Nebraska Public Power District

Sulfur Dioxide 1-Hour NAAQS Designations Modeling

for

Sheldon Station (Facility ID #33563)
Hallam, Nebraska

For submittal to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 N Street
P.O. box 98922
Lincoln, Nebraska 69509-8922

Prepared by:

HDR Engineering, Inc.

September 11, 2015

INTRODUCTION

This modeling report summarizes dispersion modeling of Sheldon Station to demonstrate attainment with the sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) for the 1-hour averaging period, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$). This modeling has been completed for submission to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the NAAQS designations. Although the Lincoln-Lancaster Health Department has air emissions permitting authority for Sheldon Station, the NDEQ has responsibility for review of all Nebraska dispersion modeling for SO_2 NAAQS designations.

The modeling in this report demonstrates compliance with the SO_2 1-hour NAAQS by inclusion of stack height increases for the Unit 1 and 2 boiler stacks. Given that NPPD has not yet decided if or when Unit 2 might be converted to gaseous fuel containing negligible sulfur, this modeling report provides results for two operating scenarios. One scenario includes only Unit 1 operating on coal, and assumes an increase in Unit 1 stack height from 174 feet to 199 feet. The second scenario assumes both Unit 1 and Unit 2 are operating on coal, and assumes an increase in the height of both stacks to 215 feet. Note that while the de minimis good engineering practice (GEP) stack height is 65 meters (213 feet), the prospective height of the stacks for the second operating scenario is well below the calculated GEP height of 102.3 meters (335.6 feet) for each stack.

While the modeling for each of the two scenarios described above demonstrates compliance with the NAAQS, NPPD has not made final design decisions on actual stack heights or other modifications to be installed, but plans to make sufficient facility modifications to demonstrate compliance with the NAAQS, regardless of whether one or both units continue with operation on coal.

MODELING PROTOCOL

The dispersion modeling results summarized in this report were obtained using the EPA's AERMOD dispersion modeling system, using the modeling procedures and data as described in a modeling protocol developed in collaboration with NDEQ, as provided in Attachment 1 to this report. In addition to this report, this submittal to NDEQ includes a compact disk/DVD containing all the data files listed at the end of the modeling protocol in Attachment 1.

MODEL INPUTS

This modeling report contains figures detailing the modeled sources, receptors, background SO_2 concentration and meteorological data locations, and the resulting 1-hour SO_2 modeled impacts. The SO_2 modeling was conducted in accordance to the attached detailed dispersion modeling protocol.

Figure 1 displays the source locations of the two point sources included in the model, which are the coal-fired boiler stacks for Sheldon Station Unit 1 and Unit 2.

Figure 1: Source Locations

Figure 2 displays the receptor locations as specified in the attached dispersion modeling protocol in accordance with NDEQ guidance.

Figure 2: Receptor Locations

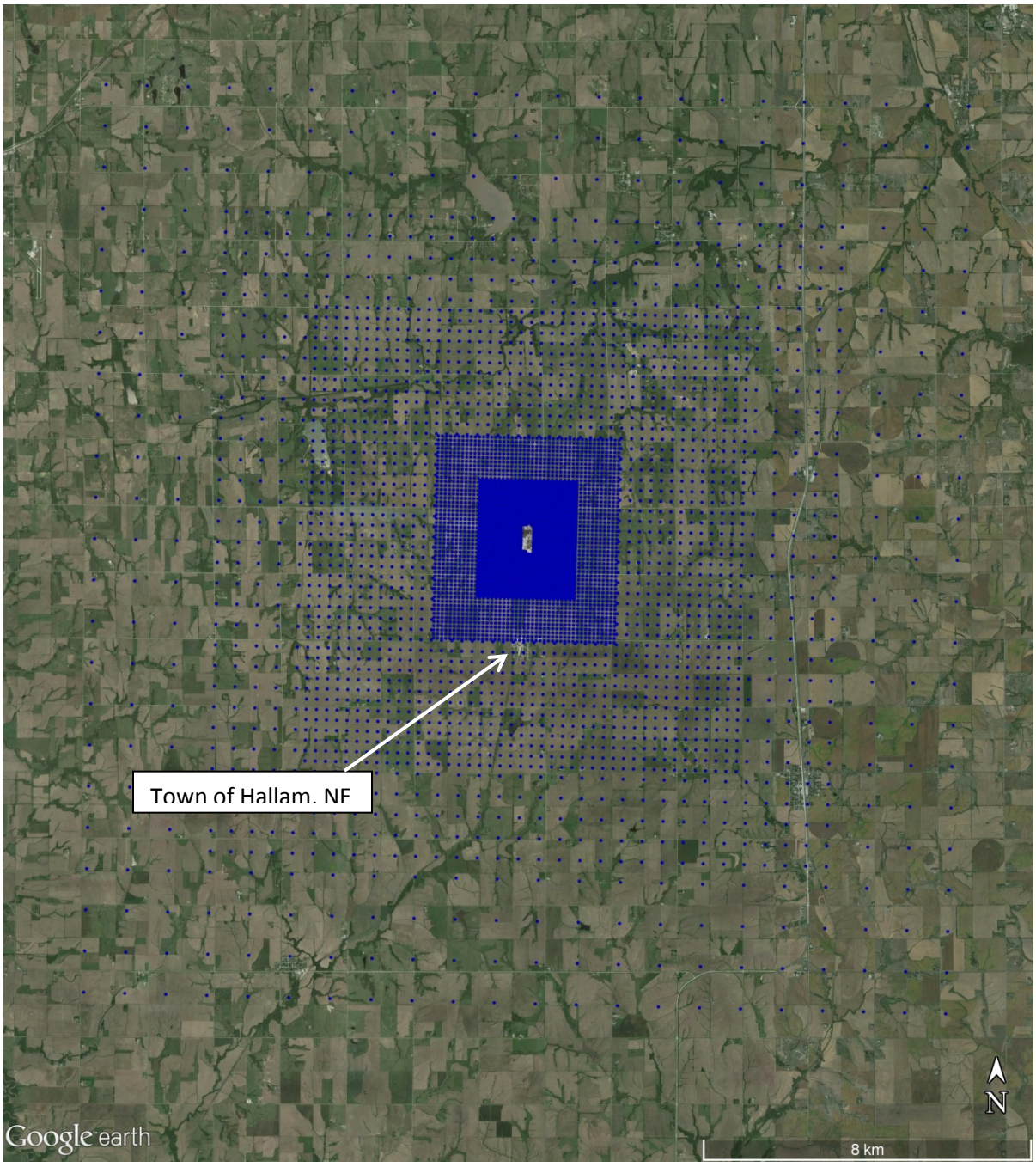
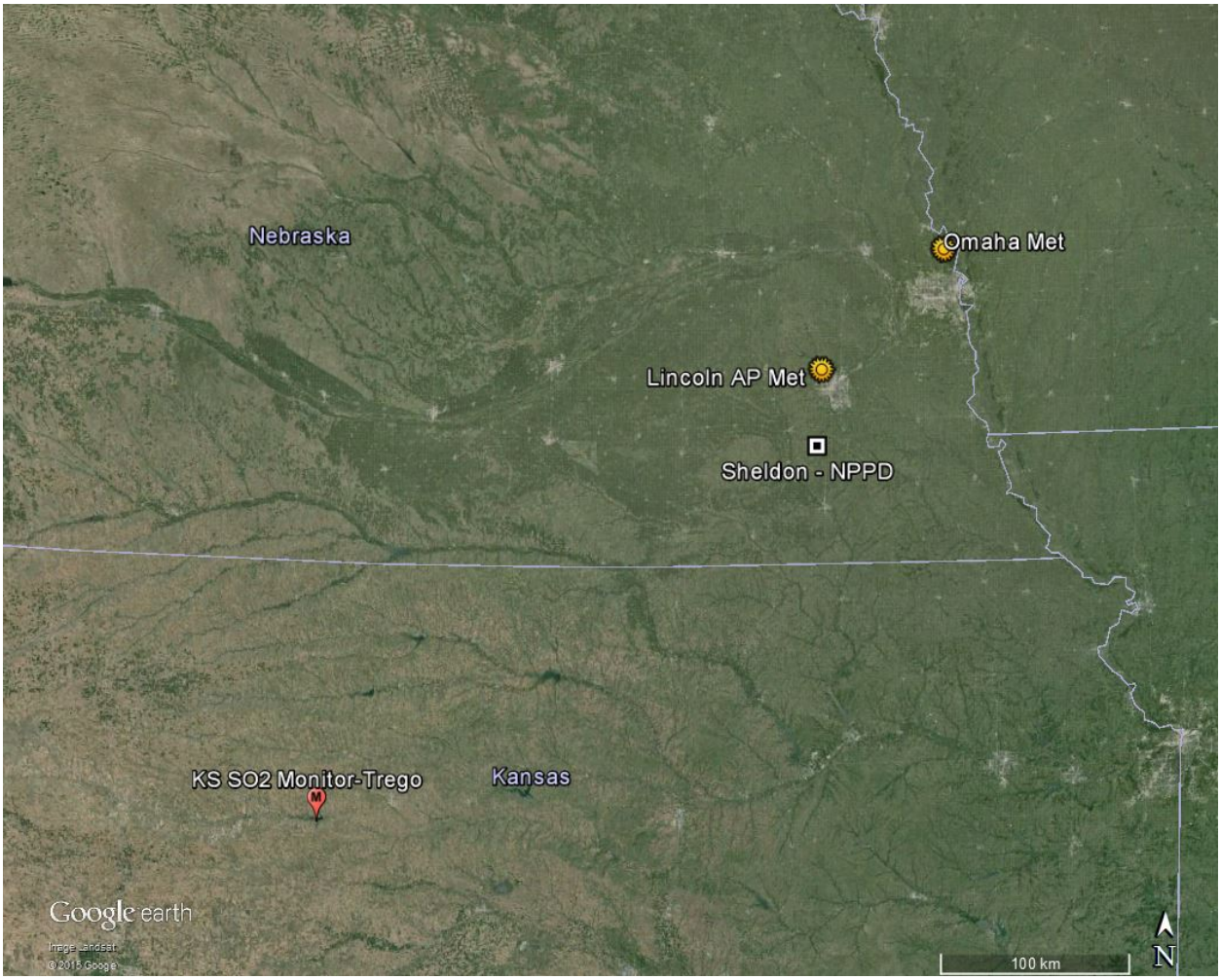


Figure 3 displays the Sheldon Station location in relation to the background SO_2 monitor location (Trego County, Kansas) and meteorological data stations for surface data (Lincoln, Nebraska) and upper-air data (Omaha, Nebraska).

Figure 3: Site, Monitor, and Meteorological Station Locations.



