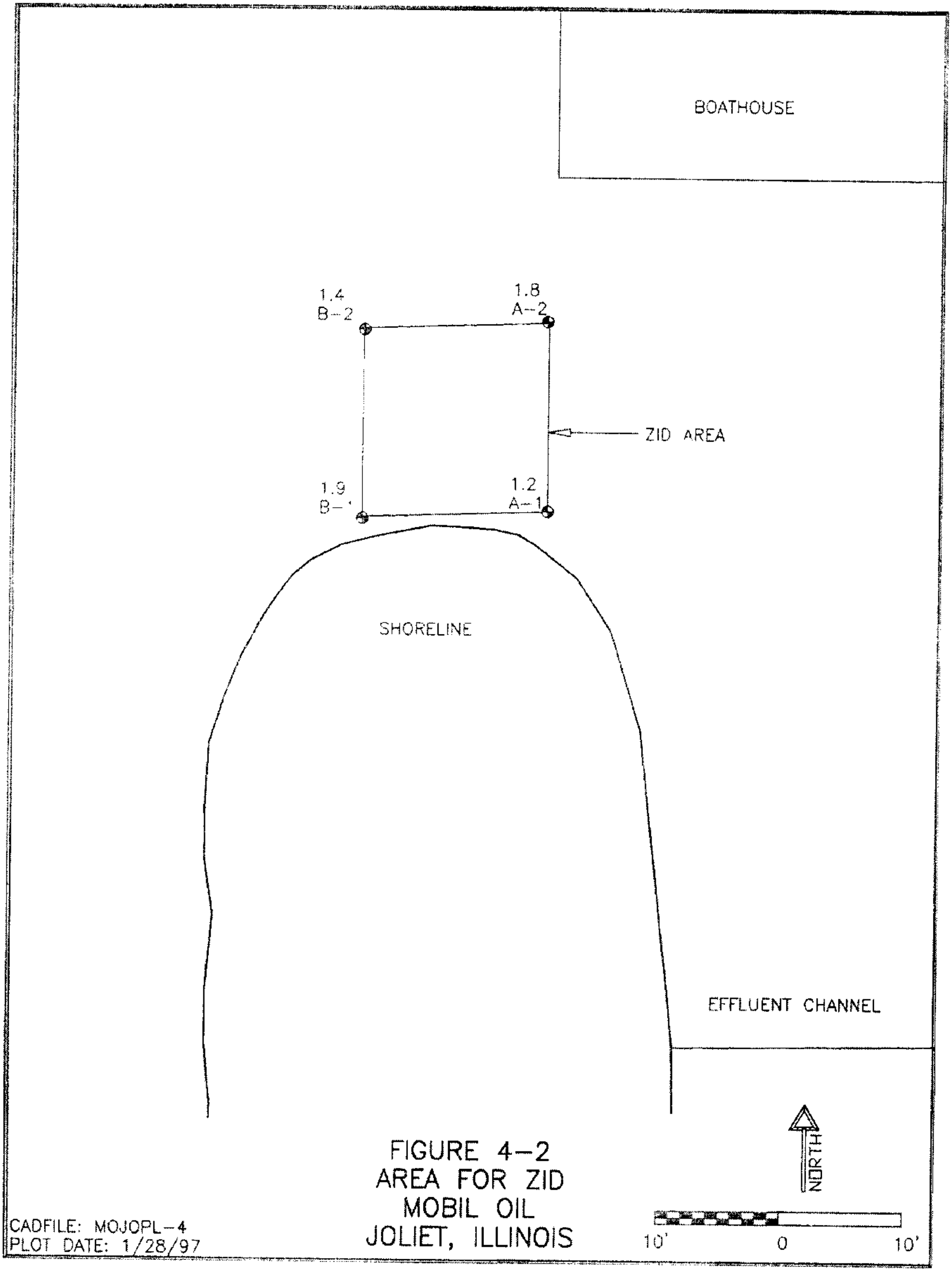

FIGURE 4-2
AREA FOR ZID
MOBIL OIL
JOLIET, ILLINOIS

4.3 Available Mixing Discussion

The dilution achieved at the edge of the mixing zone and edge of the ZID are determined based upon the dilutions determined from the chlorides analysis. Chlorides are conservative pollutants and often used for plume studies. The dilutions achieved for the mixing zone and ZID, based upon chlorides is 21:1 and 1.4:1, respectively.

The dilution ratios for non-conservative pollutants, such as ammonia, would be expected to be higher at the same sample locations for non-conservative pollutants. Effluent ammonia levels are affected by other factors besides mixing when discharged into the receiving stream. Ammonia is subject to continued nitrification, volatilization, and plant uptake. These factors combined make ammonia a non-conservative pollutant and would therefore be expected to have higher dilution ratios than those determined from the chloride samples.

A factor to be included in the WWTP ammonia effluent limit calculation is the mixing of non-contact cooling water prior to the discharge into the Des Plaines River. Based upon the schematic of water flow provided in Appendix B, the non-contact cooling water flow is 6,666 gallons per minute compared to 1,975 gallons per minute for the WWTP effluent. The non-contact cooling water accounts for 77 percent of the discharged water or a ratio of approximately 3:1. Factoring this dilution from the non-contact cooling water prior to the mixing with the river water, the appropriate dilutions to use for the effluent limit calculations for the WWTP through Outfall 001 would be as follows:

Plume Zone	Cooling Water Mixing	Des Plaines River Mixing	Total Dilution
Mixing Zone	3:1	21:1	63:1
Zone of Initial Dilution	3:1	1.4:1	4.2:1

Also of interest from Figure 4-1 is the available mixing at the I-55 Bridge. While the available mixing within the mixing zone is 21:1, by the I-55 Bridge, the available mixing is 85:1. If the maximum un-ionized ammonia at the edge of the mixing zone is 0.1 mg/l, by the I-55 Bridge, the maximum ammonia will be:

$$\frac{0.1 \text{ mg/l} \times 21:1}{85:1} = 0.025 \text{ mg/l}$$

Thus, effluent limits protective of the Secondary Contact Water Quality Standard (0.1 mg/l), will also assure compliance with the General Use Water Quality winter un-ionized standard (0.025 mg/l).

5. APPLICABLE PERMIT LIMITS

5.1 Derivation of Effluent Limits

Ammonia effluent limits are established based upon treatment technology. For dischargers to the Illinois waterway, this treatment technology was established at 3.0 mg/l ammonia, based upon a monthly average. Mobil, like other refineries, has not been able to consistently achieve the 3.0 mg/l limit, and has previously been granted relief by the Illinois Pollution Control Board.

Alternative ammonia effluent limits have been derived based upon the existing effluent quality. The derivation of existing effluent quality limits is specified in U.S. EPA's "Technical Support Document" (1991). The existing adjusted standard effluent limits were derived using this approach. In addition to calculating effluent limits based upon existing effluent quality, water quality-based effluent limits are also appropriately derived, with the lower calculated limits of the two approaches used for establishing effluent limits.

5.2 Water Quality-Based Effluent Limits

The mixing zone study and ZID study were conducted to determine the available dilution near the effluent channel outlet at Mobil. The water quality-based limits for Mobil were calculated for ammonia using the un-ionized ammonia water quality standards and the measured available dilution. The water quality standard for un-ionized ammonia in secondary contact waters is 0.1 mg/l. Using this water quality limit, the corresponding total ammonia level at the edge of the mixing zone can be determined using the 75th percentile pH and temperature values for the receiving stream, consistent with IEPA procedures.

The 75th percentile values for pH and temperature determined from the 1996 Des Plaines River data are as follows:

Season	75th percentile pH	75th percentile temperature, deg C
Summer	8.1	28.9
Winter	8.0	13.9

The dilution ratios determined from the mixing zone study were presented in Chapter 4. The total ammonia effluent limits for the WWTP outfall can be determined using the calculated water quality ammonia levels and the available dilution at the edge of the mixing zone (63:1). The calculations for these limits are provided in Appendix C. The limits derived from the water quality standard, applied at the edge of the mixing zone would establish the monthly effluent limit. The limits calculated are as follows:

Season	Water Quality Based Effluent Limits (Monthly Average Limit)
Summer	70 mg/l
Winter	243 mg/l

5.3 <u>Existing Ammonia Effluent-Based Limits</u>

The existing ammonia effluent data were used to derive ammonia effluent limits based upon existing WWTP performance. The "Technical Support Document for Water Quality-based Toxics Control" (1991) provides a methodology to calculate monthly effluent limits and daily maximum effluent limits based upon the 95th percentile distribution. Different databases were used to determine the monthly average limit and the daily maximum limit. The daily maximum limit was evaluated using ammonia effluent data collected from January 1992 through December 1996. The monthly average limit was calculated using the monthly averages generated from November 1996 through March 1997.

Mobil Oil has recently completed upgrading the WWTP at the refinery. The upgraded plant was fully operational starting in November, 1996. The ammonia effluent quality expected from the upgraded WWTP can be estimated from the November 1996 to March 1997 data. This limited database was therefore used for the monthly average limit determination. Although the upgraded plant provides better control of ammonia effluent quality, the ammonia spikes generated from the refinery operation will still occur, and carry through the upgraded WWTP. However, the WWTP recovery time will be shortened due to the upgrade. The database for determining the daily maximum includes data from January 1992 to December 1996. This data set includes periods of WWTP operation during typical ammonia spikes.

