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NSSD Modeling Protocol
STS Project No. 1-31719XH
January 22, 2002

1.0 INTRODUCTION

1.1 Project Description

Air dispersion modeling was conducted to evaluate the ambient impact of the proposed sewage sludge drying/melting facility at North Shore Sanitary District's (NSSD) Waukegan wastewater treatment plant. The proposed facility is categorized as a minor source for purposes of New Source Review. Nevertheless, NSSD agreed to perform the refined modeling documented in this report in order to resolve public concerns regarding the project's potential air quality impact.

Modeled concentrations from the proposed NSSD facility and other local emission sources were compared with the applicable National Ambient Air Quality Standard (NAAQS) for PM10, NO_2, and SO_2. The ambient impact of the NSSD facility and Prevention of Significant Deterioration (PSD) increment-consuming sources were compared with the corresponding PSD increments.

1.2 Dispersion Modeling

The current modeling exercise is a follow-up to an air quality screening analysis performed by STS Consultants, Ltd., and submitted in support of NSSD's minor source construction permit application. The screening analysis demonstrated modeled compliance with the National Ambient Air Quality Standard (NAAQS) for PM10, NO_2, SO_2, and CO, and the EPA Reference Concentration for mercury. The Illinois EPA has requested that a detailed modeling analysis be performed for PM10, NO_2, and SO_2 to further assess the air quality near the proposed NSSD facility. Although the proposed NSSD facility is a minor source and therefore not subject to the Air Quality Analysis defined in the PSD regulations, the subject modeling study is based on the stringent PSD modeling specifications.

2.0 MODELING PROTOCOL

2.1 Model Selection

The air quality model used for this analysis was the U.S. EPA's Industrial Source Complex Short-Term (ISCST3) air dispersion model version 00101. The model was accessed through Lakes Environmental's ISC-AERMOD View™ software program version 3.15. Building downwash inputs for ISCST3 were developed using U.S. EPA's Building Profile Input Program (BPIP) version 95086. BPIP was accessed through Lakes Environmental's BPIP View™ software program version 3.14.

2.2 ISCST3 Dispersion Options

Regulatory default dispersion options as identified in Appendix W to 40 CFR Part 51—Guideline on Air Quality Models (7/99) were selected for this analysis except as noted below. Rural dispersion parameters were used. The rural dispersion option was selected because the majority of the land use within 3 kilometers of the source (excluding major water bodies) is not considered industrial, commercial, or high density residential. The area surrounding the site consists of a mostly suburban community, with 46% falling over Lake Michigan to the east. The remaining 54% includes commercial, industrial, residential and open spaces. The following table summarizes the final classification. According to the Auer Classification Scheme, over 50% of the three kilometer area surrounding the site is classified as rural.

Land Use Classification

Land Use Description	Auer Classification	Urban/ Rural	Area (Sq. meters)	Percent of total area (including Lake Mich.)	Percent of total area (excluding Lake Mich.)
Commercial	C1	Urban	1,064,576	3.67%	6.81%
Industrial	I1 or I2	Urban	1,647,801	5.67%	10.54%
Ind. or Com.	C1, I1 or I2	Urban	2,176,264	7.49%	13.92%
Residential	R2 or R3	Urban	398,300	1.37%	2.55%
Residential	not R2 or R3	Rural	4,238,499	14.59%	27.12%
Open Space	A1 or A3	Rural	5,603,183	19.29%	35.85%
Lakes or Water	A5	Rural	13,915,165	47.91%	3.21%
Total Area Urban			5,286,941	18.20%	33.82%
Total Area Rural			23,756,847	81.80%	66.18%
Total Area			29,043,788	100.00%	100.00%

2.3 Coordinate System

The Universal Transverse Mercator (UTM) coordinate system North America Datum (NAD) 27, zone 16 was used to extract coordinates for all locations associated with the modeling analysis.

2.4 Pollutants and Averaging Periods

2.4.1 PSD Significant Impact Levels

The significant levels for air quality impacts in PSD Class II areas for each modeled pollutant are identified in the following table.

NAAQS

Pollutant	Averaging Period	PSD Significance Level (µg/m^3)
PM10	Annual	1
	24-Hour	5
NO_2	Annual	1
SO_2	Annual	1
	24-Hour	5
	3-Hour	25

2.4.2 National Ambient Air Quality Standards

The NAAQSs for each modeled pollutant are identified in the following table.

NAAQS

Pollutant	Averaging Period	Standard (µg/m^3)
PM10	Annual	50 [1]
	24-Hour	150 [2]
NO_2	Annual	100 [3]
SO_2	Annual	80 [3]
	24-Hour	365 [4]
	3-Hour	1300 [4]

[1] Standard is attained when the expected annual mean is less than or equal to the standard.
[2] Standard is attained when the expected number of exceedances is less than or equal to 1.
[3] Never to be exceeded.
[4] Not to be exceeded more than once per year.