The stack parameter inputs for Sheldon Station Units 1 & 2 are provided in Table 1. The stack temperature and velocity are placeholder design values. Actual temperature and velocity data were input to the AERMOD model on an hourly basis with an hourly emission file that contains emission rates, stack temperatures and exit velocities for both stacks for each hour of the model simulation, which spanned the years 2012-2014. Note that the stack heights listed represent increases from the current 174 feet (53 meters) stacks on both units. Under Scenario 1, only the Unit 1 stack would be raised to 199 feet (60.66 meters) and under Scenario 2, Unit 1 and Unit 2 stacks would be raised to 215 feet (65.53 meters).

Table 1: Source Input Data for Modeling Analysis

Source ID	UTM Coordinates X (m)	UTM Coordinates Y (m)	Base Elevation (m)	Stack Height (m)	Stack Temperature (Deg. K)	Stack Exit Velocity (m/s)	Stack Diameter (m)
Unit 1	687597.9	4492175.0	438.9	60.66/65.53	452	26.88	3.54
Unit 2	687585.2	4492213.3	438.9	65.53	450	26.81	3.54

The hourly emissions data files input to AERMOD were based on continuous emissions and stack parameter monitoring data, which have been collected and reported consistent with Acid Rain program monitoring procedures as provided in 40 CFR 75. The hourly emissions data file (including stack exhaust temperature and velocity data) is provided electronically on the CD/DVD accompanying this report.

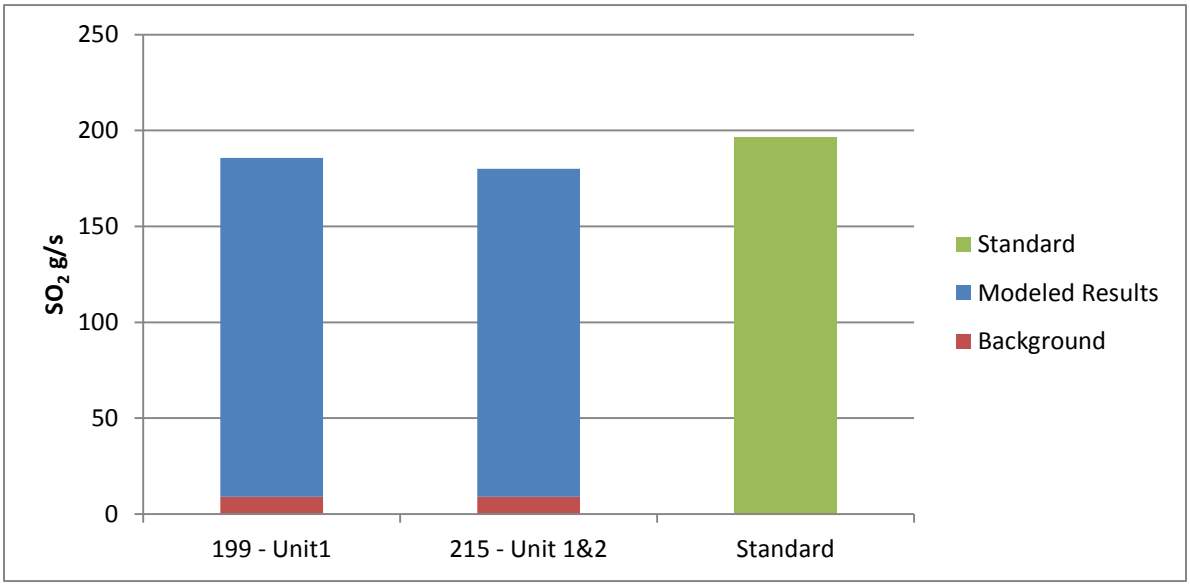
MODEL RESULTS

Modeled design impact for the 3-year average (2012-2014) 1-hour SO_2 concentration is summarized in Table 2 and presented visually in Figure 4, for both operating scenarios. The 4th high 3-year average concentrations are compared with the 1-hour SO_2 NAAQS of 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter (µg/m^3). The background 1-hour SO_2 concentration of 9 µg/m^3 was added to the modeled concentration for each scenario. The modeled plus background concentrations are below the NAAQS for each scenario, as shown in Table 2.

Table 2: Modeled Impacts (with background of 9 µg/m^3)

Pollutant	Avg. Period	Scenario	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)	Modeled Concentration (µg/m^3)	Modeled Plus Background (µg/m^3)	NAAQS (µg/m^3)
SO_2	1-hour	Unit 1 Only	687950	4491850	176.6	185.6	196.5
SO_2	1-hour	Unit 1 & 2	688050	4491750	171.0	180.0	196.5

Figure 4: Modeled Result vs. SO_2 Standard



Figures 5 and 6 are contour plots of the modeled 1-hour design concentrations (not including background), for operating scenarios 1 and 2, respectively. These plotted data represent the average of the daily maximum 4th high values over the 3 years of meteorological data. The black box surrounding the contour lines indicates the extent of the receptor grid. The contour levels are: Orange: 100 µg/m^3, Yellow: 130 µg/m^3, and Pink: 160 µg/m^3.

The location of the maximum 4th high 3-year average modeled (without background) is displayed for reference in each plot. For each operating scenario, this maximum was only a few hundred meters southeast of the boiler stacks.

Figure 5: Contour Plot of SO_2 1-Hour Design Concentrations (µg/m^3) – Unit 1 Only

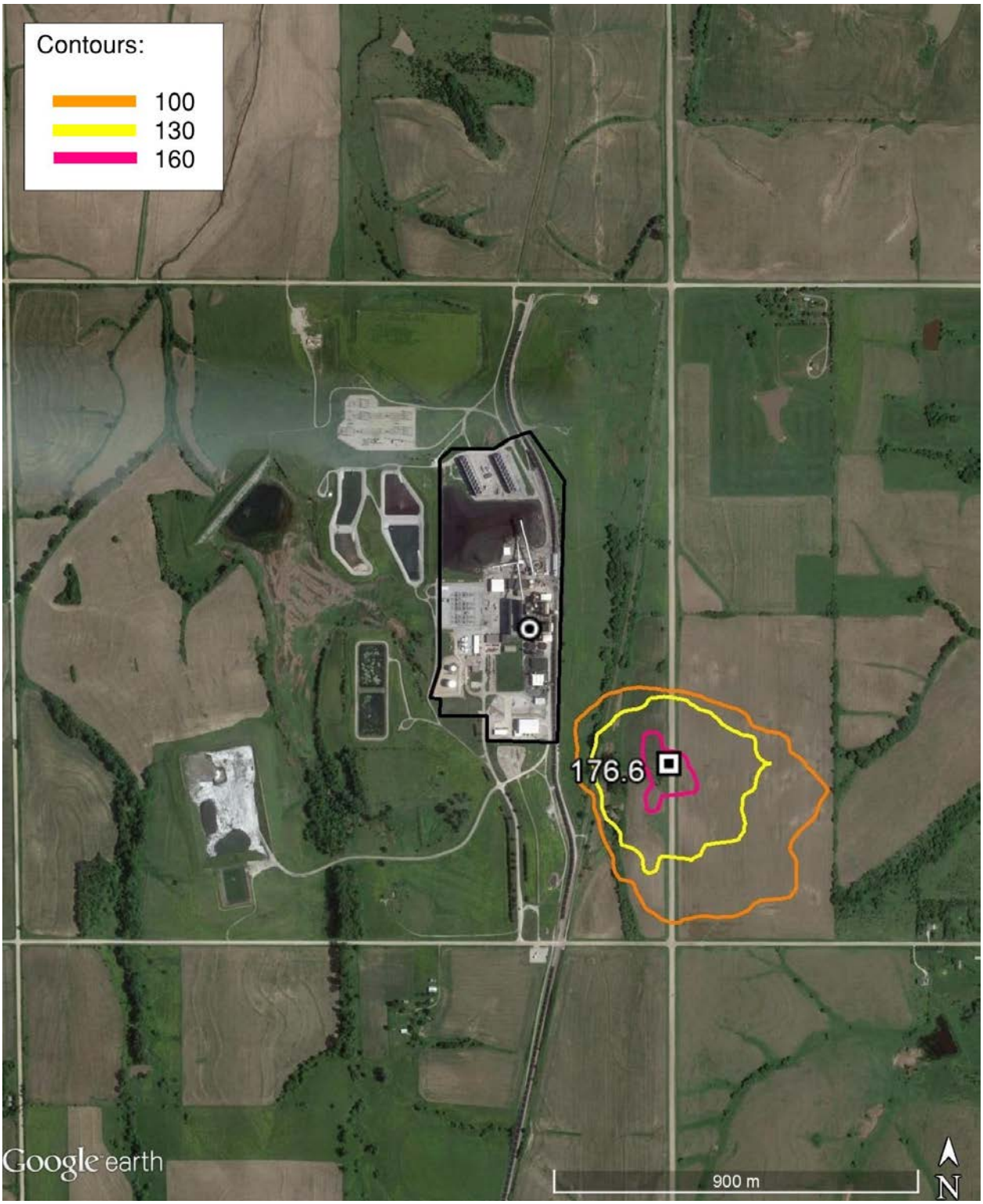
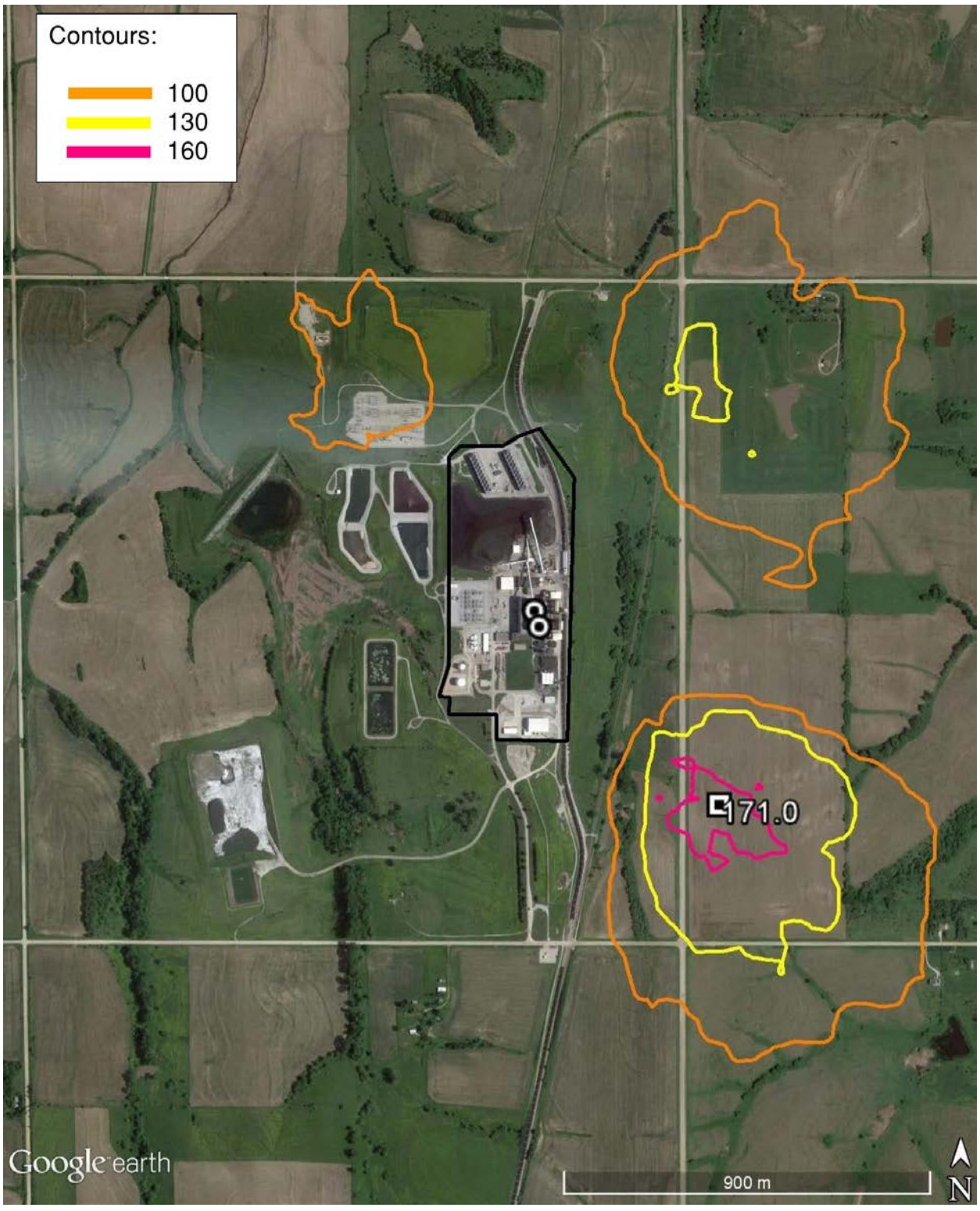