The monthly average permit limit was calculated using the methodology in the "Technical Support Document" for small sample numbers. The daily maximum limit was calculated using the delta-lognormal distribution due to the number of ammonia effluent values below the detection limits. The calculations are provided in Appendix D. The ammonia effluent levels calculated using the U.S. EPA "Technical Support Document" are as follows:

Data Set	Monthly Effluent Limit	Daily Maximum Limit
Nov. 1996 to Mar. 1996 Ammonia Effluent	9 mg/l	- - -
1996 Ammonia Effluent	18 mg/l	28 mg/l
1992 to 1996 Ammonia Effluent	16 mg/l	23 mg/l

5.4 Existing Permit Limits

The Illinois Pollution Control Board granted Mobil an ammonia effluent limit variance in 1994. The existing limits for the WWTP outfall at Mobil as they exist in the NPDES permit are as follows:

Existing Permit Limits	Monthly Effluent Limit	Daily Maximum
Ammonia Effluent	13 mg/l	26 mg/l

5.5 Applicable Ammonia Effluent Limits

The applicable ammonia effluent limits for Mobil's discharge are the most restrictive of the water quality derived limits, existing effluent quality derivation, or the existing effluent NPDES limits. The adjusted standard was granted to Mobil Oil given the inability of the WWTP to consistently achieve the technology-based ammonia effluent limit of 3.0 mg/l. The ammonia effluent limits generated based upon water quality and existing effluent then become viable options for determining appropriate ammonia effluent limits. The ammonia effluent limits generated from these methodologies are summarized as follows:

Methodology		Monthly Effluent Limit	Daily Maximum Limit
Water Quality-based	Summer	70 mg/l	---
	Winter	243 mg/l	---
Existing Effluent Ammonia Data - 1996		18 mg/l	28 mg/l
Existing Effluent Ammonia Data - 1992 to 1996		16 mg/l	**23 mg/l**
Existing Permit Limits		13 mg/l	26 mg/l
Nov. 1996 to Mar. 1997		**9 mg/l**	---

The applicable ammonia limits for Mobil's discharge become the most restrictive of these ammonia effluent limits and have been highlighted in the table. The proposed limits are as follows:

Permit Limit	Effluent Ammonia Limit
Monthly Effluent	9 mg/l
Daily Maximum	23 mg/l

5.6 Discussion

Table 5-1 summarizes Mobil's ammonia effluent quality since 1990. Over this period, Mobil's effluent has averaged 3.1 mg/l, only three percent above the 3.0 mg/l effluent limit. However, effluent limits are to be met every month, not on a long term basis. When predicting the monthly

TABLE 5-1

MOBIL OIL
AMMONIA EFFLUENT HISTORICAL QUALITY

Year	Ammonia, mg/l Annual Average	Maximum Month	Maximum Daily
1990	0.3	1.3	5.2
1991	0.6	2.5	13.0
1992	3.2	12.2	22.0
1993	4.0	9.5	24.0
1994	4.9	12.2	19.2
1995	6.3	13.7	25.5
1996	3.9	14.9	27.4
1997 a/	1.8	3.8	14.0

a/ January, February, and March

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limit based upon the last five years existing effluent quality data, a limit of 16 mg/l is derived, above the current variance limit of 13 mg/l. Due to recent upgrades of the WWTP, a more restrictive effluent limit of 9 mg/l is suggested based upon data obtained after the upgrade was complete. This represents a 31 percent reduction from the current variance limit. The 23 mg/l daily maximum limit, derived from the existing effluent database, reflects a 12 percent reduction from the current variance limit.

The water quality-based effluent limits (70 mg/l summer and 243 mg/l winter) were over five times higher than the existing and proposed monthly average ammonia limits of 13 and 9 mg/l, respectively. Thus, the proposed effluent limits are clearly protective of water quality. With the measured dilution at the I-55 Bridge, where the General Use Water Quality Standards begin, there is adequate dilution to achieve the water quality General Use Standards even if Mobil were discharging at 243 mg/l total ammonia.

Mobil Oil has expended approximately $7.8 million over the past five years to lower its effluent ammonia levels. The last two months of 1996 and the first three months of 1997 have shown a more consistent reduction in ammonia, suggesting the expenditure has resulted in lower effluent ammonia levels. However, in spite of this improvement, unanticipated deviations can occur, as evidenced by historical patterns presented in Table 5-1. In 1990 and 1991, Mobil's effluent averaged 0.3 and 0.6 mg/l, respectively, and it looked like Mobil was on its way toward complying with the 3.0 mg/l effluent standard. In fact, the maximum monthly discharge in 1990/1991 was only 2.5 mg/l. However, 1992 through 1995, Mobil's effluent ammonia level averaged 4.6 mg/l. In 1990 and 1991, Mobil could not have predicted the poorer performance of the sensitive nitrifying bacteria.

Similarly, at this time, Mobil cannot predict the future performance of the WWTP any more than it could have done so in 1990/1991. Therefore, it can only propose effluent limitation on the basis of the existing effluent quality. The proposed limits of 9 mg/l for the monthly average and 23 mg/l for the daily maximum are based on the data generated since the WWTP upgrades and the 1992 to 1996 WWTP performance, respectively. The 1992 - 1996 data set contains 517 ammonia sample measurements with the following concentration distribution:

1992 - 1996 WWTP Ammonia Discharge Samples

Concentration mg/l	No. of Samples
<0.1	83
0.1 to 3.0	215
3.0 to 6.0	72
6.0 to 13.0	88
13.0 to 23.0	56
>23.0	3
Total # Samples	517

The 1992 - 1996 data shows, that in spite of the WWTP performance disruption due to RCRA NESHAP's and other upsets, Mobil's discharge was below the 6.0 mg/l daily ammonia limit 72 percent of the time. With the recent upgrades, it is reasonable to expect that WWTP performance will further improve.

Based upon the most restrictive of the ammonia effluent limits presented, site specific relief with the following effluent limits are proposed:

Monthly Average:	9 mg/l
Daily Maximum:	23 mg/l

REFERENCES

U.S. Environmental Protection Agency, Technical Support Document For Water Quality-based Toxics Control, EPA/505/2-90-001, PB91-127415, March 1991.

APPENDICES

APPENDIX A

AMMONIA DILUTION RATIOS

Mobil Oil Refinery
Joliet, Illinois
October 29, 1996

Sample ID	Time	Ammonia, mg/l Upstream	Effluent	River	Above Background	Dilution Ratio
US 1	08:17	0.28				
EC 1	08:20		0.16			
A1	08:25			0.05	0.00	
A2	08:30	Avg. Upstream=	Avg. Effluent=	0.11	0.00	
A3	08:32	0.16	0.08	0.00	0.00	
A4	08:34			0.28	0.12	
A5	08:36			0.22	0.06	
A6	08:42			0.11	0.00	
A7	08:44			0.11	0.00	
A8	08:47			0.18	0.02	
A9	08:51			0.28	0.12	
US 2	08:54	0.05				
EC 2	08:56		0.00			
B1	09:00			0.00	0.00	
B2	09:03	Avg. Upstream=	Avg. Effluent=	0.00	0.00	
B3	09:05	0.03	0.00	0.12	0.09	
B4	09:08			0.00	0.00	
B5	09:10			0.00	0.00	
B6	09:12			0.00	0.00	
B7	09:15			0.00	0.00	
B8	09:17			0.16	0.13	
B9	09:20			0.11	0.08	
EC 3	09:31		0.00			
C1	09:33			0.12	0.09	
C2	09:37		Avg. Effluent=	0.00	0.00	
C3	09:40		0.00	0.00	0.00	
C4	09:43			0.11	0.08	
C5	09:45			0.16	0.13	
C6	09:48			0.00	0.00	
C7	09:51			0.05	0.02	
C8	09:55			0.05	0.02	
US 3	10:00	0.00				
EC 4	10:07		0.00			
D1	10:11			0.00	0.00	
D2	10:15	Avg. Upstream=	Avg. Effluent=	0.00	0.00	
D3	10:19	0.08	0.00	0.00	0.00	
D4	10:24			0.00	0.00	
US 4	10:50	0.16				
EC 5	10:53		0.00			
E7	10:56			0.00	0.00	
E6	11:00	Avg. Upstream=	Avg. Effluent=	0.00	0.00	
E5	11:02	0.08	0.03	0.16	0.08	
E4	11:06			0.00	0.00	
E3	11:08			0.00	0.00	
F4	11:15			0.00	0.00	
F5	11:17			0.00	0.00	
F3	11:20			0.00	0.00	
F2	11:23			0.22	0.14	
F1	11:25			0.00	0.00	
G1	11:30			0.22	0.14	
G2	11:31			0.00	0.00	
G3	11:34			0.00	0.00	
G4	11:42			0.00	0.00	
US 5	11:46	0.00				
EC 6	11:51		0.05			
H1	11:55			0.05	0.05	
I1	11:58	Avg. Upstream=	Avg. Effluent=	0.00	0.00	
I2	12:01	0.00	0.05	0.00	0.00	
I3	12:04			0.11	0.11	
US 6	12:09	0.00				