2.4.3 PSD Increments

The Class II PSD increments for each modeled pollutant and averaging time period are identified in the following table.

PSD Increments

Pollutant	Averaging Period	Increment ($\mu g/m^3$)
PM10	Annual	17 [1]
	24-Hour	30 [2]
NO_2	Annual	25 [1]
SO_2	Annual	20 [1]
	24-Hour	91 [2]
	3-Hour	325 [2]

[1] Never to be exceeded.
[2] Not to be exceeded more than once per year.

2.5 Elevated Terrain

2.5.1 Terrain Description

Topographic maps were used to review the terrain surrounding the facility. The facility is located near the western shore of Lake Michigan, about one kilometer north of downtown Waukegan. To the north and south of the plant site, the terrain is relatively flat for several kilometers. To the west of the plant, the terrain is flat until it rises in a bluff, approximately one kilometer from the plant. The top of the bluff is approximately 10 meters above the plant grade.

2.5.2 Terrain Modeling

Digital terrain data files (USGS Digital Elevation Model (DEM) files, NAD 27, scale 1:250,000) were used to determine the elevation of each modeled receptor and the base elevation for each emission source included in the analysis.

Lakes Environmental's ISC-AERMOD View™ software program was used to extract elevations for receptors and stack bases from the DEM data. The ISC-AERMOD View™ program selects the highest elevation that is located within the distance halfway to the next receptor point in all directions for each receptors point. This method is more conservative than those used by other proprietary software programs for air dispersion modeling receptor grid set-up.

2.6 Emission Sources

2.6.1 Facility Emission Sources

Facility emission sources included in the modeling analysis are identified in the following table.

Stack Emission Rates

Source Description	Units	PM10	SO2	NOx
Melter Stack	lb/hr	0.51	7.58	14.66
	g/s	0.06	0.96	1.85
Auxiliary Heater Stack	lb/hr	0.15	0.01	1.50
	g/s	0.02	0.001	0.19
Odor Control Scrubber Stack	lb/hr	0.30	0.00	0.12
	g/s	0.04	0.00	0.02

In accordance with Illinois EPA guidance, the facility's NO_x emission rates were adjusted to account for the expected NO_2/NO_X ratio value of 0.75. This ratio is per 40 CFR Part 51, Appendix W guidance.

The following stack parameters were used in modeling the facility sources.

Stack Parameters

Source Description	UTM E-W	UTM N-S	Stack Height (m)	Stack Temp. (K)	Stack Vel. (m/s)	Stack Dia. (m)
Melter Stack	432,840	4,691,563	24.38	319	9.1	0.3
Aux. Heater Stack	432,834	4,691,559	18.3	519	0.01	0.8
Odor Control Scrubber Stack	432,802	4,691,592	15.2	319	11.6	1.5

2.6.2 External Emission Sources

Emission data for external sources expected to impact within the modeling domain were provided by Illinois EPA. External sources within five kilometers of the proposed NSSD facility were provided by IEPA. Some of the sources provided by IEPA were no longer in operation or had incorrect coordinates. These sources were not included in the modeling.

In accordance with Illinois EPA guidance, NO_x emission rates from external sources were adjusted to account for the expected NO_2/NO_X ratio value of 0.75. This ratio is per 40 CFR Part 51, Appendix W guidance.

External Sources

Facility	Source IDs	PSD Source
PM10 Emissions		
Midwest Generation, LLC	00001, 00002, 00004-00007, 00009-00010, 4	
Outboard Marine Corp.	00011-00018, 14-35	
National Gypsum Company	00019, 00021-00022, 39-46	
Akzo Nobel Aerospace Coating Inc.	12-13	
LaFarge Corporation	47-49	
Lake Shore Foundry Co.	50-52	
Lakeside Energy Facility	P0428-P0444	X
NOx Emissions		
Midwest Generation, LLC	00001-00005	
Outboard Marine Corp.	00006-00021	
National Gypsum	00022-00024	
North Shore Printers	00025	
Victory Memorial Hospital	00026-00028	
Cherry Electric	00029	
Lakeside Energy Facility	P0428-P0434	X
SO2 Emissions		
Midwest Generation	00001-00004	
National Gypsum Company	00005-00006	
Lakeside Energy Facility	P0428-P0434	X

2.7 Background Concentrations

For the NAAQS analysis, a regional background concentration was added to each pollutant/averaging time combination. These values, based on monitoring data, were provided by IEPA.

2.8 Building Downwash

Building downwash effects were incorporated in the modeling analysis for all NSSD point sources. Building downwash inputs for ISCST3 were calculated using BPIP. Building lateral dimensions for input into BPIP for NSSD sources were estimated from facility plot plans. Each building tier was individually entered.

2.8.1 Good Engineering Practice Stack Height

None of the proposed emission release points exceeds the calculated GEP stack height, so they were modeled using their actual physical stack height.