Figure 6: Contour Plot of SO_2 1-Hour Design Concentrations (µg/m^3) – Units 1 & 2



CONCLUSION

This modeling analysis shows that the design maximum SO_2 impact from Sheldon Station, when added to the estimated background concentration of 9 µg/m^3, would comply with the SO_2 1-hour NAAQS of 196.5 µg/m3 (75 ppb) for each operating scenario, with the associated adjustments in stack heights. NPPD may elect to modify stack heights differently than those analyzed here, but these results show that relatively modest increases in stack height will demonstrate compliance with the 1-hour SO_2 NAAQS for only the Unit 1 boiler operating on coal, or both the Unit 1 and 2 boilers operating on coal.

Sulfur Dioxide 1-Hour NAAQS Designations Modeling Protocol
Nebraska Public Power District, Sheldon Station (Facility ID #33563)
Hallam, NE
July 15, 2015

INTRODUCTION

This modeling protocol addresses proposed dispersion modeling for the Nebraska Public Power District (NPPD) Sheldon Station, in Lancaster County, near Hallam, Nebraska. The protocol summarizes the information that will be used to conduct dispersion modeling with respect to the National Ambient Air Quality Standard (NAAQS) for 1-hour average sulfur dioxide (SO_2) concentration, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$)

This protocol has been prepared for 1-hour SO_2 State Implementation Plan (SIP) dispersion modeling and is being submitted to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the NAAQS attainment/nonattainment area designations for SIP purposes. EPA will review and use this information, along with any available monitoring data, to propose and finalize attainment/nonattainment designations for affected areas with respect to the 1-hour SO_2 NAAQS.

MODELING SOFTWARE

The following EPA modeling software will be used for this analysis.

- AERMOD (Version 14134)
- BPIP-Prime (Version 04274)
- AERMAP (Version 11103)

The AERMOD model will be executed using the rural dispersion mode, given the predominantly rural character of the land surrounding the subject facility.

METEOROLOGICAL DATA

Meteorological data for this analysis will be provided by NDEQ in preprocessed format, based on the most recent versions of AERMET (Version 14134), AERMINUTE (Version 14337), and AERSURFACE (Version 13016).

The surface meteorological will be from Lincoln, Nebraska and the upper air data will be from Omaha, Nebraska, which are considered representative of the Hallam area. This analysis will use three years of meteorological data for the years 2012 through 2014.

POLLUTANT AND AVERAGING PERIOD

The AERMOD model will be executed for SO_2 for 1-hour averages. By selecting SO_2 as the pollutant and 1-hour as the averaging period, AERMOD will automatically average the results over the three years of meteorology. The model result for comparison with the 1-hour SO_2 NAAQS of 196.5 $\mu g/m^3$ (75 parts per billion) will be the maximum of the 3-year average of the 4th highest (99th

percentile) daily 1-hour maximum concentration, as automatically output by AERMOD from the multiyear (3-year) model run.

POINT SOURCES

Emission points to be modeled for Sheldon Station will include only the Unit 1 and 2 coal boiler stacks. The NDEQ and EPA have reviewed the other emissions sources in the region and determined that there are no nearby sources with large enough emissions to be included in a modeling analysis together with Sheldon Station. Thus, total impact for comparison with the NAAQS will consist of Unit 1 for Scenario 1, and Unit 1 and Unit 2 combined for Scenario 2, plus the background concentration (see below). The AERMOD output will be set up to produce source contributions for each unit, plus the total ("ALL" source group) concentrations.

The actual, hourly SO_2 emissions measured by the continuous emissions monitoring system (CEMS) on the Unit 1and 2 stacks will be used for this analysis, by using the optional hourly emissions input file for input to AERMOD. The single hourly emissions file will correspond with the same period of record represented by the three year period of meteorological data (2012-2014) input to AERMOD.

In addition to hourly SO_2 emissions in grams/second, the hourly emissions file will include hourly average stack gas exhaust temperature and exhaust gas exit velocity. These additional hourly parameters will be based on measurements recorded by the same CEMS systems being used to track hourly SO_2 emissions for each stack, in accordance with the routine monitoring requirements under 40 CFR 60 (New Source Performance Standards) and 40 CFR 75 (Continuous Emission Monitoring under the Acid Rain program).

In addition to the stack heights and the hourly emissions and stack parameters described above, the only other stack parameters needed by AERMOD are the stack exit diameters. The stack diameters to be input for Units 1 and 2 will be identical at 11.6 feet (3.536 m), based on the current design of these stacks.

BUILDING DOWNWASH INPUTS

The AERMOD input will include building downwash parameters calculated using the EPA's Building Profile Input Program "PRIME" (BPIPPRIME) software (Version 04274). The BPIPPRIME input and output (I/O) files will be provided along with all the other modeling I/O files on CD with the final modeling report.

TERRAIN ELEVATIONS

Terrain data will be processed to determine receptor elevations and "hill heights" for input to AERMOD using AERMAP, Version 11103. The AERMAP input will include terrain elevation data from the National Elevation Dataset (NED). The NED data available on-line in 1 arc-second spacing from the US Geological Survey will be used for this analysis. The receptor grid (extent defined below) will include receptors only in UTM Zone 14. The NED data for this analysis will be based on North American Datum (NAD) 83 for horizontal locations and NAD88 for vertical locations (elevations).

The NED terrain file downloaded from the USGS will be provided on CD along with all other model I/O files.

RECEPTOR GRID

Given there will be no nearby facilities included in this analysis, the receptor grid can be focused on just Sheldon Station. The receptor grid will include the following spacing on the fence lines and at downwind distances from the nearest fence lines.

- 50 meter spacing on the fence line
- 50 meter spacing from the fence to 1 kilometer from the fence
- 100 meter spacing from 1 kilometer to 2 kilometers from the fence
- 250 meter spacing from 2 kilometer to 5 kilometers from the fence
- 500 meter spacing from 5 kilometer to 7 kilometers from the fence
- 1000 meter spacing from 7 to 10 kilometers from the fence

The extent of this receptor grid is shown in the figure at the end of this protocol, and based on prior modeling experience, is expected to encompass areas of maximum 1-hour SO_2 concentration.

Any hot spots in the 250 meter and coarser receptor spacing will be refined by performing a separate model run centered on the hot spot, with a 1000-meter by 1000-meter grid of 50-meter spacing centered on the highest impact receptor from the initial model run.

BACKGROUND CONCENTRATION

The background 1-hour SO_2 concentration will be based on data from the rural monitor located at Cedar Bluff Reservoir (EPA Site ID number 201950001) in Trego County in western Kansas. This monitor is far from any nearby large SO_2 sources, so is representative of background concentrations in rural areas of Nebraska exclusive of nearby major source impacts.

Given that there are apparent monitor operational problems evidenced in the data for the most recent year of complete data, 2014, the background concentration will be based on the next most recent three years of available data, those being 2011-2013. The table below shows the calculated average of the 99th percentile daily maximum 1-hour value as 8.7 µg/m^3 across the three years. Therefore, a background 1-hour SO_2 concentration of 9 µg/m^3 will be used for this analysis.

	Daily Maximum 1-hour, 99th Percentile	
Year	**(ppm)**	**(µg/m^3)**
2011	3	7.9
2012	4	10.5
2013	3	7.9
Average	**3.3**	**8.7**

MODELING REPORT

A final modeling report will be submitted to NDEQ for review, describing modeling procedures (attaching this protocol), mitigation features (design changes), if any, proposed by the utility, and including all model and preprocessor input and output files on CD/DVD, with the exception of the meteorological data preprocessing files given that the NDEQ performed the meteorological data preprocessing. The data on CD/DVD will include all the hourly emissions (CEM) data files used to input actual emissions to AERMOD.

The modeling report will contain graphics displaying, at a minimum,

- source locations,
- receptor locations,
- meteorological data locations,
- background monitor location,
- contour plots displaying modeled design values (for general receptor grid and any refined grid model runs), and
- a bar chart showing background plus source impact for comparison with the NAAQS.