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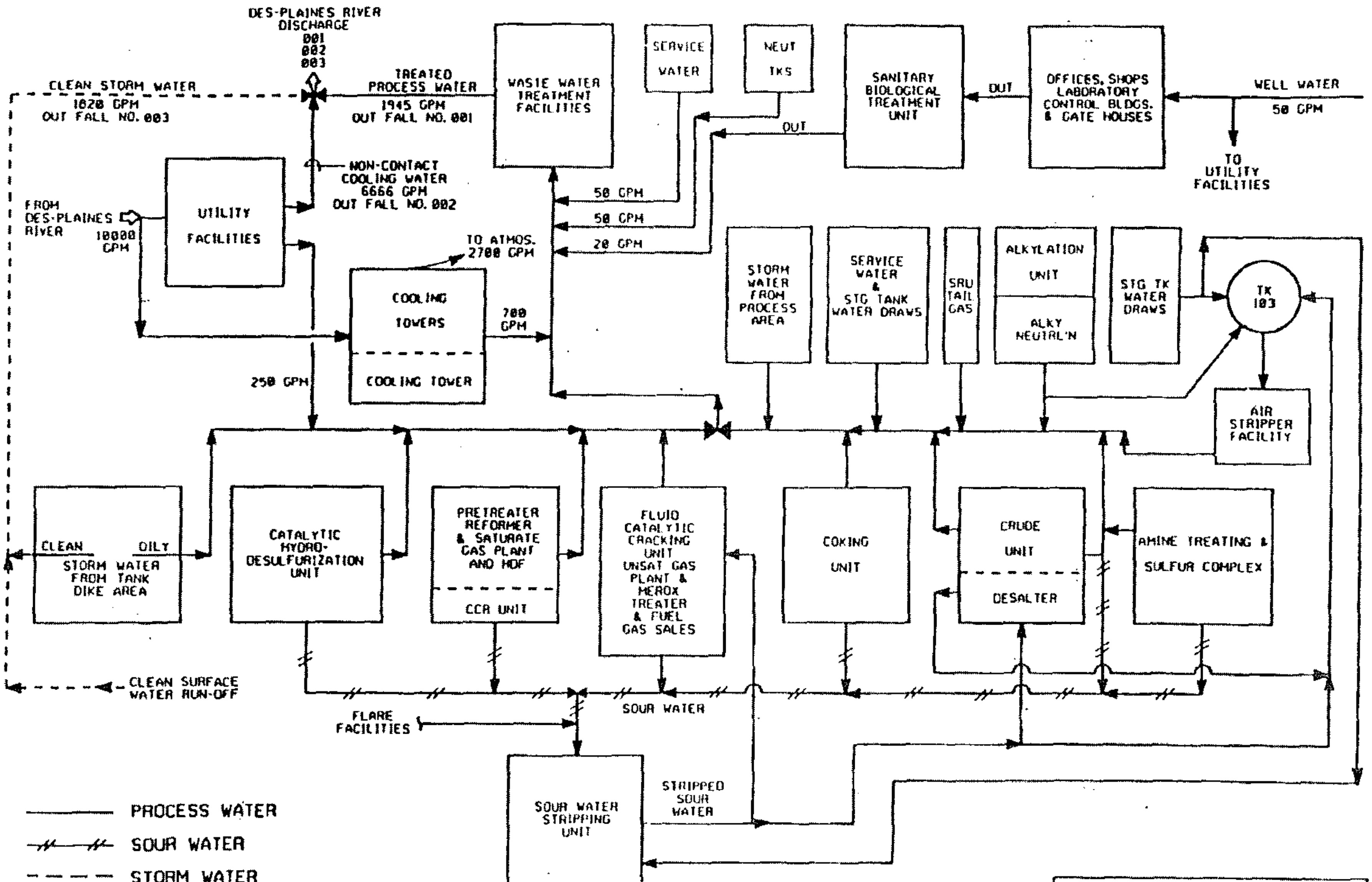
APPENDIX B

FIGURE A



SCHEMATIC OF WATER FLOW
MOBIL JOLIET REFINING CORP.
JOLIET, WILL, ILLINOIS

APPENDIX C

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

Project: Mobil Oil Effluent Ammonia Client: Mobil Oil
Title: Ammonia Effluent Calculation
Signature: [illegible] Date: 02/18/97 Sheet 1 of 3

CALCULATION OF MOBIL OIL AMMONIA EFFLUENT LIMITS BASED ON WATER QUALITY

FROM PROPOSED AMMONIA WATER QUALITY REGULATIONS:

WATER QUALITY STANDARDS BASED ON UN-IONIZED AMMONIA

SEASON	CHRONIC, mg/l
SUMMER	0.10 (as [illegible])
WINTER	0.10 (as [illegible])

75th PERCENTILE VALUES FROM MOBIL OIL / COMM. ED RIVER DATA

SEASON	TEMPERATURE	pH
SUMMER	28.9°C	8.1
WINTER	13.9°C	8.0

USING FORMULA IN 35 Ill Adm Code 302.212 CALCULATE TOTAL AMMONIA (CONFIGURED TO SOLVE FOR N)

$$N = U\left(0.94412 \times (1+10^{x}) + 0.0559\right)$$

$$X = 0.09018 + \frac{2729.92}{(T + 273.16)} - pH$$

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

Project [illegible] Ammonia Client [illegible]
Title [illegible]
Signature [illegible] Date [illegible] Sheet 2 of 3

CALCULATIONS:

SUMMER CHRONIC LEVEL:

pH = 8.1 TEMP = 28.9°C

$$X = 0.09018 + \frac{2729.92}{28.9 + 273.16} - 8.1$$

$$X = 1.0279$$

$$N = 0.10\ ([illegible])$$

N = 1.1068 mg/l TOTAL AMMONIA

WINTER CHRONIC LEVEL:

pH = 8.0 TEMP = 13.9°C

$$X = 0.09018 + \frac{2729.92}{13.9 + 273.16} - 8.0$$

$$X = 1.600$$

$$N = 0.10\ (0.9412\ (1 + 10^{1.600}) + 0.0559)$$

N = 3.3586 mg/l TOTAL AMMONIA

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

Project [illegible] Effluent Ammonia   Client [illegible]
Title Ammonia Effluent Calc.
Signature [illegible]   Date 02/18/97   Sheet 3 of 3

SUMMARY OF TOTAL AMMONIA EFFLUENT WITH NO DILUTION
SUMMER - 1.1068 mg/l
WINTER - 3.8586 mg/l

BASED ON MIXING ZONE and ZID STUDIES, THE AVAILABLE DILUTION AT THE EDGE OF THESE ZONES, BASED ON THE MEASUREMENT OF A CONSERVATIVE POLLUTANT (CHLORIDES), THE AVAILABLE DILUTION IS AS FOLLOWS:

EDGE OF MIXING ZONE ⇒ 21:1 ([illegible] CHRONIC)

TO DETERMINE THE AMMONIA EFFLUENT LEVELS FOR THE NWTP, THE COOLING WATER DISCHARGE MUST BE ACCOUNTED FOR, THIS PROVIDES ADDITIONAL DILUTION OF 3:1 THE COMBINED DILUTION FOR THE TWO ZONES BECOMES:

EDGE OF MIXING ZONE ⇒ 63:1

BASED UPON THESE DILUTIONS THE TOTAL AMMONIA EFFLUENT LIMITS BECOME THE FOLLOWING:

SEASON	TO MEET CHRONIC LEVELS (x 63)
SUMMER	69.73 mg/l
WINTER	243.1 mg/l

} MONTHLY AVERAGE LIMITS

APPENDIX D

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

1996 DATA

Project: Mobil Oil Ammonia Client: Mobil

Title: Effluent Calculations Based Upon T-D ... W/O Based Tower Control

Signature: S. ... Date: 02/07/97 Sheet 1 of 5

Calculate Ammonia Permit Limits Based upon Mobil Effluent Data

Use the delta-lognormal distribution used for data containing a mixture of nondetect values and values above non detect.

Data Set – 1996

– 35 non detect values (0.0 mg/l)

Daily Average : $\hat{E}(X^*) = \hat{\delta} D + (1-\hat{\delta}) \exp(\hat{\mu}_y + 0.5\hat{\sigma}_y^2)$

Variance : $(1-\hat{\delta})\exp(2\hat{\mu}_y + \hat{\sigma}_y^2)[\exp(\hat{\sigma}_y^2) - (1-\hat{\delta})] + \hat{\delta}(1-\hat{\delta}) D [D - 2\exp(\hat{\mu}_y + 0.5\hat{\sigma}_y^2)]$

Coefficient of Var: $[\hat{V}(X^*)]^{1/2} / \hat{E}(X^*)$

k = number of Samples
D = detection limits
r = number of nondetect values in sample
$k-r$ = number of values greater than the detection limit.
$y_i = \ln(x_i)$
$\hat{\mu}_y = \Sigma(y_i)/(k-r)$
$\hat{\sigma}_y^2 = \Sigma(y_i - \hat{\mu}_y)^2/(k-r-1)$
$\hat{\delta} = r/k$

$k = 105$
$r = 35$
$k-r = 70$
$D = 0.10$ mg/l.