2.9 Receptors

Receptors were placed at approximately 50 meter intervals along the facility property line. A Cartesian receptor grid was laid out to a maximum of 3,000 meters from the melter stack. From the property line out to 1,000 meters from the melter stack, receptor grid spacing was 100 meters. From 1,000-3,000 meters from the melter stack, receptor grid spacing was 250 meters.

The receptor grid places receptors on property owned by one or more external sources included in the analysis. If modeled concentrations at those receptors exceed applicable increments/standards, the model was rerun, excluding any impact on each property attributable to the sources located on each property. This is because these receptors do not constitute “ambient air”, with respect to the resident source(s).

If any notable "high impact areas" were encountered outside the 100 meter grid domain, the model was rerun with 100 meter grid spacing in those areas.

2.10 Meteorology

Five years (1982-1986) of representative meteorological data were used in the modeling. Surface data was drawn from Milwaukee, Wisconsin. Upper air data was drawn from Green Bay, Wisconsin.

3.0 RESULTS

The preliminary modeling analysis demonstrated that PM10, NO_2, and SO_2 emissions from the proposed NSSD facility would result in ambient air concentrations exceeding the PSD significant impact levels, thereby warranting a full impact modeling analysis, including the impact of nearby external sources. The full impact modeling analysis demonstrated that emissions from the proposed NSSD facility and nearby external sources would not result in modeled ambient concentrations that exceed either the NAAQS or the PSD increment thresholds for PM10, NO_2, and SO_2.

Electronic versions of modeling input/output files are located in Appendix A.

3.1 Preliminary Modeling Results

The preliminary modeling results identified those receptors at which PM10, NO_2, and SO_2 emissions from the proposed NSSD facility may cause ambient air concentrations to exceed their respective PSD significant impact thresholds. The largest impact area for each pollutant was determined from the preliminary results. The impact area was defined as a circular area with a radius extending from the proposed facility to the most distant point where the modeling predicted that a significant impact would occur for each pollutant. The impact area for each pollutant defined the area for which a full impact analysis was conducted.

The preliminary modeling results are summarized in the following table. Isopleth maps were also prepared to graphically illustrate the area impacted by the proposed NSSD facility for each modeled pollutant and applicable averaging time period. The isopleth maps are located in Appendix B.

Preliminary Modeling Results

	PM10		SO2			NO2
	Annual	24-Hr	Annual	24-Hr	3-Hr	Annual
1982	1.3	8.7	8.7	67.2	224.9	19.6
1983	1.3	7.9	8.0	67.9	168.2	18.2
1984	1.3	7.4	8.3	53.2	196.7	18.7
1985	1.2	7.7	8.9	61.7	194.7	19.9
1986	1.3	10.0	9.7	66.1	186.4	21.9
Worst-Case	1.3	10.0	9.7	67.9	224.9	21.9
Significant Impact Threshold	1	5	1	5	25	1
Significant Impact Distance (m)	100	300	600	2000	2250	1750

3.2 Full Impact Modeling Results – NAAQS

The NAAQS modeling results demonstrated that emissions from the proposed NSSD facility and nearby external sources would not result in modeled ambient concentrations that exceed the NAAQSs for PM10, NO_2, and SO_2. The NAAQS modeling results are summarized in the following table.

Full Impact Modeling Results – NAAQS

	PM10		SO2			NO2 [1]
	Annual	24-Hr	Annual	24-Hr	3-Hr	Annual
1982	---	---	8.9	63.2	150.1	20.2
1983	---	---	8.2	67.5	157.2	18.8
1984	---	---	8.6	50.5	164.9	19.4
1985	---	---	9.2	59.0	159.1	20.6
1986	---	---	10.0	56.2	153.3	22.6
Worst-case	11.3	62.8	10.0	67.5	164.9	22.6
Background	21.0	50.0	7.9	76.0	167.7	33.8
Total	32.3	112.8	17.9	143.5	332.6	56.4
Standard	50	150	80	365	1300	100
% of Standard	64.6%	75.2%	22.4%	39.3%	25.6%	56.4%

Note:

[1] An initial NO_2 NAAQS modeling analysis indicated that sources associated with one specific facility were contributing greatly to high ambient concentrations within that facility's property boundary. Because this is not considered ambient air for that facility, further analysis was conducted to determine the impact from all sources (including NSSD) not associated with that facility. That analysis indicated that all sources not associated with that facility would not result in ambient concentrations that exceed the NAAQS for NO_2. The results from that analysis are presented in the table.

3.3 Full Impact Modeling Results – PSD Increment

The PSD increment modeling results demonstrated that emissions from the proposed NSSD facility and nearby PSD-consuming external sources would not result in modeled ambient concentrations that exceed the PSD increment thresholds for PM10, NO_2, and SO_2. The PSD modeling results are summarized in the following table.