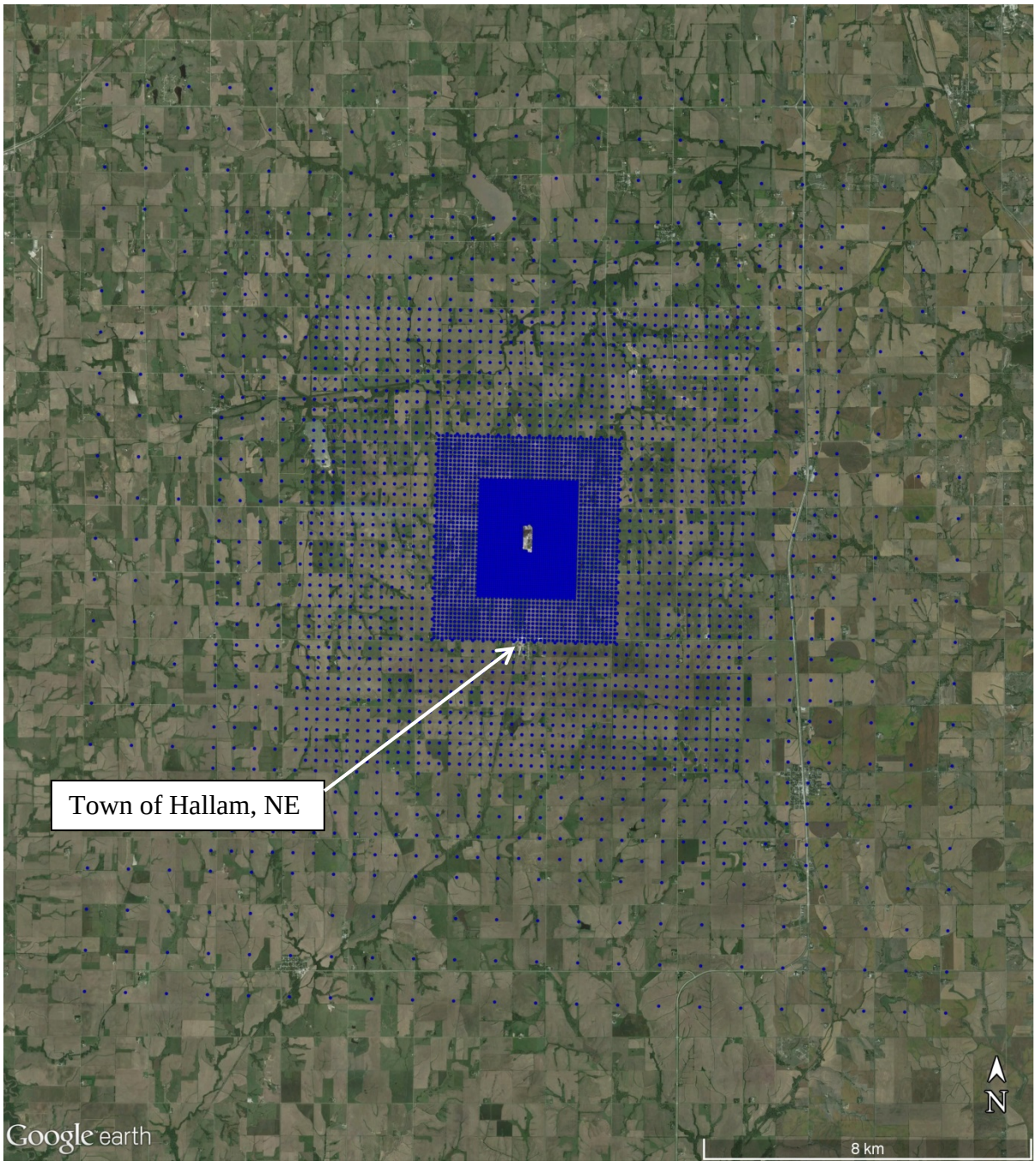
A copy of the final modeling files used to support the analysis will be provided on CD/DVD to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
1200 "N" Street, Suite 400
P.O. Box 98922
Lincoln, Nebraska 68509-8922

The data and graphics files included on the CD/DVD will include as a minimum:

- AERMOD input and output files (source and receptor input data file, hourly emissions file, output listing file, and output graphics/plot file)
- Contour plot and bar chart graphics file(s)
- Source location graphic file (*.kml) from Google Earth
- Source, met data and background monitor location map/graphic
- AERMAP terrain data processor input file
- Preprocessed meteorological data (*.sfc and *.pfl) files provided by NDEQ
- BPIP-PRIME preprocessor input and output files

Receptor Grid for Sheldon Station SO_2 Dispersion Modeling



BEFORE THE NEBRASKA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE CASE OF NEBRASKA PUBLIC POWER DISTRICT, SHELDON STATION, Respondent.	)))))	Case No. 3336 CONSENT ORDER

I. INTRODUCTION

1. The Nebraska Department of Environmental Quality ("NDEQ") and Respondent Nebraska Public Power District ("NPPD") Sheldon Station, Facility # 33563, voluntarily enter into this Consent Order. This Consent Order establishes a schedule for changes to NPPD's Sheldon Station facility necessary to attain compliance with the 2010 National Ambient Air Quality Standard ("NAAQS") for one-hour sulfur dioxide ("one-hour SO2") promulgated by the Environmental Protection Agency ("EPA") pursuant to 42 U.S.C. §7409.

II. JURISDICTION

2. The NDEQ is the agency of the State of Nebraska charged with the duty pursuant to Neb. Rev. Stat. § 81-1504(1) (Reissue 2014) of exercising exclusive general supervision, administration and enforcement of the Nebraska Environmental Protection Act. This Consent Order is issued under the authority vested in the Director of the NDEQ by Neb. Rev. Stats. §81-1504(25) and §81-1507(1).
3. NPPD agrees to undertake all actions required by the terms and conditions of this Consent Order. NPPD agrees that it will not contest the basis or validity of this Consent Order in any proceedings by the NDEQ to enforce this Consent Order.
4. NPPD waives its rights to receipt of a complaint and all notice and hearing requirements provided in Neb. Rev. Stat. § 81-1507.

III. PARTIES

5. This Consent Order is binding on the NDEQ and NPPD and their successors and assigns.
6. NPPD shall ensure that any contractors, sub-contractors and representatives implementing any provision of this Consent Order receive a copy of this Consent Order. NPPD shall be responsible for its noncompliance with this Consent Order.
7. NPPD admits to the jurisdictional allegations and agrees not to contest, but does not admit to, the findings of fact and conclusions of law referenced within Section V herein.

IV. LIABILITY

8. Nothing in this Consent Order shall be construed as an admission of liability or acknowledgement of any liability, wrong doing or unlawful conduct by NPPD .

V. FINDINGS OF FACT AND CONCLUSIONS OF LAW

Clean Air Act

9. The federal Clean Air Act ("CAA") requires EPA to publish regulations prescribing a NAAQS for specified pollutants. 42 U.S.C. §7409(a).

One-Hour SO_2 Status

10. EPA revised the NAAQS for SO2 on June 22, 2010. 75 Fed. Reg. 35520 (June 22, 2010).
11. States were directed to submit their designations by June 2, 2011. 75 Fed. Reg. at 35585.
12. Nebraska Governor Dave Heineman submitted Nebraska's designation recommendation for the 1-hour Sulfur Dioxide (SO_2) NAAQS on June 1, 2011. Governor Heineman recommended an *unclassifiable* designation for the entire state of Nebraska.
13. EPA did not initially promulgate a designation for any areas in Nebraska.

14. Pursuant to Neb. Rev. Stat. 81-1505(1) and (12), the Nebraska Environmental Quality Council adopted the revised NAAQS for SO2 in Title 129, Nebraska Air Quality Regulations, Chapter 4, Section 002, effective December 9, 2013.

15. On May 13, 2014, EPA proposed the Data Requirements Rule for the 1-Hour Sulfur Dioxide (SO_2) Primary National Ambient Air Quality Standard (NAAQS) ("Data Requirements Rule"). 79 Fed. Reg. 27446 (May 13, 2014). The Data Requirements Rule contained timeframes and processes for promulgation of designations.

16. EPA released a Memo ("Memo") which contains interim deadlines for states to provide updated recommendations and supporting information to assist EPA in its designations. Memo from Stephen D. Page to Regional Air Division Directors, Regions 1-10, Updated Guidance for Area Designations for the 2010 Primary Sulfur Dioxide National Ambient Air Quality Standard (March 20, 2015).

17. Due to the abbreviated timeframes allowed for designations under the EPA Memo, areas that do not currently have SO_2 monitors installed must base their designations on air quality modeling conducted pursuant to a draft protocol, SO_2 NAAQS Designations Modeling Technical Assistance Document issued by EPA in March 2011 and supplemented in December 2013 ("Modeling TAD").

Sheldon Station

18. NPPD's Sheldon Station is a coal-fired electric generating unit ("EGU") located near Hallam, Nebraska. Sheldon Station has two units with a combined generation capacity of approximately 225 megawatts.

19. Sheldon Station is a major source of air emissions under the Title V program and currently holds a Class I Operating Permit issued by Lincoln-Lancaster County Health

Department (LLCHD). Sheldon Station emits or may emit air pollutants including but not limited to SO2.

20. NPPD's Sheldon Station is one of the specified sources for which EPA requires promulgation of a designation by July 2, 2016.

21. NPPD intends to conduct air modeling pursuant to the Modeling TAD.

NDEQ Authority

22. Neb. Rev. Stat. 81-1506(2)(b) makes it unlawful to emit air pollutants that cause or contribute to a violation of an air quality standard established by the Nebraska Environmental Quality Council.

23. The Director of NDEQ is authorized pursuant to Neb. Rev. Stat. §81-1504(7) to issue this Consent Order requiring changes at NPPD's Sheldon Station to attain the NAAQS for one-hour SO_2 by the dates set forth in Paragraph 26.

24. This Consent Order sets out a schedule for NPPD to make changes to its Sheldon Station units to meet the NAAQS.

25. This Consent Order shall have the force and effect of a final order of the Director of the NDEQ issued pursuant to the Nebraska Environmental Protection Act.

VI. COMPLIANCE ORDER

26. NPPD agrees to attain compliance with the 2010 one-hour SO_2 NAAQS by performing the following activities at Sheldon Station:

    a. Sheldon Station Unit 1: NPPD agrees to sufficiently extend the stack height to the extent necessary to model attainment with the 2010 one-hour SO_2 NAAQS based on actual hourly emission rates while burning fuel under the existing permit, such project to be completed by July 2, 2016, subject to Section VIII.

    b. Sheldon Station Unit 2: NPPD retains an option to switch coal fuel for Unit 2 to hydrogen and other gaseous fuel. In such case, NPPD shall exercise said option

by informing NDEQ in writing by July 1, 2016, of its decision and will also present information that it entered into binding and enforceable contracts to construct the necessary changes to Unit 2 to accommodate the switch to hydrogen and other gaseous fuel, which fuel switch will be completed on or before December 31, 2021, subject to Section VIII.