$n = 8.75$ AVG NUMBER OF SAMPLES / MONTH

HUFF & HUFF, INC.
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CALCULATION SHEET

Project [illegible] Client Mobil
Title [illegible] Calculations Based upon TSD for WQ Based Toxics Control
Signature [illegible] Date 02/07/[illegible] Sheet 2 of 5

Use 95th percentile to determine Monthly Avg. Limit.

$X_{0.95}$ = 95th percentile n-day moving avg. limit.

$X_{0.95}$ = [illegible] $\hat{\delta} \geq 0.95$

$\max [D, \exp(\mu_n + z^* \sigma_n)]$

where z^* = $\Phi_n^{-1} [(0.95 - \delta)/(1 - \delta)]$

Φ_n^{-1} = 1.645

$\hat{\delta}$ = [illegible] = [illegible]/105 = [illegible]

$\hat{\mu}_y$ = [illegible] (See Lotus Table)

[illegible] $\hat{\sigma}_y^2$ = 3.0 (See Lotus Table)

$$\hat{E}(x^*) = (0.33)(0.10) + (1 - 0.33)\exp(0.7 + 0.5(3.0))$$
$$= (0.033) + (0.67)\exp(2.2)$$
$$\underline{\hat{E}(x^*) = 6.0797}$$

$$\hat{V}(x^*) = (1-0.33)\exp(2(0.7) + 3.0)[\exp(3.0) - (1-0.33)] + 0.33(1-0.33)(0.1)[0.1 - 2\exp(0.7 + 0.5(3))]$$

$$= 0.67 \exp(4.4)(19.416) + (0.0221)[-17.95]$$

$$= 1053.57 + (-0.3969)$$

$$\hat{V}(x^*) = 1053.17$$

HUFF & HUFF, INC.
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CALCULATION SHEET

Project: Mobil Oil Ammonia | Client: Mobil
Title: Effluent Calculations Based upon TSD for WQ Based Toxics Control
Signature: [illegible] | Date: 02/10/97 | Sheet 3 of 5

$$\hat{\sigma}_n^2 = \ln\left\{(1-\hat{\delta}^n)\left[1+A+B+C\right]\right\}$$

Where:

$$A = \hat{V}(x^*) \Big/ \left[n\left(\hat{E}(x^*) - \hat{\delta}^n D\right)^2\right]$$

$$A = 1059.17 \Big/ \left[8.75\left(6.0797 - (0.33)^{8.75}(0.1)\right)^2\right]$$

$$A = 1059.17 \Big/ \left[8.75(36.963)\right]$$

$$A = 1059.17 / (323.43)$$

$$\underline{\underline{A = 3.275}}$$

$$B = -\left[\hat{\delta}^n D^2 (1-\hat{\delta}^n)\right] \Big/ \left(\hat{E}(x^*) - \hat{\delta}^n D\right)^2$$

$$B = -\left[0.33^{8.75}(0.1)^2(1-0.33^{8.75})\right] \Big/ \left(6.0797 - 0.33^{8.75}(0.1)\right)^2$$

$$B = -\left[6.123 \times 10^{-7}\right] \Big/ 36.963$$

$$\underline{\underline{B = -1.6566 \times 10^{-8}}}$$

$$C = (2\hat{\delta}^n D) \Big/ \left(\hat{E}(x^*) - \hat{\delta}^n D\right)$$

$$C = \left(2(0.33)^{8.75}(0.1)\right) \Big/ \left(6.0797 - (0.33)^{8.75}(0.1)\right)$$

$$C = 1.2247 \times 10^{-5} / 6.0797$$

$$\underline{\underline{C = 2.014 \times 10^{-6}}}$$

HUFF & HUFF, INC.
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CALCULATION SHEET

Project [illegible] Client [illegible]
Title [illegible]
Signature [illegible] Date [illegible] Sheet 4 of 5

$$\hat{\sigma}_n^2 = \ln\{(1-0.33^{[illegible]})[1+3.275(-1.6566\times10^{-8})+2.014\times10^{-6}]\}$$

$$\hat{\sigma}_n^2 = \ln[(0.9999)(4.2750)]$$

$$\hat{\sigma}_n^2 = 1.4527$$

$$\hat{\mu}_n = \ln[(\hat{E}(x^*) - \delta^{n} D_1)/(1-\delta^{n})] - 0.5\hat{\sigma}_n^2$$

$$= \ln[[illegible]] - 0.5(1.4527)$$

$$= \ln[[illegible]/0.[illegible]] - (0.5)(1.4527)$$

$$= 1.8050 - 0.7264$$

$$\hat{\mu}_n = 1.0787$$

$$Z^* = \Phi_n^{-1}[0.95 - \delta]/(1-\delta)]$$

$$= 1.645[0.95 - 0.33/(1-0.33)]$$

$$= 1.5222$$

WITHOUT CORRECTION TO Z^* FORMULA CORRECTION (δ^n) WOULD MAKE Z^* HIGHER.

$$X_{0.95} = \exp(\hat{\mu}_n + Z^* \hat{\sigma}_n)$$

$$= \exp(1.0787 + 1.5222(1.4527)^{1/2})$$

$$= \exp(1.0787 + 1.8347)$$

$$X_{0.95} = 18.42 \text{ mg/l}$$

✓ MONTHLY AVERAGE

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CALCULATION SHEET

Project	Mobil Oil Ammonia	Client	Mobil Oil		
Title	Effluent Calculations				
Signature	[illegible]	Date	3/14/97	Sheet	5 of 5

DAILY MAXIMUM

$$Y_{0.95} = \exp(\mu_y + z^* \hat{\sigma}_y)$$

$$= \exp(0.7 + 1.522(3.0)^{1/2})$$

$$= \exp(3.407)$$

$$Y_{0.95} = 28.11$$

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CALCULATION SHEET

1992-1996 DATA

Project [illegible] Client Mobil Oil

Title [illegible] Calculations – Based in 752

Signature [illegible] Date [illegible] Sheet 1 of 5

Calculate [illegible] Permit Limit [illegible]

[illegible]

Use [illegible] lognormal [illegible] for data containing a mixture of non-detect values and [illegible]

[illegible] 1992 [illegible]

– [illegible] non-detect [illegible]

[illegible]

[illegible]

[illegible]

K = number of samples
D = detection limits
r = number of nondetect values in sample
K–r = number of values greater than the detection

$y_i = \ln(x_i)$

$\bar{y}_1 = \Sigma(y_i) / K-r$

$\hat{\sigma}_1^2 = \Sigma(y_i - \bar{y}_1)^2 / (K-r-1)$

$\hat{\delta} = r/K$

K = 517.

r = 82

K–r = 435

D = 0.10 mg/l.

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CALCULATION SHEET

Project: MOBIL OIL AMMONIA	Client: MOBIL OIL		
Title: EFFLUENT CASES.			
Signature: S. LaDiem	Date: 02/07/97	Sheet 2 of 5	

n = number of samples per month (average)

1992	TOTAL	100	
1993	TOTAL	104	
1994	TOTAL	104	60 months
1995	TOTAL	103	
1996	TOTAL	105	

$$516 / 60 = 8.6$$

$n = 8.6$

USE 95th PERCENTILE TO DETERMINE MONTHLY AVG LIMIT

$X_{0.95}$ = 95th percentile n-day monthly avg limit

$$X_{0.95} = \begin{cases} D & \hat{\delta} \geq 0.95 \\ MAX\ [D, \exp(\hat{\mu}_n + z^* \hat{\sigma}_n)] \end{cases}$$

where $z^* = \phi^{-1}\left[(0.95 - \hat{\delta})/(1 - \hat{\delta})\right]$

$$\phi^{-1} = 1.645$$

$$\hat{\delta} = r/k = 82/517 = 0.16$$

$$\hat{\mu}_y = 0.8 \text{ (SEE LOTUS TABLE)}$$

$$\hat{\sigma}_y^2 = 2.3 \text{ (SEE LOTUS TABLE)}$$

HUFF & HUFF, INC.
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CALCULATION SHEET

Project [illegible]	Client [illegible]		
Title [illegible]			
Signature [illegible]	Date [illegible]	Sheet 3 of 5	

$\hat{E}(x^*) = (0.16)(0.1) + (1-0.16)\exp(0.8 + 0.5(2.3))$

$= 0.016 + 0.84(\exp 1.95)$

$\hat{E}(x^*) = \underline{5.9201}$

$\hat{V}(x^*) = (1-0.16)\exp(2(0.8)+2.3)[\exp(2.3) - (1-0.16)] - 0.16(1-0.16)(0.1)[0.1 - 2\exp(0.8+0.5(2.3))]$

$= (0.84)\exp(3.9)(9.1392) + 0.1344(-13.9574)$

$\hat{V}(x^*) = \underline{377.1157}$

[illegible]

[illegible]