Full Impact Modeling Results – PSD

	PM10		SO2			NO2
	Annual	24-Hr	Annual	24-Hr	3-Hr	Annual
1982	1.3	6.8	8.7	63.0	146.1	19.6
1983	1.3	7.6	8.0	67.3	150.9	18.2
1984	1.3	6.4	8.3	50.4	162.3	18.8
1985	1.2	6.4	8.9	58.9	137.2	20.0
1986	1.3	6.8	9.7	56.2	153.3	21.9
Worst-case	1.3	7.6	9.7	67.3	162.3	21.9
Increment	17	30	20	91	325	25
% of Increment	7.6%	25.3%	48.5%	74.0%	49.9%	87.6%

Appendix A

Modeling Electronic Input and Output Files

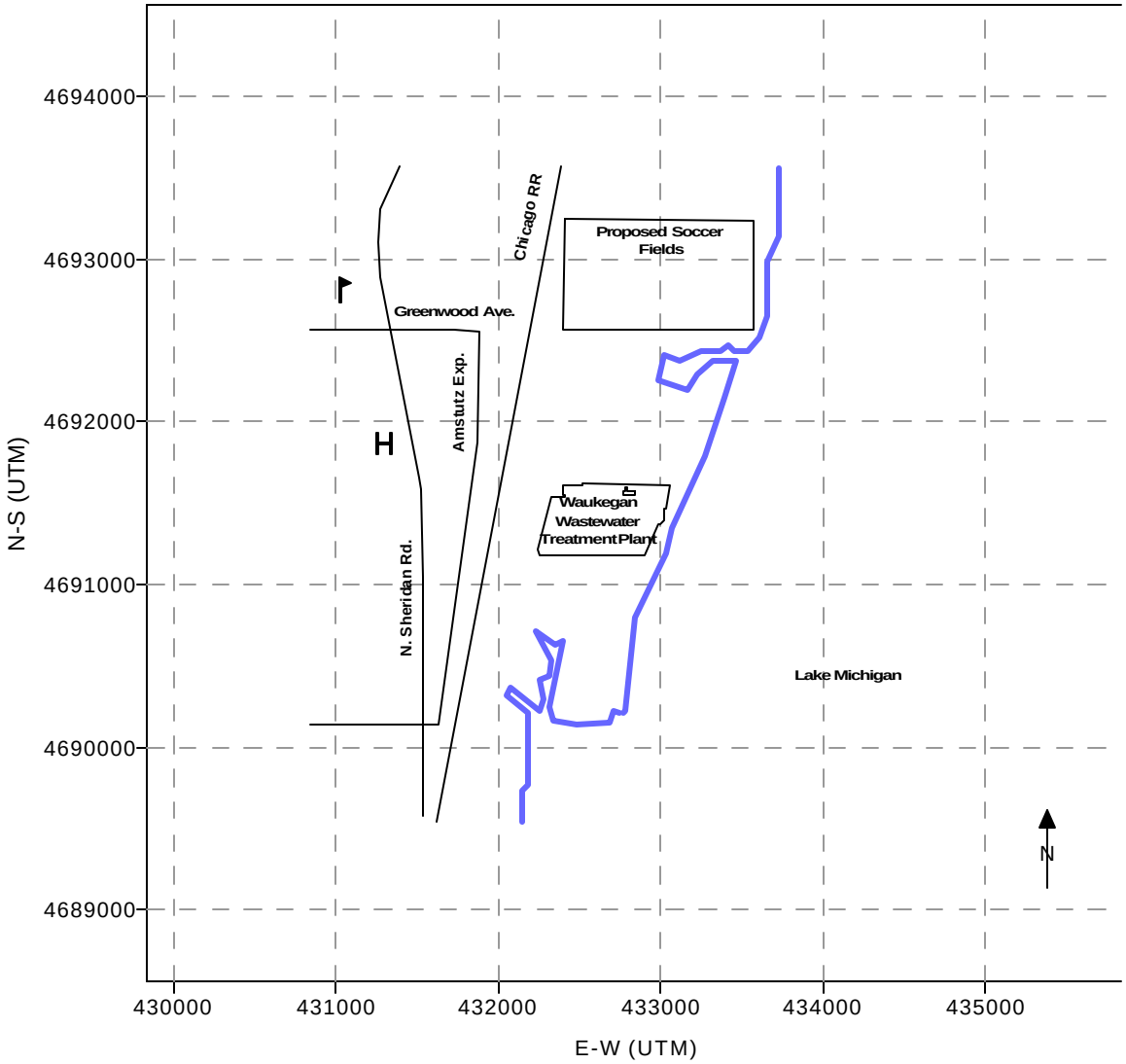
(IEPA Copy Only)