In the event NPPD elects not to exercise the above option, NPPD shall inform the NDEQ on or before July 1, 2016, that NPPD will sufficiently extend the stack height to the extent necessary to model attainment with the 2010 one-hour SO_2 NAAQS based on actual hourly emissions rates while burning fuel under the existing permit. Such project will be completed on or before July 2, 2017, subject to Section VIII.

27. NPPD shall submit a report by July 1, 2016, describing the then current status of its performance of activities under Paragraph 26, above.

28. In consideration of this Order, NDEQ shall provide a copy of this Consent Order to the Environmental Protection Agency and request that the area around Sheldon Station remain "unclassifiable" for one hour $S0_2$ NAAQS while and until this Order has been completely and satisfactorily performed by NPPD.

29. NPPD shall conduct base-case modeling scenario in accordance with EPA's Modeling TAD associated with the Data Requirements Rule after completion of the project to ensure compliance with the standards. Based on the NDEQ's guidance and protocol approval specifically for the Sheldon SO_2 modeling, NPPD will run the AERMOD model and prepare a summary of results, along with spreadsheets and figures that convey the concentrations predicted by the model, and add the maximum 1-hour design concentration (maximum 99th percentile average over 3 years of meteorology, of any receptor) to the background concentration of 9 μg/m3 agreed upon by NDEQ and EPA Region 7.

30. All terms and references used in this Consent Order shall have the same meaning as in NPPD's current Construction and Operating Permits. No other terms or conditions of the Permits are affected by this Consent Order.

31. Information required to be submitted under this Consent Order shall be sent to:

For NPPD:
Joseph L. Citta
P.O. Box 499
1414 15th Street
Columbus, NE 68602
(402) 563-5355
jlcitta@nppd.com

For NDEQ:
Air Quality Division
Nebraska Department of Environmental Quality
PO Box 98922
Lincoln, NE 68509-8922
(402) 471-4210

VII. COMPLIANCE WITH OTHER LAWS

32. NPPD shall perform all actions required by this Consent Order in accordance with all applicable local, state and federal laws, regulations and permits.

VIII. FORCE MAJEURE, EXCUSABLE DELAY

33. Force majeure for purposes of this Consent Order is as set forth in NPPD's various contracts related to any NPPD activity described in paragraph 26, above. In addition, NPPD shall be excused from any delays in its performance hereunder, or failure to perform, caused in whole or in part by any act of God, the order of any court or agency having jurisdiction, or caused in whole or in part by any of NPPD's contractors, suppliers or vendors. NPPD shall exercise best efforts to anticipate any potential force majeure

events and address the potential effects as the event is occurring, and following the event, to ensure that any delay is minimized to the greatest extent practicable..

34. If any event occurs that may delay the performance of any obligation under this Consent Order, whether or not caused by a force majeure event, NPPD shall notify the NDEQ by telephone within three business days of learning of the event. Within 10 business days of learning of the event, NPPD shall provide in writing the reasons for the delay, the anticipated duration of the delay, all actions taken or to be taken to prevent or minimize the delay, and a schedule for implementation of any action.

35. In addition to force majeure, NDEQ, in its discretion, may agree to an extension of the time for performance of any obligation under this Consent Order caused by any other event.

IX. RESERVATION OF RIGHTS

36. Nothing in this Consent Order shall be construed to limit the power and authority of the NDEQ to take or order any action necessary to protect public health, welfare or the environment, or to enforce any provision of the Nebraska Environmental Protection Act and any rules, regulations, orders or permits issued pursuant to the Nebraska Environmental Protection Act.

X. NEGATION OF AGENCY RELATIONSHIP

37. Nothing contained in this Consent Order shall be construed to create, either expressly or by implication, the relationship of agency between the NDEQ and NPPD.

XI. REOPENING, AMENDING AND MODIFYING

38. This Consent Order may be modified and amended in writing by mutual agreement of the NDEQ and NPPD.

XII. EFFECTIVE DATE

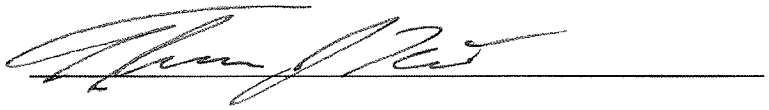
39. This Consent Order shall become effective on the date it is signed by the Director of the NDEQ or his designee.

XIII. SEVERABILITY

40. If any provision or authority of this Order or the application of this Order to any party or circumstances is held by any judicial or administrative authority to be invalid, the application of such provisions to other parties or circumstances and the remainder of the Order shall remain in force and shall not be affected thereby.

XIV. SIGNATURES

For NPPD: The undersigned representative of NPPD certifies that he is fully authorized to enter into the terms and conditions of this Consent Order and bind NPPD.



By: Thomas J. Kent

Title: Vice President & Chief Operating Officer

Date: September 18, 2015

For NDEQ: IT IS SO ORDERED and agreed to on this 18th day of September, 2015.

By: _____
Jim Macy
Director, Nebraska Department of Environmental Quality

Nebraska Public Power District

Sulfur Dioxide 1-Hour NAAQS Designations Modeling

for

Gerald Gentleman Station (Facility ID #34385)
Sutherland, Nebraska

For submittal to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 N Street
P.O. box 98922
Lincoln, Nebraska 69509-8922

Prepared by:

HDR Engineering, Inc.

September 4, 2015

INTRODUCTION

This modeling report summarizes dispersion modeling of Gerald Gentleman Station to demonstrate attainment with the sulfur dioxide (SO_2) National Ambient Air Quality Standard (NAAQS) for the 1-hour averaging period, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$). This modeling has been completed for submission to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the NAAQS designations.

MODELING PROTOCOL

The dispersion modeling results summarized in this report were obtained using the EPA's AERMOD dispersion modeling system, using the modeling procedures and data as described in a modeling protocol developed in collaboration with NDEQ, as provided in Attachment 1 to this report. In addition to this report, this submittal to NDEQ includes a compact disk/DVD containing all the data files listed at the end of the modeling protocol in Attachment 1.

MODEL INPUTS

This modeling report contains figures detailing the modeled sources, receptors, background SO_2 concentration and meteorological data locations, and the resulting 1-hour SO_2 modeled impacts. The SO_2 modeling was conducted in accordance to the attached detailed dispersion modeling protocol.

Figure 1 displays the source locations of the two point sources included in the model, which are the coal-fired boiler stacks for Gerald Gentleman Station (GGS) Unit 1 (GGS1) and GGS Unit 2 (GGS2).

Figure 1: Source Locations

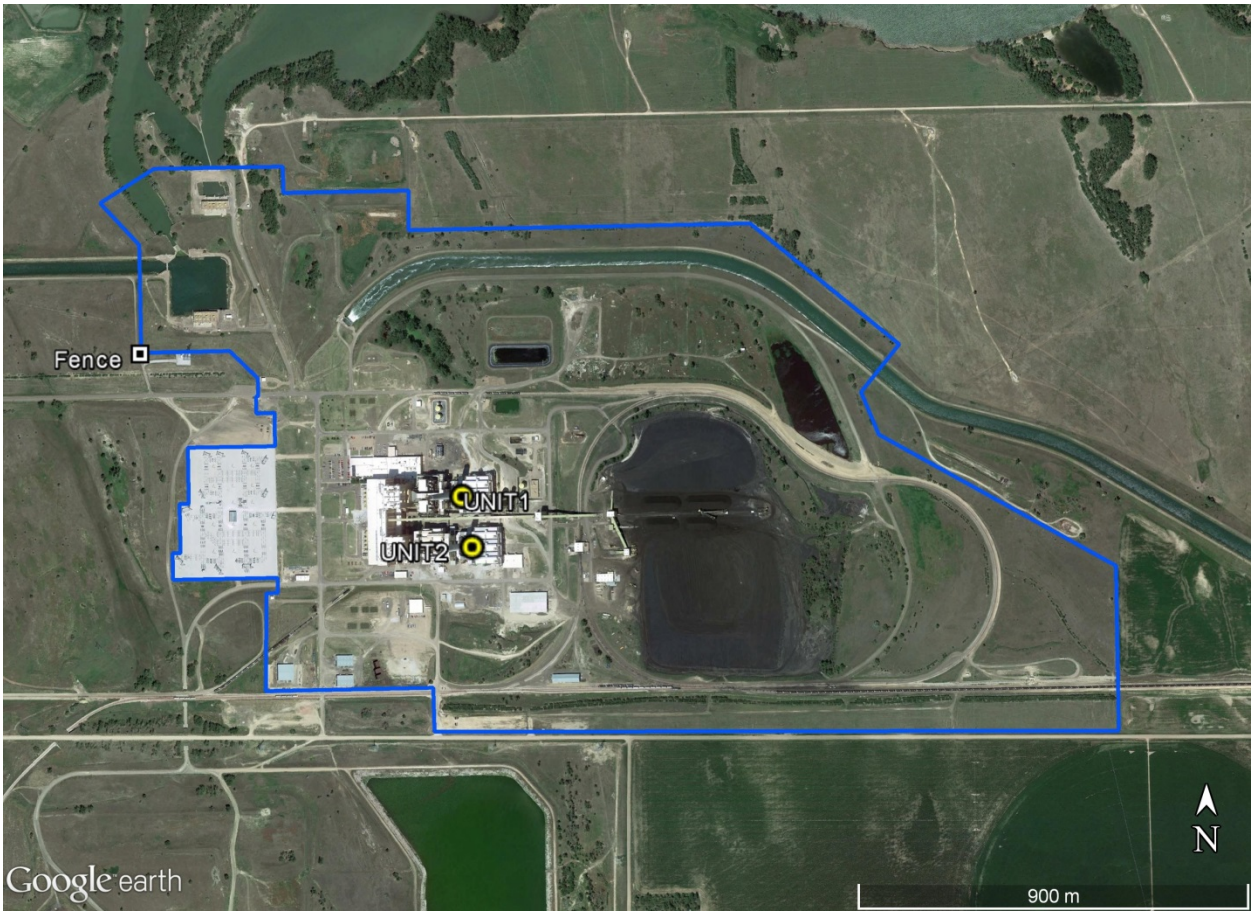


Figure 2 displays the receptor locations as specified in the attached dispersion modeling protocol in accordance with NDEQ guidance. Note that receptors are not included over water bodies in accordance with EPA guidance, and therefore, receptors have been excluded over the waters of Sutherland Reservoir.