$A = \hat{V}(x^*) / [\ldots(\hat{E}(x^*) - \delta^n D)^2]$

$A = 377.1157 / [3.6(5.9201 - 0.16^{8.6}(0.1))^2]$

$A = 377.1157 / [3.6(35.0476)]$

$A = \underline{1.2514}$

$B = -[\delta^n D^2 (1 - \delta^n)] / (\hat{E}(x^*) - \delta^n D)^2$

$B = -[0.16^{8.6}(0.1)^2(1-0.16^{8.6})] / (5.9201 - 0.16^{8.6}(0.1))^2$

$B = -[1.4303] / 35.0476$

$B = \underline{-4.0811 \times 10^{-11}}$

$$c = (2\hat{\delta}^n D) / (\hat{E}(x^*) - \hat{\delta}^n D)$$

$$c = (2(0.16)^{86}(0.1)) / (5.9201 - (0.16)^{86}(0.1))$$

$$c = 2.9606 \times 10^{-8} / 5.9201$$

$$c = 4.3321 \times 10^{-2}$$

$$\hat{\sigma}_n^2 = \ln\{(1 - 0.16^{86})(1 + 1.25 \ldots + (-4.031 \times 10^{-4}) + 4.88 \times 10^{-9})\}$$

$$= \ln\{(0.9999)(2.2514)\}$$

$$= \ln\{2.2514\}$$

$$\hat{\sigma}_n^2 = 0.8116$$

$$\hat{\mu}_n = \ln[(\hat{E}(x) - \delta^n D)/(1 - \delta^n)] - 0.5\hat{\sigma}_n^2$$

$$= \ln[(5.9201 - (0.16^{86})(0.1))/(1 - 0.16^{86})] - 0.5(0.8116)$$

$$= \ln[5.9201 / 0.9999] - 0.4058$$

$$\hat{\mu}_n = 1.3726$$

$$Z^* = \phi^{-1}[(0.95 - \hat{\delta})/(1 - \delta)]$$

$$= 1.645[(0.95 - 0.16)/(1 - 0.16)]$$

$$Z^* = 1.5471$$

WITHOUT CORRECTION TO Z^* FORMULA CORRECTION (δ^n) WOULD MAKE Z^* HIGHER

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

Project [illegible] Client [illegible]

Title [illegible] CALCS

Signature [illegible] Date [illegible] Sheet 5 of 5

$X_{0.95} = \exp(\hat{\mu}_n + z \cdot \hat{\sigma}_n)$

$= \exp(1.5726 + 1.5471(0.1116)^{1/2})$

$= \exp(1.5726 + 1.3038)$

$= \exp(2.7664)$

$X_{0.95} = 15.90$ mg/l

Daily Maximum

$X_{0.95} = \exp(\hat{\mu}_y + z \cdot \hat{\sigma}_y)$

$= \exp(0.8 + 1.5471(2.0)^{1/2})$

$X_{0.95} = 23.25$

HUFF & HUFF, INC.
Environmental Consultants

CALCULATION SHEET

Project: Mobil Oil Ammonia
Client: Mobil Oil
Title: Effluent Calculations - Monthly Avg
Signature: S. Cu Dim.
Date: 4/21/97
Sheet 1 of 1

Calculate Monthly Average

Data set - Nov. 96 through Mar 97

Monthly Average Ammonia Effluent, mg/l

November 96	0.3
December	1.9
January 97	3.8 ← MAX MONTHLY AVG FOR DATA SET
February	0.3
March	1.3

Coefficient of Variation (CV) = 0.6 (Assumed value for less than 10 samples)

Multiplier for CV = 0.6 and 5 samples = 2.3
(Table 5-2, TSD, EPA/505/2-90-001)

X_{95} = MAX MONTHLY AVG × 2.3

X_{95} = 3.8 mg/l × 2.3

X_{95} = 8.74 mg/l

X_{95} = 9 mg/l

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
01/ 2 /91	0.0	
01/ 3 /91	0.0	
01/ 8 /91	0.0	
01/ 10 /91	0.0	
01/ 15 /91	0.0	
01/ 17 /91	0.0	
01/ 22 /91	0.0	
01/ 24 /91	2.0	0.693147
01/ 29 /91	0.0	
01/ 31 /91	0.0	
02/ 5 /91	0.0	
02/ 7 /91	0.0	
02/ 12 /91	0.0	
02/ 15 /91	1.0	0
02/ 19 /91	0.5	-0.69315
02/ 21 /91	0.0	
02/ 26 /91	0.0	
02/ 28 /91	0.4	-0.91629
03/ 5 /91	0.0	
03/ 7 /91	0.0	
03/ 12 /91	0.4	-0.91629
03/ 14 /91	0.4	-0.91629
03/ 19 /91	0.0	
03/ 21 /91	0.3	-1.20397
03/ 26 /91	0.0	
03/ 28 /91	0.2	-1.60944
04/ 2 /91	0.8	-0.22314
04/ 4 /91	0.4	-0.91629
04/ 9 /91	0.2	-1.60944
04/ 11 /91	0.0	
04/ 16 /91	0.0	
04/ 18 /91	0.4	-0.91629
04/ 23 /91	0.2	-1.60944
04/ 25 /91	0.3	-1.20397
04/ 30 /91	0.1	-2.30259
05/ 2 /91	0.0	
05/ 7 /91	0.0	
05/ 9 /91	0.4	-0.91629
05/ 14 /91	0.0	
05/ 16 /91	0.4	-0.91629
05/ 21 /91	0.2	-1.60944
05/ 23 /91	0.9	-0.10536
05/ 29 /91	0.0	
05/ 30 /91	0.0	
06/ 4 /91	0.0	
06/ 6 /91	0.0	
06/ 11 /91	0.0	
06/ 13 /91	0.0	
06/ 18 /91	0.0	
06/ 20 /91	0.0	
06/ 25 /91	0.0	
07/ 2 /91	0.0	
07/ 5 /91	0.0	
07/ 9 /91	0.0	
07/ 11 /91	0.0	
07/ 16 /91	0.0	
07/ 18 /91	0.0	
07/ 23 /91	0.3	-1.20397
07/ 25 /91	0.3	-1.20397
07/ 30 /91	0.2	-1.60944
08/ 2 /91	0.0	
08/ 6 /91	0.1	-2.30259
08/ 8 /91	0.2	-1.60944
08/ 13 /91	0.8	-0.22314
08/ 15 /91	0.4	-0.91629
08/ 20 /91	0.0	

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
08/ 22 /91	0.3	-1.20397
08/ 28 /91	13.0	2.564949
08/ 30 /91	7.6	2.028148
09/ 3 /91	3.7	1.308333
09/ 5 /91	3.0	1.098612
09/ 10 /91	0.0	
09/ 12 /91	0.3	-1.20397
09/ 17 /91	0.2	-1.60944
09/ 19 /91	0.0	
09/ 24 /91	0.0	
09/ 26 /91	0.3	-1.20397
10/ 1 /91	0.0	
10/ 3 /91	0.0	
10/ 8 /91	0.5	-0.69315
10/ 10 /91	0.5	-0.69315
10/ 15 /91	0.0	
10/ 17 /91	0.0	
10/ 22 /91	0.0	
10/ 24 /91	0.0	
10/ 29 /91	5.6	1.722767
10/ 31 /91	2.5	0.916291
11/ 5 /91	0.2	-1.60944
11/ 7 /91	0.0	
11/ 12 /91	3.0	1.098612
11/ 14 /91	0.3	-1.20397
11/ 19 /91	0.0	
11/ 21 /91	0.3	-1.20397
11/ 22 /91	0.0	
11/ 26 /91	0.0	
11/ 27 /91	0.0	
12/ 3 /91	0.0	
12/ 5 /91	1.0	0
12/ 10 /91	3.0	1.098612
12/ 12 /91	1.0	0
12/ 17 /91	0.8	-0.22314
12/ 19 /91	0.9	-0.10536
12/ 24 /91	3.9	1.360977
12/ 26 /91	2.0	0.693147
12/ 31 /91	2.0	0.693147
01/ 2 /92	0.8	-0.22314
01/ 7 /92	0.3	-1.20397
01/ 9 /92	0.3	-1.20397
01/ 14 /92	5.8	1.757858
01/ 16 /92	12.0	2.484907
01/ 21 /92	16.0	2.772589
01/ 23 /92	4.0	1.386294
01/ 28 /92	0.5	-0.69315
02/ 4 /92	4.5	1.504077
02/ 6 /92	13.3	2.587764
02/ 11 /92	19.0	2.944439
02/ 13 /92	22.0	3.091042
02/ 18 /92	12.0	2.484907
02/ 20 /92	4.0	1.386294
02/ 25 /92	10.4	2.341806
02/ 27 /92	8.6	2.151762
03/ 3 /92	0.4	-0.91629
03/ 5 /92	0.6	-0.51083
03/ 10 /92	0.3	-1.20397
03/ 12 /92	0.3	-1.20397
03/ 17 /92	0.3	-1.20397
03/ 19 /92	0.4	-0.91629
03/ 24 /92	1.0	0
03/ 26 /92	0.3	-1.20397
04/ 2 /92	0.0	
04/ 7 /92	0.4	-0.91629