Appendix B

NSSD Impact
Isopleth Maps

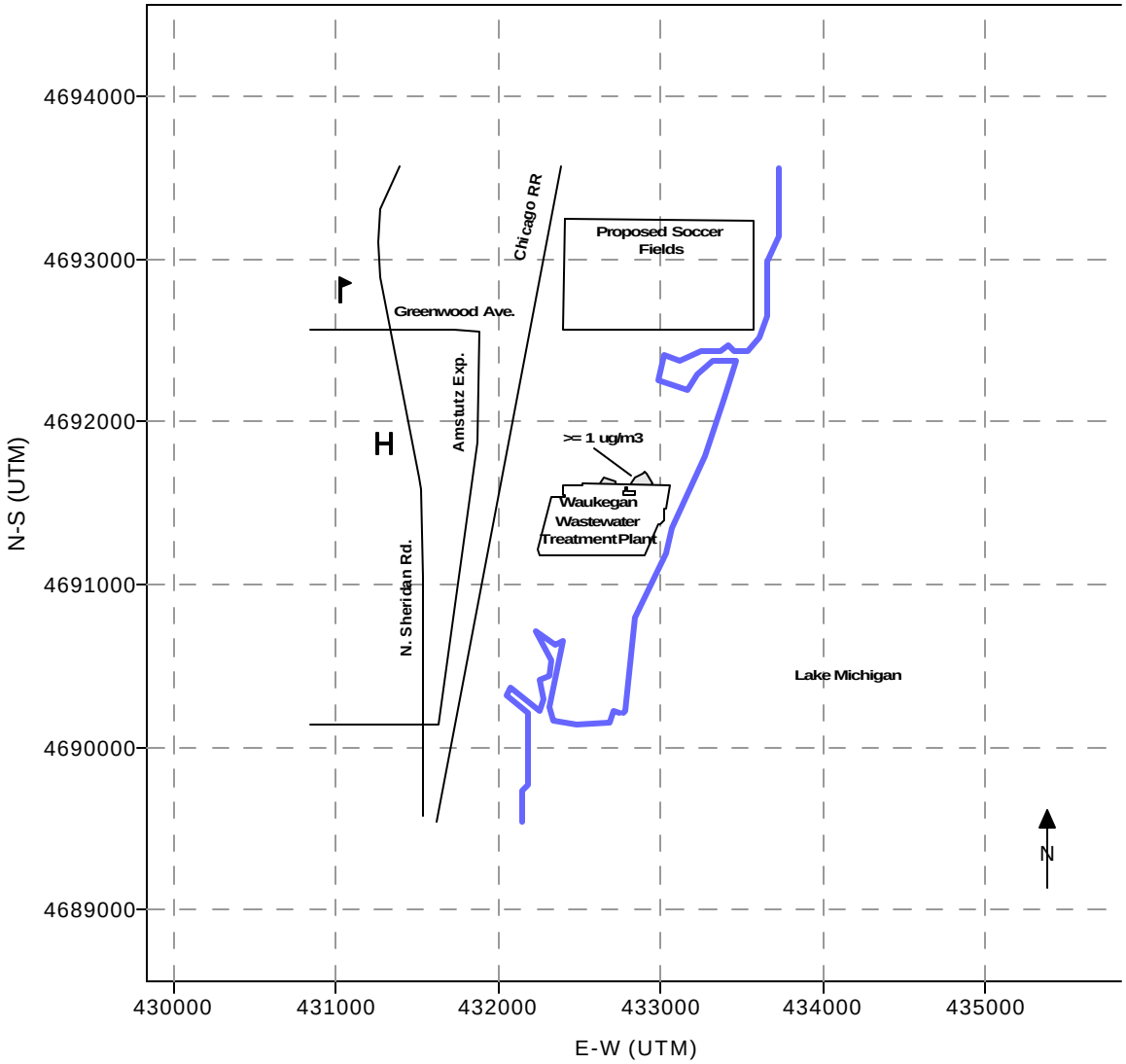
PM10

Highest Annual Average Concentration