Figure 2: Receptor Locations

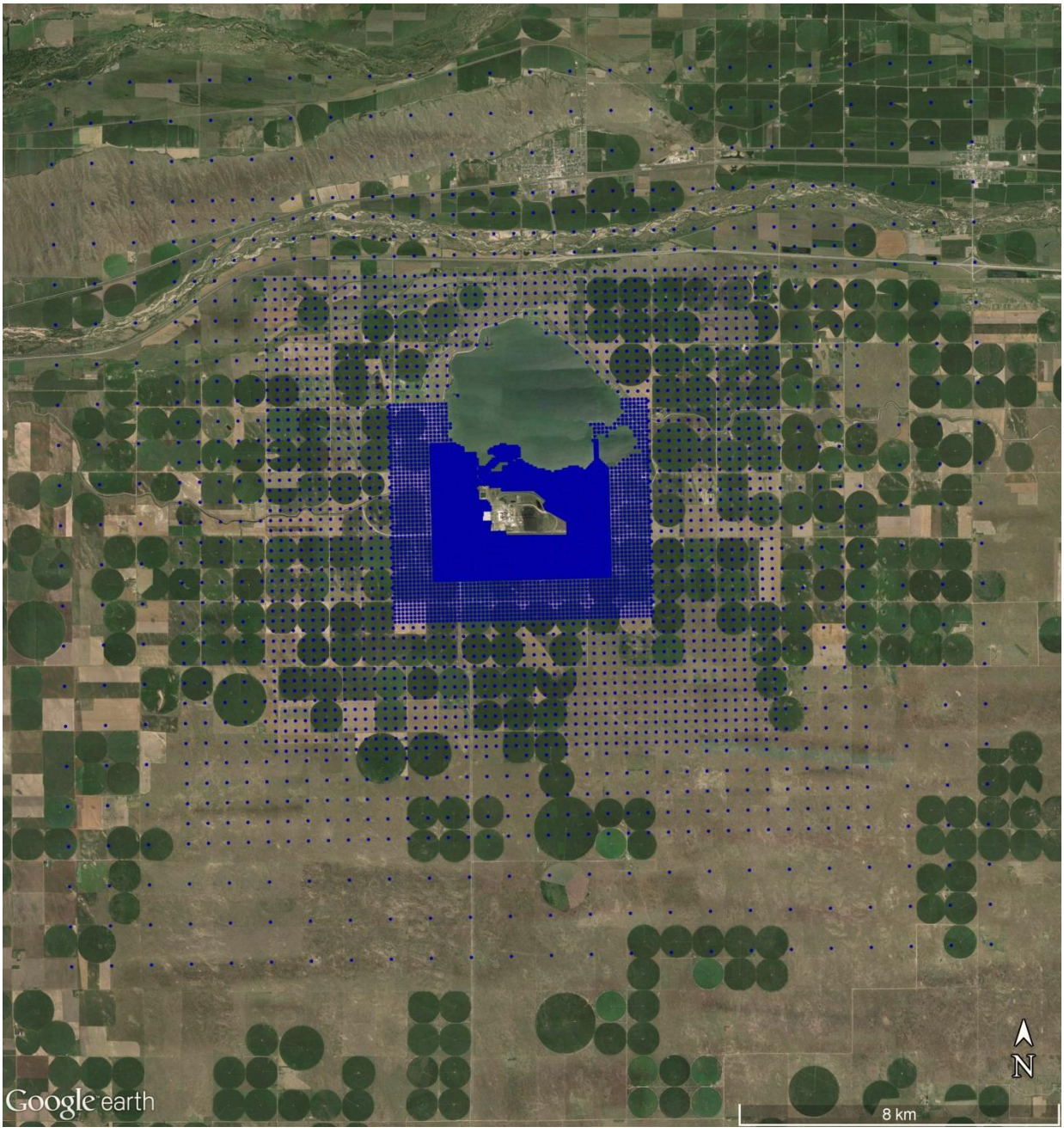


Figure 3 displays the NPPD facility location in relation to the background SO_2 monitor location (Trego County, Kansas) and meteorological data stations for surface data (Imperial, Nebraska) and upper-air data (North Platte, Nebraska).

Figure 3: Site, Monitor, and Meteorological Station Locations.

The stack parameter inputs for GGS1 and GGS2 are provided in Table 1. The stack temperature and velocity are placeholder design values. Actual temperature and velocity data were input to the AERMOD model on an hourly basis with an hourly emission file that contains emission rates, stack temperatures and exit velocities for both stacks for each hour of the model simulation, which spanned the years 2012-2014.

Table 1: Source Input Data for Modeling Analysis

Source ID	UTM Coordinates X (m)	UTM Coordinates Y (m)	Base Elevation (m)	Stack Height (m)	Stack Temperature (Deg. K)	Stack Exit Velocity (m/s)	Stack Diameter (m)
Unit 1	320171.7	4550011	954.1	168.56	432	23.14	8.54
Unit 2	320192.2	4549894	957.5	167.64	417	25.62	8.54

The hourly emissions data files input to AERMOD were based on continuous emissions and stack parameter monitoring data, which have been collected and reported consistent with Acid Rain program monitoring procedures as provided in 40 CFR 75. The hourly emissions data file (including stack exhaust temperature and velocity data) is provided electronically on the CD/DVD accompanying this report.

MODEL RESULTS

Modeled design impact for the 3-year average 1-hour SO_2 concentration is summarized in Table 2 and presented visually in Figure 4. The 4th high 3-year average concentrations are compared with the 1-hour SO_2 NAAQS of 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter (µg/m^3). The modeled concentration is the combined impact of Units 1 and 2. The background 1-hour SO_2 concentration of 9 µg/m^3 was added to the modeled concentration. The modeled plus background concentration is well below the NAAQS as shown in Table 2.

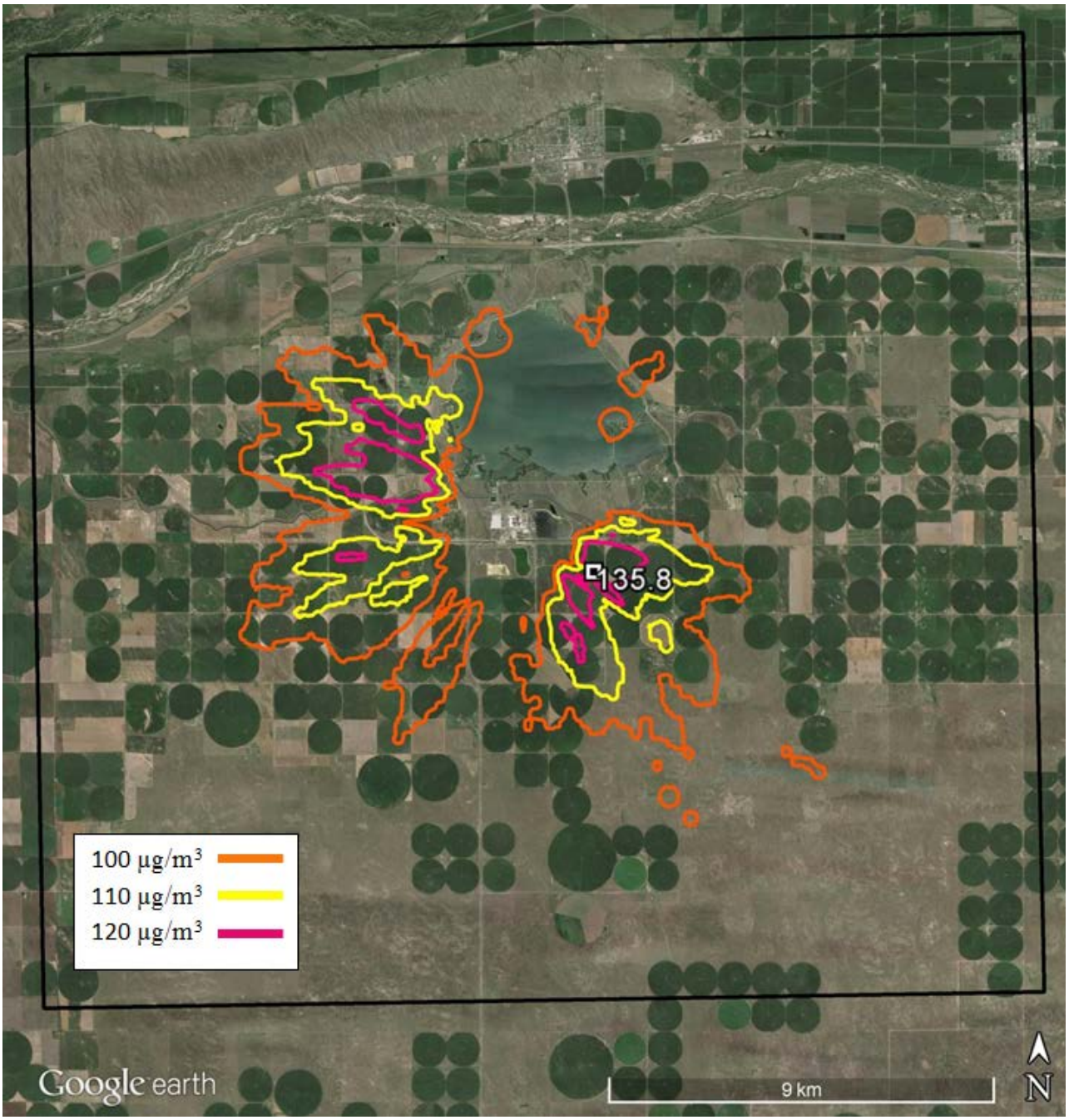
Table 2: Modeled Impacts (with background of 9 µg/m^3)

Pollutant	Averaging Period	Years	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)	Modeled Concentration (µg/m^3)	Modeled Plus Background (µg/m^3)	NAAQS (µg/m^3)
SO_2	1-hour	2012-14	321900	4548800	135.8	144.8	196.5

Figure 4: Modeled Result vs. SO_2 Standard

Figure 5 is a contour plot of the modeled 1-hour design concentrations (not including background), representing the average of the daily maximum 4th high values over the 3 years of meteorological data. The black box surrounding the contour lines indicates the extent of the receptor grid. The contour levels are: Orange: 100 µg/m^3, Yellow: 110 µg/m^3, and Pink: 120 µg/m^3. The location of the maximum 4th high 3-year average modeled (without background) concentration (135.8 µg/m^3) is displayed for reference.

Figure 5: Contour Plot of SO_2 1-Hour Design Concentrations



CONCLUSION

This modeling analysis shows that the design maximum SO_2 impact from GGS, when added to the estimated background concentration of 9 µg/m^3, would cause a total maximum impact of 144.8 µg/m^3, which is well below (under 75%) of the SO_2 1-hour NAAQS of 196.5 µg/m3 (75 ppb).