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DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
04/ 9 /92	0.7	-0.35667
04/ 14 /92	0.8	-0.22314
04/ 16 /92	6.0	1.791759
04/ 21 /92	0.3	-1.20397
04/ 23 /92	0.2	-1.60944
04/ 28 /92	0.0	
04/ 30 /92	0.0	
05/ 5 /92	16.0	2.772589
05/ 7 /92	8.9	2.186051
05/ 12 /92	0.0	
05/ 14 /92	0.0	
05/ 19 /92	0.0	
05/ 21 /92	0.0	
05/ 26 /92	0.0	
05/ 28 /92	0.0	
06/ 2 /92	0.0	
06/ 4 /92	0.3	-1.20397
06/ 9 /92	1.1	0.09531
06/ 11 /92	0.0	
06/ 16 /92	0.0	
06/ 18 /92	0.3	-1.20397
06/ 23 /92	0.3	-1.20397
06/ 25 /92	0.0	
07/ 2 /92	0.0	
07/ 7 /92	0.0	
07/ 9 /92	0.0	
07/ 14 /92	0.6	-0.51083
07/ 16 /92	0.5	-0.69315
07/ 21 /92	0.0	
07/ 23 /92	0.1	-2.30259
07/ 28 /92	0.3	-1.20397
07/ 30 /92	4.6	1.526056
08/ 4 /92	0.0	
08/ 6 /92	0.0	
08/ 11 /92	0.4	-0.91629
08/ 13 /92	1.0	0
08/ 18 /92	0.0	
08/ 20 /92	0.0	
08/ 25 /92	0.0	
08/ 27 /92	1.4	0.336472
09/ 1 /92	5.0	1.609438
09/ 3 /92	2.0	0.693147
09/ 8 /92	0.0	
09/ 10 /92	0.0	
09/ 15 /92	0.0	
09/ 17 /92	0.0	
09/ 22 /92	0.0	
09/ 24 /92	1.2	0.182322
09/ 29 /92	0.0	
10/ 6 /92	0.0	
10/ 8 /92	0.8	-0.22314
10/ 13 /92	6.7	1.902108
10/ 15 /92	14.0	2.639057
10/ 20 /92	9.3	2.230014
10/ 22 /92	2.7	0.993252
10/ 27 /92	0.0	
10/ 29 /92	5.4	1.686399
11/ 3 /92	22.0	3.091042
11/ 6 /92	13.0	2.564949
11/ 10 /92	1.5	0.405465
11/ 13 /92	0.0	
11/ 17 /92	0.0	
11/ 20 /92	0.2	-1.60944
11/ 24 /92	0.2	-1.60944
11/ 27 /92	0.0	
12/ 1 /92	0.3	-1.20397

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
12/ 3 /92	0.2	-1.60944
12/ 8 /92	0.1	-2.30259
12/ 10 /92	0.8	-0.22314
12/ 15 /92	0.8	-0.22314
12/ 17 /92	3.0	1.098612
12/ 22 /92	11.0	2.397895
12/ 24 /92	20.1	3.00072
12/ 29 /92	14.0	2.639057
01/ 5 /93	11.4	2.433613
01/ 7 /93	6.3	1.84055
01/ 12 /93	6.4	1.856298
01/ 14 /93	6.8	1.916923
01/ 19 /93	2.6	0.955511
01/ 21 /93	3.8	1.335001
01/ 26 /93	2.4	0.875469
01/ 28 /93	5.9	1.774952
02/ 2 /93	4.8	1.568616
02/ 4 /93	6.3	1.84055
02/ 9 /93	14.0	2.639057
02/ 11 /93	14.9	2.701361
02/ 16 /93	3.9	1.360977
02/ 18 /93	3.5	1.252763
02/ 23 /93	6.0	1.791759
02/ 25 /93	8.4	2.128232
03/ 2 /93	2.9	1.064711
03/ 4 /93	4.0	1.386294
03/ 9 /93	6.2	1.824549
03/ 11 /93	8.3	2.116256
03/ 16 /93	10.5	2.351375
03/ 18 /93	8.2	2.104134
03/ 24 /93	8.0	2.079442
03/ 26 /93	4.8	1.568616
03/ 30 /93	0.6	-0.51083
04/ 1 /93	0.3	-1.20397
04/ 6 /93	3.6	1.280934
04/ 8 /93	4.6	1.526056
04/ 13 /93	1.3	0.262364
04/ 15 /93	0.7	-0.35667
04/ 20 /93	0.8	-0.22314
04/ 22 /93	2.7	0.993252
04/ 27 /93	1.8	0.587787
04/ 29 /93	1.8	0.587787
05/ 4 /93	0.4	-0.91629
05/ 6 /93	0.3	-1.20397
05/ 11 /93	0.9	-0.10536
05/ 13 /93	0.6	-0.51083
05/ 18 /93	3.1	1.131402
05/ 20 /93	3.3	1.193922
05/ 25 /93	7.2	1.974081
05/ 27 /93	7.2	1.974081
06/ 1 /93	13.2	2.580217
06/ 3 /93	5.3	1.667707
06/ 8 /93	0.3	-1.20397
06/ 10 /93	0.1	-2.20727
06/ 15 /93	0.2	-1.77196
06/ 17 /93		0.0
06/ 22 /93		0.0
06/ 24 /93		0.0
06/ 29 /93	0.1	-2.20727
07/ 1 /93		0.0
07/ 6 /93		0.0
07/ 8 /93	0.1	-2.30259
07/ 13 /93		0.0
07/ 15 /93		0.0
07/ 20 /93		0.0

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
07/ 22 /93	0.2	-1.60944
07/ 27 /93	12.6	2.533697
07/ 29 /93	6.2	1.824549
08/ 3 /93		0.0
08/ 5 /93		0.0
08/ 10 /93		0.0
08/ 12 /93	0.3	-1.20397
08/ 17 /93	0.3	-1.20397
08/ 19 /93		0.0
08/ 24 /93	0.9	-0.10536
08/ 26 /93	1.1	0.09531
08/ 31 /93	0.2	-1.60944
09/ 2 /93	0.1	-2.30259
09/ 7 /93	0.3	-1.20397
09/ 9 /93	0.2	-1.60944
09/ 14 /93	0.1	-2.30259
09/ 16 /93	0.1	-2.30259
09/ 21 /93	0.2	-1.60944
09/ 23 /93	0.3	-1.20397
09/ 28 /93	0.4	-0.91629
09/ 30 /93	0.3	-1.20397
10/ 5 /93	18.0	2.890372
10/ 7 /93	24.0	3.178054
10/ 12 /93	3.6	1.280934
10/ 14 /93	1.2	0.182322
10/ 19 /93	0.9	-0.10536
10/ 21 /93	0.6	-0.51083
10/ 26 /93	0.6	-0.51083
10/ 28 /93	1.6	0.470004
11/ 2 /93	0.5	-0.69315
11/ 4 /93	0.6	-0.51083
11/ 9 /93	0.2	-1.60944
11/ 11 /93	1.3	0.262364
11/ 16 /93	12.3	2.509599
11/ 18 /93	12.2	2.501436
11/ 23 /93	21.6	3.072693
11/ 24 /93	15.7	2.753661
11/ 30 /93	21.3	3.058707
12/ 2 /93	15.7	2.753661
12/ 7 /93	4.1	1.410987
12/ 9 /93	1.6	0.470004
12/ 14 /93	0.6	-0.51083
12/ 16 /93	0.7	-0.35667
12/ 21 /93	0.8	-0.22314
12/ 23 /93	0.8	-0.22314
12/ 28 /93	0.3	-1.20397
12/ 30 /93	0.6	-0.51083
01/ 4 /94	0.5	-0.69315
01/ 6 /94	0.4	-0.91629
01/ 11 /94	0.6	-0.51083
01/ 13 /94	0.4	-0.91629
01/ 18 /94	0.4	-0.91629
01/ 20 /94	0.2	-1.60944
01/ 25 /94	0.9	-0.10536
01/ 27 /94	0.7	-0.35667
02/ 1 /94	0.6	-0.51083
02/ 3 /94	0.6	-0.51083
02/ 8 /94		0.0
02/ 10 /94	3.5	1.252763
02/ 15 /94	11.4	2.433613
02/ 17 /94	9.0	2.197225
02/ 22 /94	4.5	1.504077
02/ 24 /94	1.9	0.641854
03/ 1 /94	1.4	0.336472
03/ 3 /94	1.4	0.336472