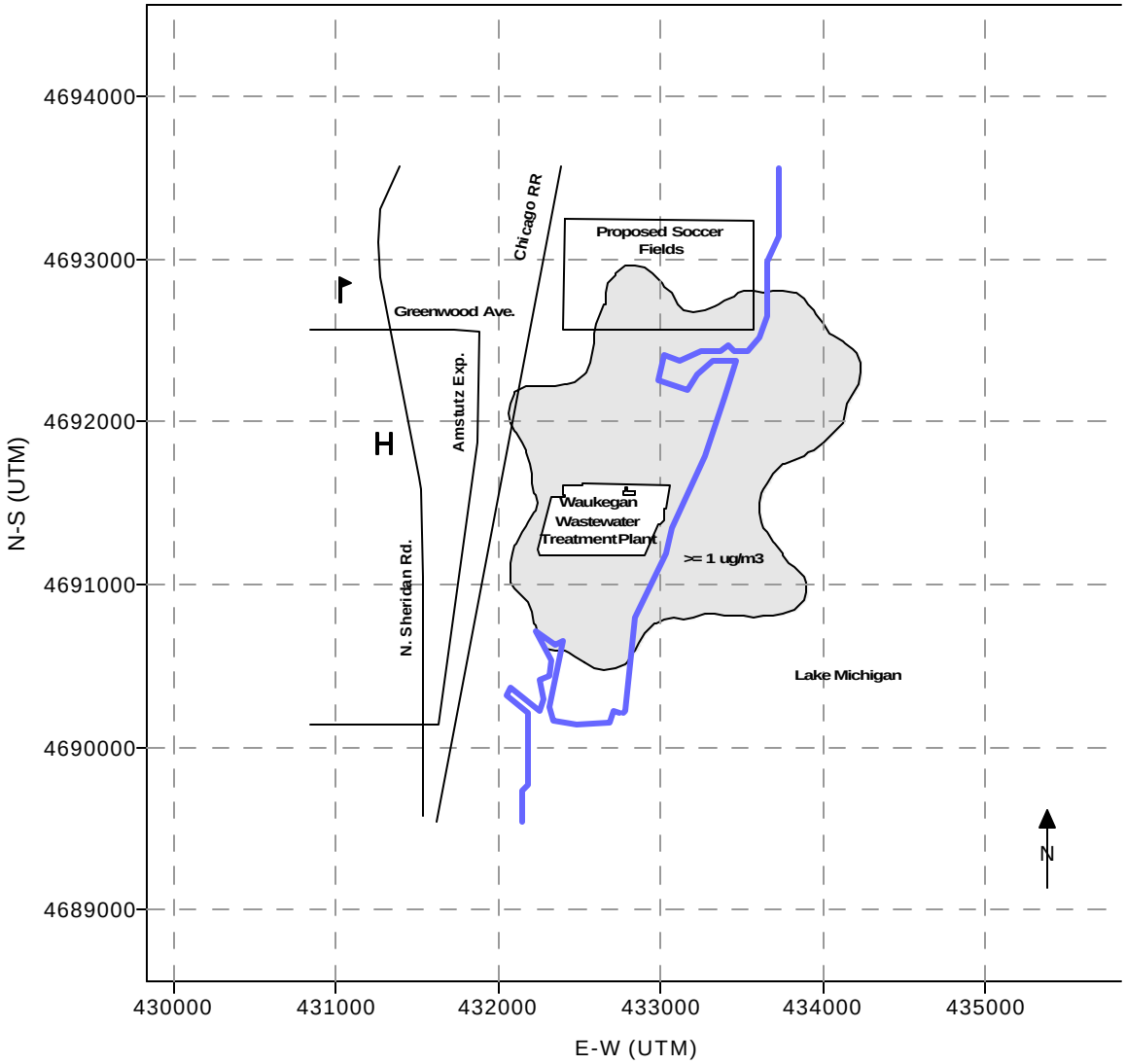
PM10

Highest 24-Hour Average Concentration



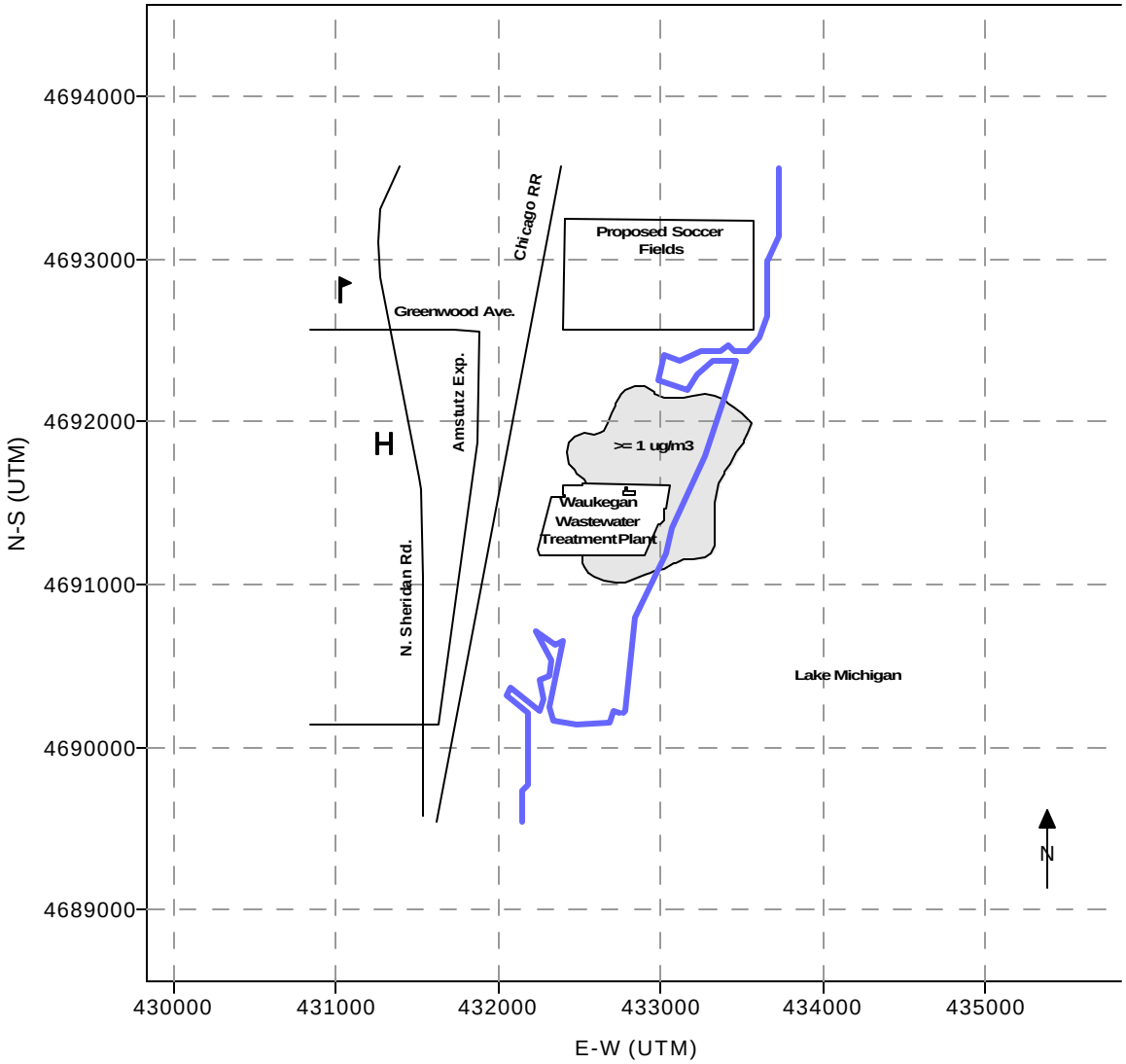