Attachment 1

Sulfur Dioxide 1-Hour NAAQS Designations Modeling Protocol
Nebraska Public Power District, Gerald Gentleman Station (NDEQ Facility ID #34385)
Sutherland, NE
July 15, 2015

INTRODUCTION

This modeling protocol addresses proposed dispersion modeling for the Nebraska Public Power District (NPPD) Gerald Gentleman Station (GGS), in Lincoln County, near Sutherland, Nebraska. The protocol summarizes the information that will be used to conduct dispersion modeling with respect to the National Ambient Air Quality Standard (NAAQS) for 1-hour average sulfur dioxide (SO_2) concentration, which is equal to 75 parts per billion (ppb) or approximately 196.5 micrograms per cubic meter ($\mu g/m^3$)

This protocol has been prepared for 1-hour SO_2 State Implementation Plan (SIP) dispersion modeling and is being submitted to the Nebraska Department of Environmental Quality (NDEQ) for review and approval. The results of the dispersion modeling analysis will be used by the NDEQ to formulate recommendations to EPA on the NAAQS attainment/nonattainment area designations for SIP purposes. EPA will review and use this information, along with any available monitoring data, to propose and finalize attainment/nonattainment designations for affected areas with respect to the 1-hour SO_2 NAAQS.

MODELING SOFTWARE

The following EPA modeling software will be used for this analysis.

- AERMOD (Version 14134)
- BPIP-Prime (Version 04274)
- AERMAP (Version 11103)

The AERMOD model will be executed using the rural dispersion mode, given the predominantly rural character of the land surrounding the subject facility.

METEOROLOGICAL DATA

Meteorological data for this analysis will be provided by NDEQ in preprocessed format, based on the most recent versions of AERMET (Version 14134), AERMINUTE (Version 14337), and AERSURFACE (Version 13016).

The surface meteorological will be from Imperial, Nebraska and the upper air data will be from North Platte, Nebraska, which are considered representative of the Sutherland area. This analysis will use three years of meteorological data for the years 2012 through 2014.

POLLUTANT AND AVERAGING PERIOD

The AERMOD model will be executed for SO_2 for 1-hour averages. By selecting SO_2 as the pollutant and 1-hour as the averaging period, AERMOD will automatically average the results over the three years of meteorology. The model result for comparison with the 1-hour SO_2 NAAQS of 196.5 $\mu g/m^3$ (75 parts per billion) will be the maximum of the 3-year average of the 4th highest (99th

percentile) daily 1-hour maximum concentration, as automatically output by AERMOD from the multiyear (3-year) model run.

POINT SOURCES

Emission points to be modeled for GGS will include only the Unit 1 and Unit 2 coal boiler stacks. The NDEQ and EPA have reviewed the other emissions sources in the region and determined that there are no nearby sources with large enough emissions to be included in a modeling analysis together with GGS. Thus, total impact for comparison with the NAAQS will consist of the Unit 1 and Unit 2 combined impact plus the background concentration (see below). The AERMOD output will be set up to produce source contributions for each unit, plus the total ("ALL" source group) concentrations.

The actual, hourly SO_2 emissions measured by the continuous emissions monitoring system (CEMS) on the Unit 1and 2 stacks will be used for this analysis, by using the optional hourly emissions input file for input to AERMOD. The single hourly emissions file will correspond with the same period of record represented by the three year period of meteorological data (2012-2014) input to AERMOD.

In addition to hourly SO_2 emissions in grams/second, the hourly emissions file will include hourly average stack gas exhaust temperature and exhaust gas exit velocity. These additional hourly parameters will be based on measurements recorded by the same CEMS systems being used to track hourly SO_2 emissions for each stack, in accordance with the routine monitoring requirements under 40 CFR 60 (New Source Performance Standards) and 40 CFR 75 (Continuous Emission Monitoring under the Acid Rain program).

In addition to the stack heights and the hourly emissions and stack parameters described above, the only other stack parameters needed by AERMOD are the stack exit diameters. The stack diameters to be input for Units 1 and 2 will be 28 feet (8.535 m), based on the current design of these stacks.

BUILDING DOWNWASH INPUTS

The AERMOD input will include building downwash parameters calculated using the EPA's Building Profile Input Program "PRIME" (BPIPPRIME) software (Version 04274). The BPIPPRIME input and output (I/O) files will be provided along with all the other modeling I/O files on CD with the final modeling report.

TERRAIN ELEVATIONS

Terrain data will be processed to determine receptor elevations and "hill heights" for input to AERMOD using AERMAP, Version 11103. The AERMAP input will include terrain elevation data from the National Elevation Dataset (NED). The NED data available on-line in 1 arc-second spacing from the US Geological Survey will be used for this analysis. The receptor grid (extent defined below) will include receptors only in UTM Zone 14. The NED data for this analysis will be based on North American Datum (NAD) 83 for horizontal locations and NAD88 for vertical locations (elevations).

The NED terrain file downloaded from the USGS will be provided on CD along with all other model I/O files.

RECEPTOR GRID

Given there will be no nearby facilities included in this analysis, the receptor grid can be focused on just Gerald Gentleman Station. The receptor grid will include the following spacing on the fence lines and at downwind distances from the nearest fence lines.

- 50 meter spacing on the fence line
- 50 meter spacing from the fence to 1 kilometer from the fence
- 100 meter spacing from 1 kilometer to 2 kilometers from the fence
- 250 meter spacing from 2 kilometer to 5 kilometers from the fence
- 500 meter spacing from 5 kilometer to 7 kilometers from the fence
- 1000 meter spacing from 7 to 10 kilometers from the fence

The extent of this receptor grid is shown in the figure at the end of this protocol, and based on prior modeling experience, is expected to encompass areas of maximum 1-hour SO_2 concentration. Note that in accordance with EPA guidance[1], receptors that would be over water (Sutherland Reservoir, just north of the facility) are excluded from analysis, given that it would not be practical to monitor at these locations.

Any hot spots in the 250 meter and coarser receptor spacing will be refined by performing a separate model run centered on the hot spot, with a 1000-meter by 1000 meter grid of 50-meter spacing centered on the highest impact receptor from the initial model run.

BACKGROUND CONCENTRATION

The background 1-hour SO_2 concentration will be based on data from the rural monitor located at Cedar Bluff Reservoir (EPA Site ID number 201950001) in Trego County in western Kansas. This monitor is far from any nearby large SO_2 sources, so is representative of background concentrations in rural areas of Nebraska exclusive of nearby major source impacts.

Given that there are apparent monitor operational problems evidenced in the data for the most recent year of complete data, 2014, the background concentration will be based on the next most recent three years of available data, those being 2011-2013. The table below shows the calculated average of the 99th percentile daily maximum 1-hour value as 8.7 µg/m^3 across the three years. Therefore, a background 1-hour SO_2 concentration of 9 µg/m^3 will be used for this analysis.

Year	Daily Maximum 1-hour, 99th Percentile	
	(ppm)	(µg/m^3)
2011	3	7.9
2012	4	10.5
2013	3	7.9
Average	**3.3**	**8.7**

[1] SO_2 NAAQS Designations Modeling Technical Assistance Document, U.S. EPA Office of Air and Radiation Office of Air Quality Planning and Standards, Air Quality Assessment Division, December 2013, DRAFT ("EPA TAD")

MODELING REPORT

A final modeling report will be submitted to NDEQ for review, describing modeling procedures (attaching this protocol), mitigation features (design changes), if any, proposed by the utility, and including all model and preprocessor input and output files on CD/DVD, with the exception of the meteorological data preprocessing files given that the NDEQ performed the meteorological data preprocessing. The data on CD/DVD will include all the hourly emissions (CEM) data files used to input actual emissions to AERMOD.

The modeling report will contain graphics displaying, at a minimum,

- source locations,
- receptor locations,
- meteorological data locations,
- background monitor location,
- contour plots displaying modeled design values (for general receptor grid and any refined grid model runs), and
- a bar chart showing background plus source impact for comparison with the NAAQS.

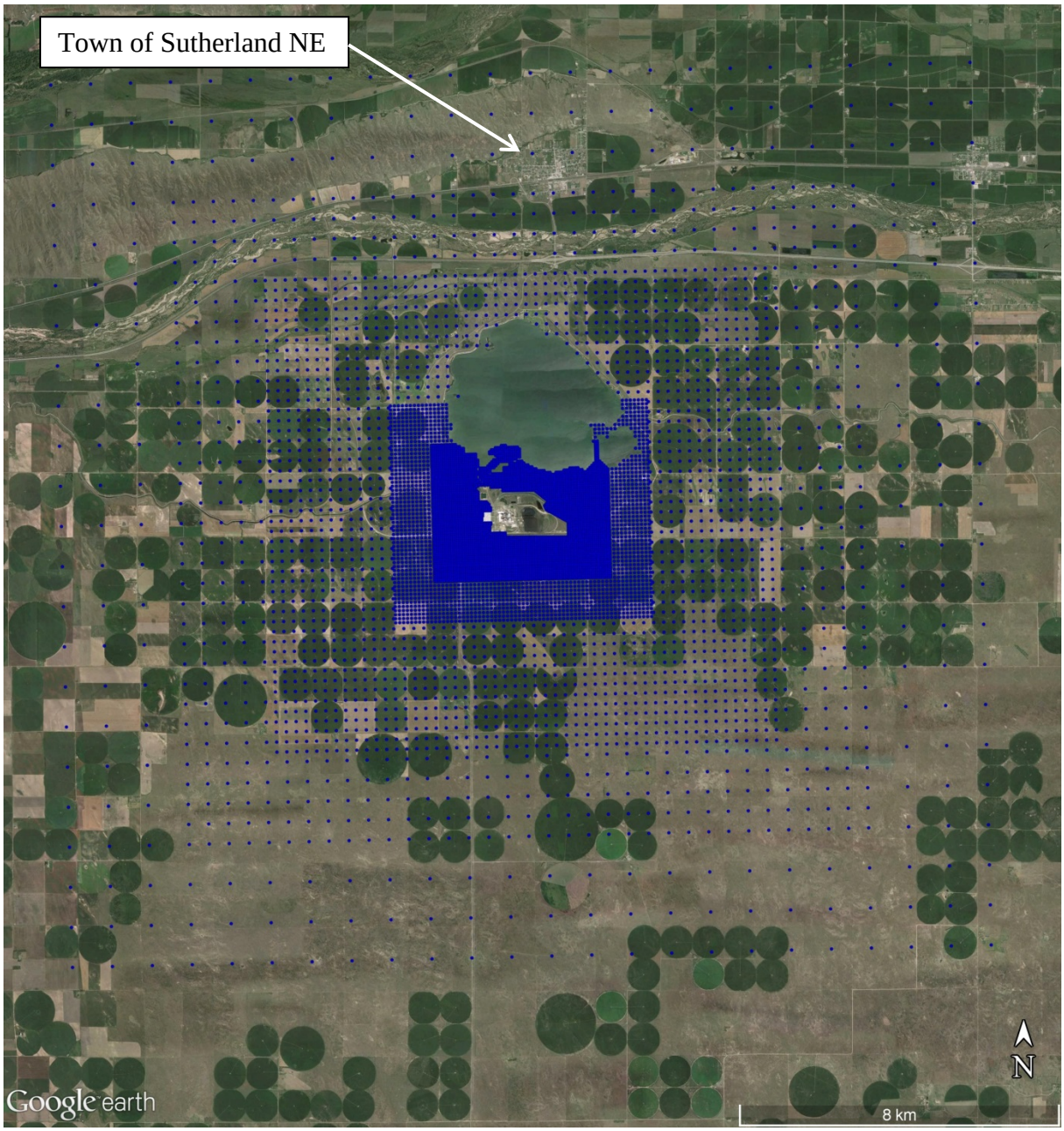
A copy of the final modeling files used to support the analysis will be provided on CD/DVD to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
1200 "N" Street, Suite 400
P.O. Box 98922
Lincoln, Nebraska 68509-8922