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
03/ 8 /94	1.8	0.587787
03/ 10 /94	2.6	0.955511
03/ 15 /94	2.7	0.993252
03/ 17 /94	6.2	1.824549
03/ 22 /94	10.1	2.312535
03/ 24 /94	14.9	2.701361
03/ 29 /94	4.1	1.410987
03/ 31 /94	3.8	1.335001
04/ 5 /94	1.2	0.182322
04/ 7 /94	3.4	1.223775
04/ 12 /94	0.9	-0.10536
04/ 14 /94	0.8	-0.22314
04/ 19 /94	1.3	0.262364
04/ 21 /94	3.5	1.252763
04/ 26 /94	1.2	0.182322
04/ 28 /94	0.7	-0.35667
05/ 3 /94	0.6	-0.51083
05/ 5 /94	0.4	-0.91629
05/ 10 /94	0.4	-0.91629
05/ 12 /94	0.8	-0.22314
05/ 17 /94	1.0	0
05/ 19 /94	3.4	1.223775
05/ 24 /94	12.9	2.557227
05/ 26 /94	9.9	2.292535
05/ 31 /94	4.0	1.386294
06/ 3 /94	10.4	2.341806
06/ 7 /94	5.8	1.757858
06/ 9 /94	5.4	1.686399
06/ 14 /94	16.6	2.809403
06/ 16 /94	14.0	2.639057
06/ 21 /94	3.2	1.163151
06/ 23 /94	12.0	2.484907
06/ 28 /94	1.7	0.530628
06/ 30 /94	4.2	1.435085
07/ 5 /94	1.2	0.182322
07/ 7 /94	2.1	0.741937
07/ 12 /94	0.8	-0.22314
07/ 14 /94	1.2	0.182322
07/ 19 /94	0.8	-0.22314
07/ 21 /94	4.7	1.547563
07/ 26 /94	14.3	2.66026
07/ 28 /94	4.8	1.568616
08/ 2 /94	2.4	0.875469
08/ 4 /94	10.4	2.341806
08/ 9 /94	4.5	1.504077
08/ 11 /94	3.3	1.193922
08/ 16 /94	7.3	1.987874
08/ 18 /94	3.9	1.360977
08/ 23 /94	7.1	1.960095
08/ 25 /94	10.8	2.379546
08/ 30 /94	4.3	1.458615
09/ 1 /94	5.8	1.757858
09/ 6 /94	11.0	2.397895
09/ 8 /94	12.0	2.484907
09/ 13 /94	7.8	2.054124
09/ 15 /94	5.0	1.609438
09/ 20 /94	16.0	2.772589
09/ 22 /94	11.6	2.451005
09/ 27 /94	6.6	1.88707
09/ 29 /94	13.0	2.564949
10/ 4 /94	2.1	0.741937
10/ 6 /94	0.0	
10/ 11 /94	0.7	-0.35667
10/ 13 /94	0.6	-0.51083
10/ 18 /94	0.3	-1.20397
10/ 20 /94	0.2	-1.60944

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
10/ 25 /94	2.5	0.916291
10/ 27 /94	3.0	1.098612
11/ 1 /94	3.0	1.098612
11/ 3 /94	8.0	2.079442
11/ 8 /94	6.9	1.931521
11/ 10 /94	3.1	1.131402
11/ 15 /94	1.8	0.587787
11/ 17 /94	2.0	0.693147
11/ 22 /94	0.6	-0.51083
11/ 23 /94	0.4	-0.91629
11/ 29 /94	5.6	1.722767
12/ 1 /94	10.7	2.370244
12/ 6 /94	8.5	2.140066
12/ 8 /94	5.5	1.704748
12/ 13 /94	18.6	2.923162
12/ 15 /94	19.2	2.95491
12/ 20 /94	11.1	2.406945
12/ 22 /94	12.5	2.525729
12/ 27 /94	13.9	2.631889
12/ 29 /94	9.7	2.272126
01/ 3 /95	19.1	2.949688
01/ 5 /95	18.1	2.895912
01/ 10 /95	16.9	2.827314
01/ 12 /95	8.7	2.163323
01/ 17 /95	10.6	2.360854
01/ 19 /95	9.0	2.197225
01/ 24 /95	13.7	2.617396
01/ 26 /95	10.4	2.341806
01/ 31 /95	16.8	2.821379
02/ 2 /95	20.4	3.015535
02/ 7 /95	15.5	2.74084
02/ 9 /95	13.0	2.564949
02/ 14 /95	5.1	1.629241
02/ 16 /95	1.0	0
02/ 21 /95	0.6	-0.51083
02/ 23 /95	1.0	0
02/ 28 /95	0.6	-0.51083
03/ 2 /95	0.4	-0.91629
03/ 7 /95	0.7	-0.35667
03/ 9 /95	0.6	-0.51083
03/ 14 /95	3.7	1.308333
03/ 16 /95	1.1	0.09531
03/ 21 /95	1.2	0.182322
03/ 23 /95	2.8	1.029619
03/ 28 /95	3.5	1.252763
03/ 30 /95	2.2	0.788457
04/ 4 /95	2.4	0.875469
04/ 6 /95	2.6	0.955511
04/ 11 /95	3.3	1.193922
04/ 13 /95	3.8	1.335001
04/ 18 /95	8.5	2.140066
04/ 21 /95	4.4	1.481605
04/ 25 /95	13.9	2.631889
04/ 27 /95	13.7	2.617396
05/ 2 /95	9.6	2.261763
05/ 4 /95	8.0	2.079442
05/ 9 /95	10.2	2.322388
05/ 11 /95	8.3	2.116256
05/ 16 /95	4.8	1.568616
05/ 18 /95	4.1	1.410987
05/ 23 /95	5.8	1.757858
05/ 25 /95	10.8	2.379546
05/ 30 /95	6.1	1.808289
06/ 1 /95	9.0	2.197225
06/ 6 /95	17.1	2.839078

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l	ln (ammonia
06/ 9 /95	20.4	3.015535
06/ 13 /95	20.3	3.010621
06/ 17 /95	22.9	3.131137
06/ 20 /95	10.0	2.302585
06/ 22 /95	8.6	2.151762
06/ 27 /95	0.8	-0.22314
06/ 29 /95	0.3	-1.20397
07/ 5 /95	0.8	-0.22314
07/ 6 /95	0.6	-0.51083
07/ 11 /95	0.2	-1.60944
07/ 13 /95	0.5	-0.69315
07/ 18 /95	0.1	-2.30259
07/ 20 /95	0.2	-1.60944
07/ 25 /95	0.3	-1.20397
07/ 27 /95	0.7	-0.35667
08/ 1 /95	0.3	-1.20397
08/ 4 /95	0.2	-1.60944
08/ 8 /95	0.3	-1.20397
08/ 10 /95	0.3	-1.20397
08/ 15 /95	0.6	-0.51083
08/ 17 /95	5.8	1.757858
08/ 22 /95	4.8	1.568616
08/ 25 /95	0.4	-0.91629
08/ 29 /95	5.1	1.629241
08/ 31 /95	2.6	0.955511
09/ 5 /95	0.5	-0.69315
09/ 7 /95	1.5	0.405465
09/ 12 /95	5.0	1.609438
09/ 14 /95	2.2	0.788457
09/ 19 /95	1.0	0
09/ 21 /95	0.7	-0.35667
09/ 26 /95	0.8	-0.22314
09/ 28 /95	5.7	1.740466
10/ 3 /95	0.7	-0.35667
10/ 5 /95	0.8	-0.22314
10/ 10 /95	0.3	-1.20397
10/ 12 /95	0.2	-1.60944
10/ 17 /95	5.5	1.704748
10/ 19 /95	7.2	1.974081
10/ 24 /95	7.2	1.974081
10/ 26 /95	1.4	0.336472
10/ 31 /95	1.4	0.336472
11/ 2 /95	1.9	0.641854
11/ 7 /95	0.2	-1.60944
11/ 9 /95	5.0	1.609438
11/ 14 /95	1.3	0.262364
11/ 16 /95	1.3	0.262364
11/ 21 /95	13.6	2.61007
11/ 22 /95	19.0	2.944439
11/ 28 /95	17.5	2.862201
11/ 30 /95	12.9	2.557227
12/ 5 /95	10.4	2.341806
12/ 7 /95	11.3	2.424803
12/ 12 /95	11.0	2.397895
12/ 14 /95	25.5	3.238678
12/ 19 /95	6.0	1.791759
12/ 21 /95	8.0	2.079442
12/ 26 /95	10.3	2.332144
12/ 28 /95	6.4	1.856298
01/ 2 /96	7.9	2.066863
01/ 4 /96	10.6	2.360854
01/ 9 /96	2.6	0.955511
01/ 11 /96	5.3	1.667707
01/ 16 /96	7.9	2.066863
01/ 18 /96	6.7	1.902108

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l		ln (ammonia
01/ 23 /96	12.0		2.484907
01/ 25 /96	6.2		1.824549
01/ 30 /96	16.9		2.827314
02/ 1 /96	21.4		3.063391
02/ 6 /96	5.4		1.686399
02/ 8 /96	1.3		0.262364
02/ 13 /96	8.5		2.140066
02/ 15 /96	7.8		2.054124
02/ 20 /96	3.0		1.098612
02/ 22 /96		0.0	
02/ 27 /96		0.0	
02/ 29 /96		0.0	
03/ 5 /96		0.0	
03/ 7 /96		0.0	
03/ 12 /96	0.6		-0.51083
03/ 14 /96	4.8		1.568616
03/ 19 /96	20.6		3.025291
03/ 21 /96	27.4		3.310543
03/ 26 /96	11.8		2.4681
03/ 28 /96	8.2		2.104134
04/ 2 /96	17.3		2.850707
04/ 4 /96	17.5		2.862201
04/ 9 /96	21.1		3.049273
04/ 11 /96	19.0		2.944439
04/ 16 /96	17.1		2.839078
04/ 17 /96	19.5		2.970414
04/ 23 /96	13.4		2.595255
04/ 25 /96	8.5		2.140066
04/ 30 /96	0.6		-0.51083
05/ 2 /96	0.4		-0.91629
05/ 7 /96		0.0	
05/ 9 /96		0.0	
05/ 14 /96	0.3		-1.20397
05/ 16 /96	3.0		1.098612
05/ 21 /96	3.4		1.223775
05/ 23 /96		0.0	
05/ 28 /96	0.2		-1.60944
05/ 30 /96	4.2		1.435085
06/ 4 /96	2.8		1.029619
06/ 6 /96	0.6		-0.51083
06/ 11 /96		0.0	
06/ 13 /96		0.0	
06/ 19 /96		0.0	
06/ 20 /96		0.0	
06/ 25 /96	11.9		2.476538
06/ 27 /96	13.7		2.617396
07/ 2 /96	1.1		0.09531
07/ 3 /96	1.2		0.182322
07/ 9 /96	4.1		1.410987
07/ 11 /96	4.2		1.435085
07/ 16 /96		0.0	
07/ 18 /96		0.0	
07/ 23 /96	0.2		-1.60944
07/ 25 /96	0.4		-0.91629
07/ 30 /96	0.1		-2.30259
08/ 1 /96		0.0	
08/ 6 /96	0.5		-0.69315
08/ 8 /96	0.6		-0.51083
08/ 13 /96		0.0	
08/ 15 /96	0.7		-0.35667
08/ 20 /96	0.2		-1.60944
08/ 22 /96	0.3		-1.20397
08/ 28 /96	0.3		-1.20397
08/ 29 /96	0.2		-1.60944
09/ 3 /96	0.2		-1.60944
09/ 5 /96	0.1		-2.30259