NO2

Highest Annual Average Concentration



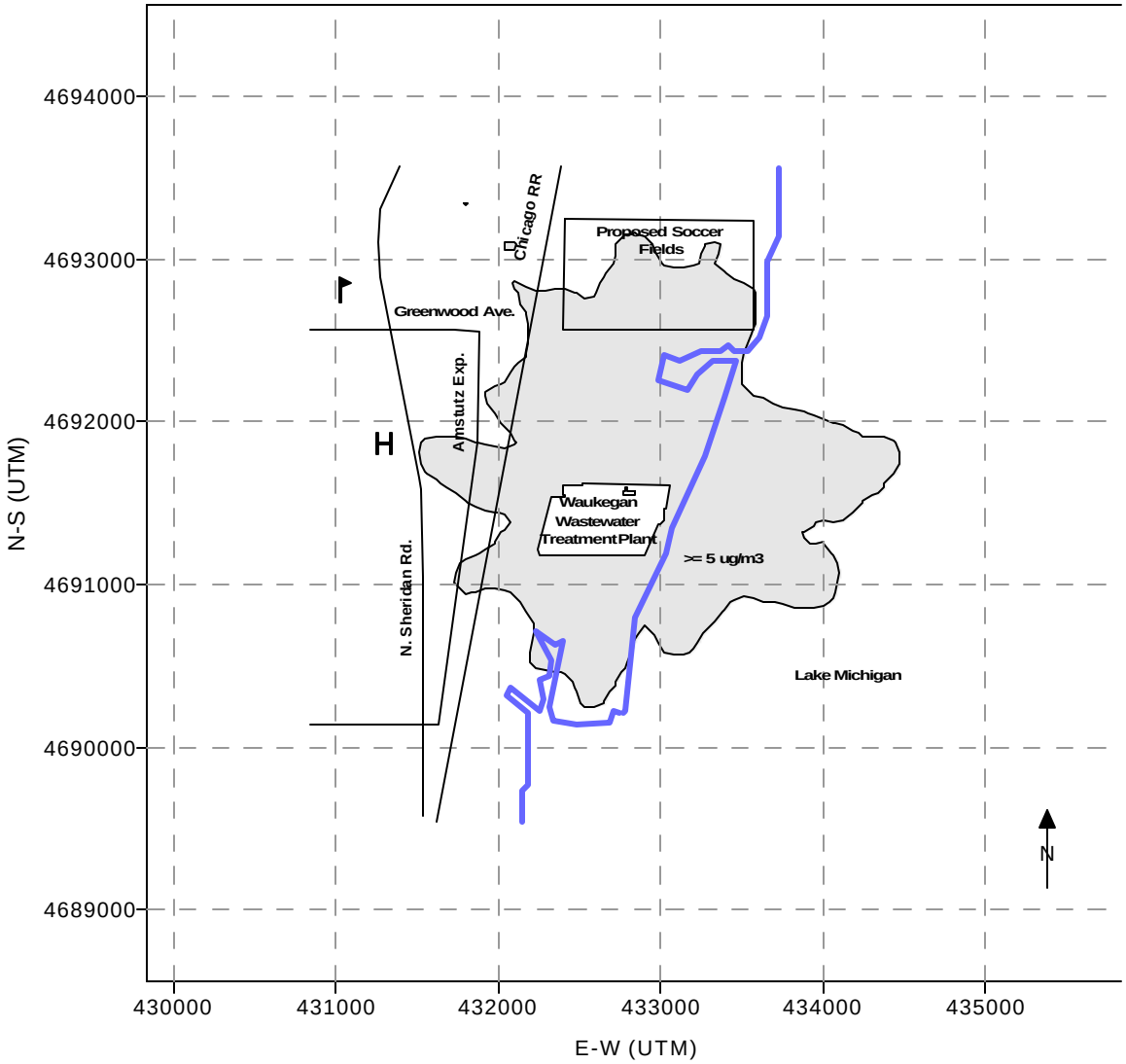
SO2

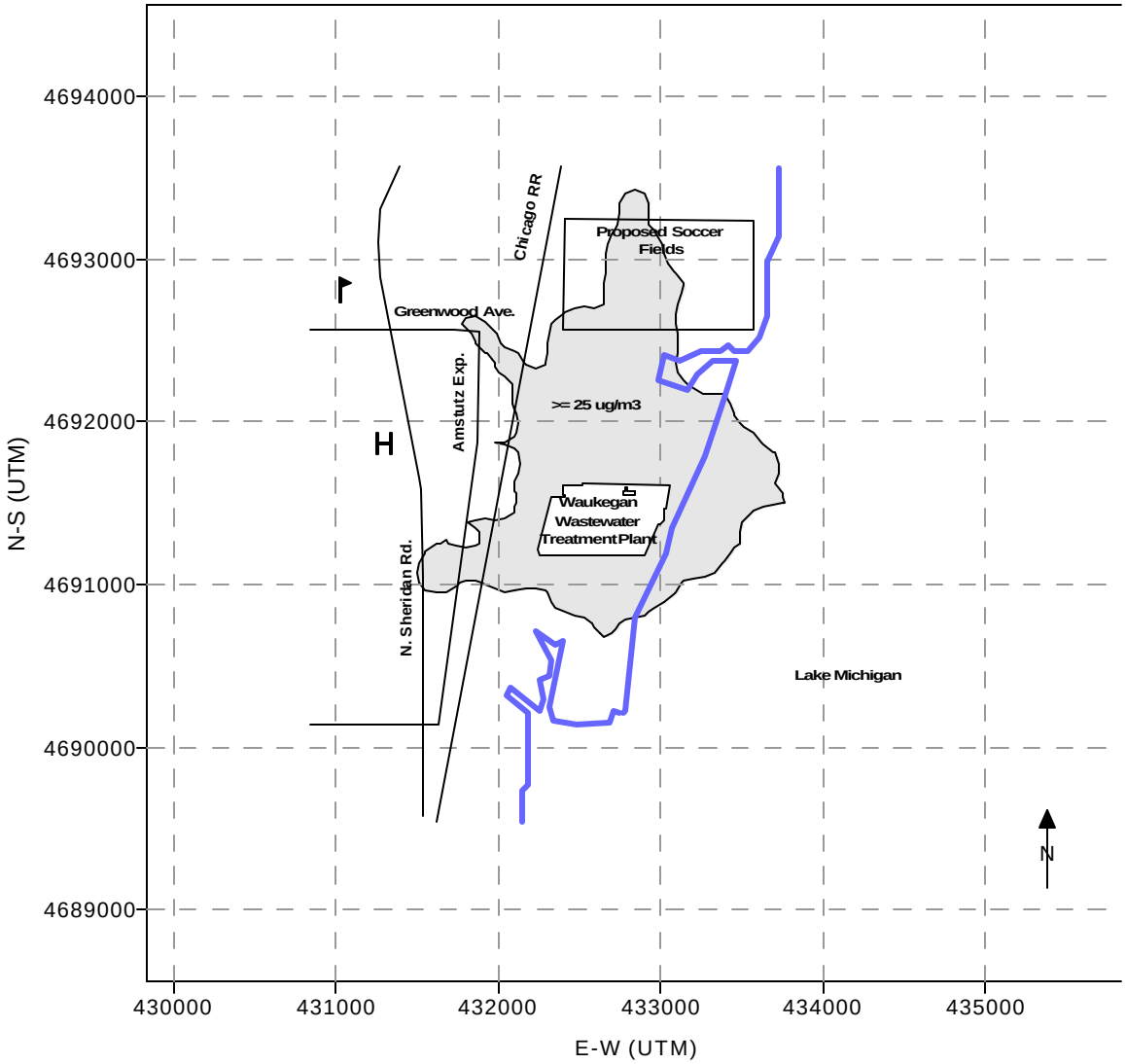
Highest Annual Average Concentration



SO2

Highest 24-Hour Average Concentration



SO2

Highest 3-Hour Average Concentration