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l		ln (ammonia
09/ 10 /96		0.0	
09/ 12 /96		0.0	
09/ 17 /96		0.0	
09/ 19 /96		0.0	
09/ 25 /96	1.7		0.530628
09/ 26 /96	0.4		-0.91629
10/ 1 /96		0.0	
10/ 3 /96		0.0	
10/ 9 /96	0.1		-2.30259
10/ 10 /96		0.0	
10/ 15 /96	0.2		-1.60944
10/ 17 /96		0.0	
10/ 22 /96	0.2		-1.60944
10/ 24 /96	0.2		-1.60944
10/ 29 /96		0.0	
10/ 31 /96	0.1		-2.30259
11/ 5 /96		0.0	
11/ 7 /96	0.7		-0.35667
11/ 12 /96		0.0	
11/ 14 /96		0.0	
11/ 19 /96		0.0	
11/ 21 /96	0.8		-0.22314
11/ 26 /96	0.5		-0.69315
11/ 27 /96		0.0	
12/ 3 /96	0.4		-0.91629
12/ 5 /96		0.0	
12/ 10 /96		0.0	
12/ 12 /96		0.0	
12/ 17 /96		0.0	
12/ 19 /96		0.0	
12/ 24 /96	14.0		2.639057
12/ 27 /96	1.3		0.262364
12/ 31 /96	1.3		0.262364
01/ 2 /97	2.6		0.955511
01/ 7 /97	0.4		-0.91629
01/ 9 /97		0.0	
01/ 14 /97	1.4		0.336472
01/ 16 /97	0.7		-0.35667
01/ 21 /97	14.0		2.639057
01/ 23 /97	12.0		2.484907
01/ 28 /97	2.0		0.693147
01/ 30 /97	1.0		0
02/ 4 /97		0.0	
02/ 6 /97	0.8		-0.22314
02/ 11 /97	0.3		-1.20397
02/ 13 /97	0.3		-1.20397
02/ 18 /97	0.2		-1.60944
02/ 21 /97	0.3		-1.20397
02/ 25 /97	0.8		-0.22314
02/ 27 /97		0.0	
03/ 4 /97	0.1		-2.30259
03/ 6 /97	6.5		1.871802
03/ 11 /97	0.4		-0.91629
03/ 13 /97	0.6		-0.51083
03/ 18 /97	1.4		0.336472
03/ 20 /97	0.3		-1.20397
03/ 25 /97	0.6		-0.51083
03/ 27 /97	0.6		-0.51083

January 1991 - December 1996

Average	4.8	0.0	0.6
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	507	140	507
Std. Dev.	5.8	0.0	1.5
Variance	33.4	0.0	2.4

DAILY AMMONIA EFFLUENT VALUES

Mobil Oil Joliet Refinery
1991 - 1997

Date	Ammonia, mg/l		ln (ammonia
January 1992 - December 1996			
Average	5.3	0.0	0.8
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	435	82	435
Std. Dev.	6.0	0.0	1.5
Variance	35.7	0.0	2.3
January 1996 - December 1996			
Average	5.8	0.0	0.7
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	70	35	70
Std. Dev.	7.0	0.0	1.7
Variance	48.6	0.0	3.0
November 1995 - March 1997 (with April 1996 upset)			
Average	5.7	0.0	0.671
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	109	38	109
Std. Dev.	6.8	0.0	1.7
Variance	45.8	0.0	2.8
November 1995 - March 1997 (without April 1996 upse			
Average	4.9	0.0	0.5
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	103	38	103.0
Std. Dev	6.2	0.0	1.6
Variance	38.1	0.0	2.6
January 1996 - March 1997 (without April 1996 upset)			
Average	4.0	0.0	0.3
Minimum	0.1	0.0	-2.3
Maximum	27.4	0.0	3.3
Count	86	38	86
Std. Dev.	5.6	0.0	1.6
Variance	31.6	0.0	2.5
November 1996 - March 1997			
Average	2.3	0.0	-0.1
Minimum	0.1	0.0	-2.3
Maximum	14.0	0.0	2.6
Count	29.0	13.0	29.0
Std. Dev.	3.9	0.0	1.2
Variance	15.5	0.0	1.5

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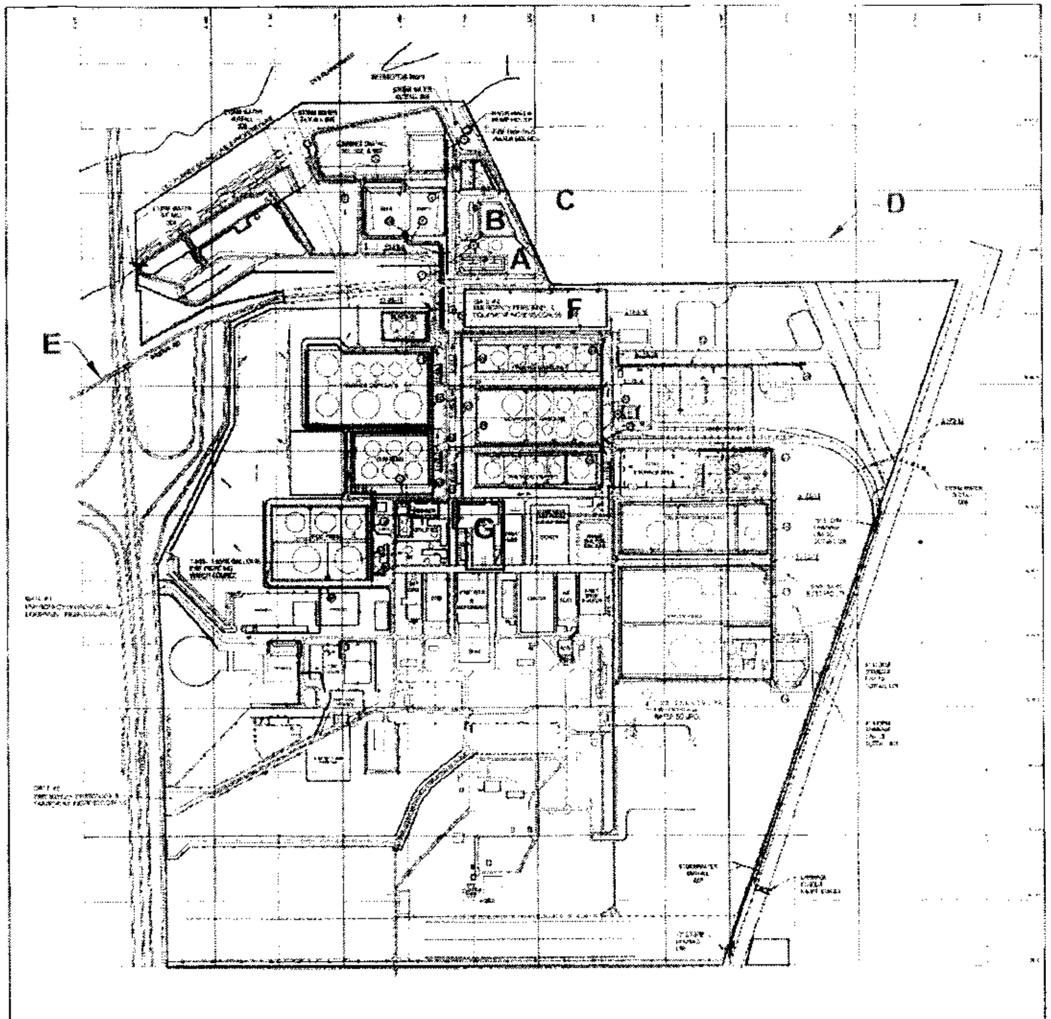

LEGEND:

A - NEW AERATION BASIN
B - STORM WATER BASIN
C - NOT OWNED BY REFINERY
D - POWER LINES
E - ARSENAL ROAD (TO BE WIDENED)
F - INSUFFICIENT ROOM FOR TANKS
G - WET GAS SCRUBBER & SELECTIVE CATALYTIC REDUCTION UNITS

NORTH

NOT TO SCALE

EXXONMOBIL REFINERY LAYOUT

ATTACHMENT 15