The data and graphics files included on the CD/DVD will include as a minimum:

- AERMOD input and output files (source and receptor input data file, hourly emissions file, output listing file, and output graphics/plot file)
- Contour plot and bar chart graphics file(s)
- Source location graphic file (*.kml) from Google Earth
- Source, met data and background monitor location map/graphic
- AERMAP terrain data processor input file
- Preprocessed meteorological data (*.sfc and *.pfl) files provided by NDEQ
- BPIP-PRIME preprocessor input and output files

Receptor Grid for Gerald Gentleman Station SO_2 Dispersion Modeling



Omaha Public Power District

Sulfur Dioxide 1-Hour NAAQS Designations Modeling

for

Nebraska City Station (Facility ID #58343)
Nebraska City, Nebraska

For submittal to:

Lisa Alam
c/o Records Management
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 N Street
P.O. box 98922
Lincoln, Nebraska 69509-8922

Prepared by:

HDR Engineering, Inc.

August 2015

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Figure 2 displays the receptor locations as specified in the attached dispersion modeling protocol in accordance with NDEQ guidance.

Figure 2: Receptor Locations

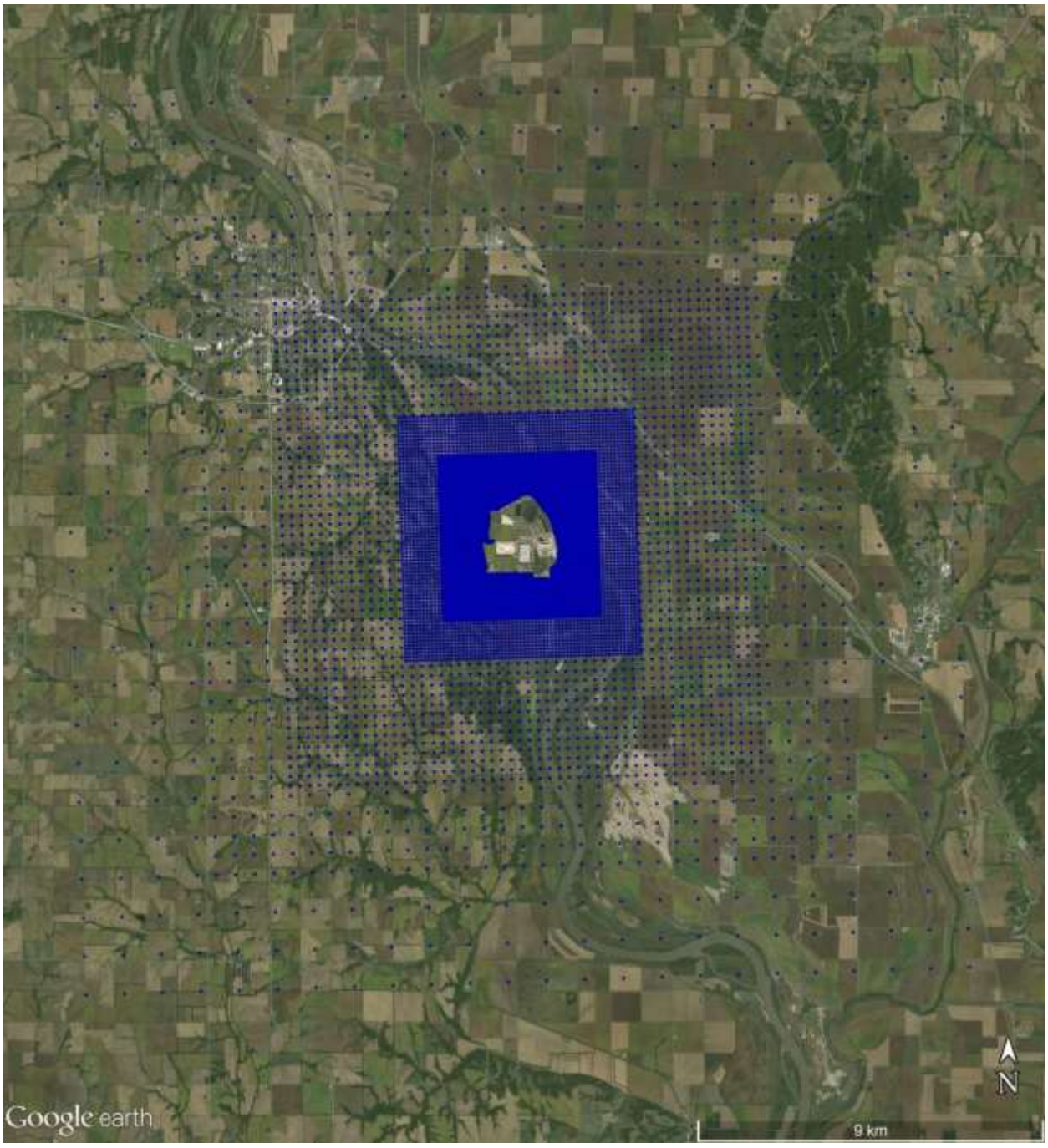
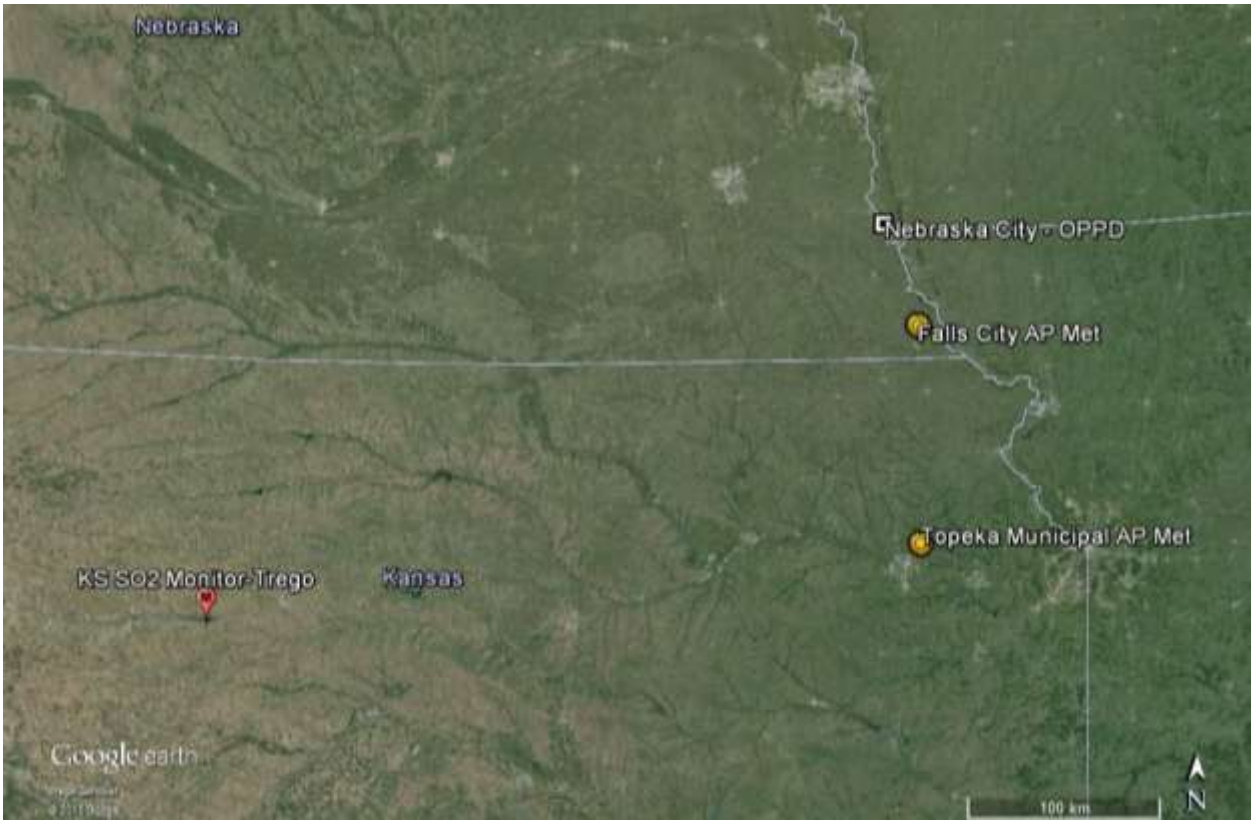


Figure 3 displays the OPPD facility in relation to the background SO_2 monitor location and meteorological data stations for surface data (Falls City, Nebraska) and upper-air data (Topeka, Kansas).

Figure 3: Site, Monitor, and Meteorological Station Locations.



The stack parameter inputs for NC1 and NC2 at OPPD are provided in Table 1. The stack temperature and velocity are placeholder average values. Actual temperature and velocity data were input to the AERMOD model on an hourly basis with an hourly emission file that contains emission rates, stack temperatures and exit velocities for both stacks for each hour of the model simulation, which spanned the years 2012-2014.

Table 1: Source Input Data for Modeling Analysis

Source ID	UTM Coordinates X (m)	UTM Coordinates Y (m)	Base Elevation (m)	Stack Height (m)	Stack Temperature (Deg. K)	Stack Exit Velocity (m/s)	Stack Diameter (m)
NC1	265387	4500392	281.9	213.36	415.37	30.02	7.19
NC2	265447	4500318	281.9	121.92	347.04	24.29	7.01

The hourly emissions data files input to AERMOD were based on continuous emissions and stack parameter monitoring data, which have been collected and reported consistent with Acid Rain program monitoring procedures as provided in 40 CFR 75. The hourly emissions data files (including stack exhaust temperature and velocity data) are provided electronically on the CD/DVD accompanying this report.

MODEL RESULTS

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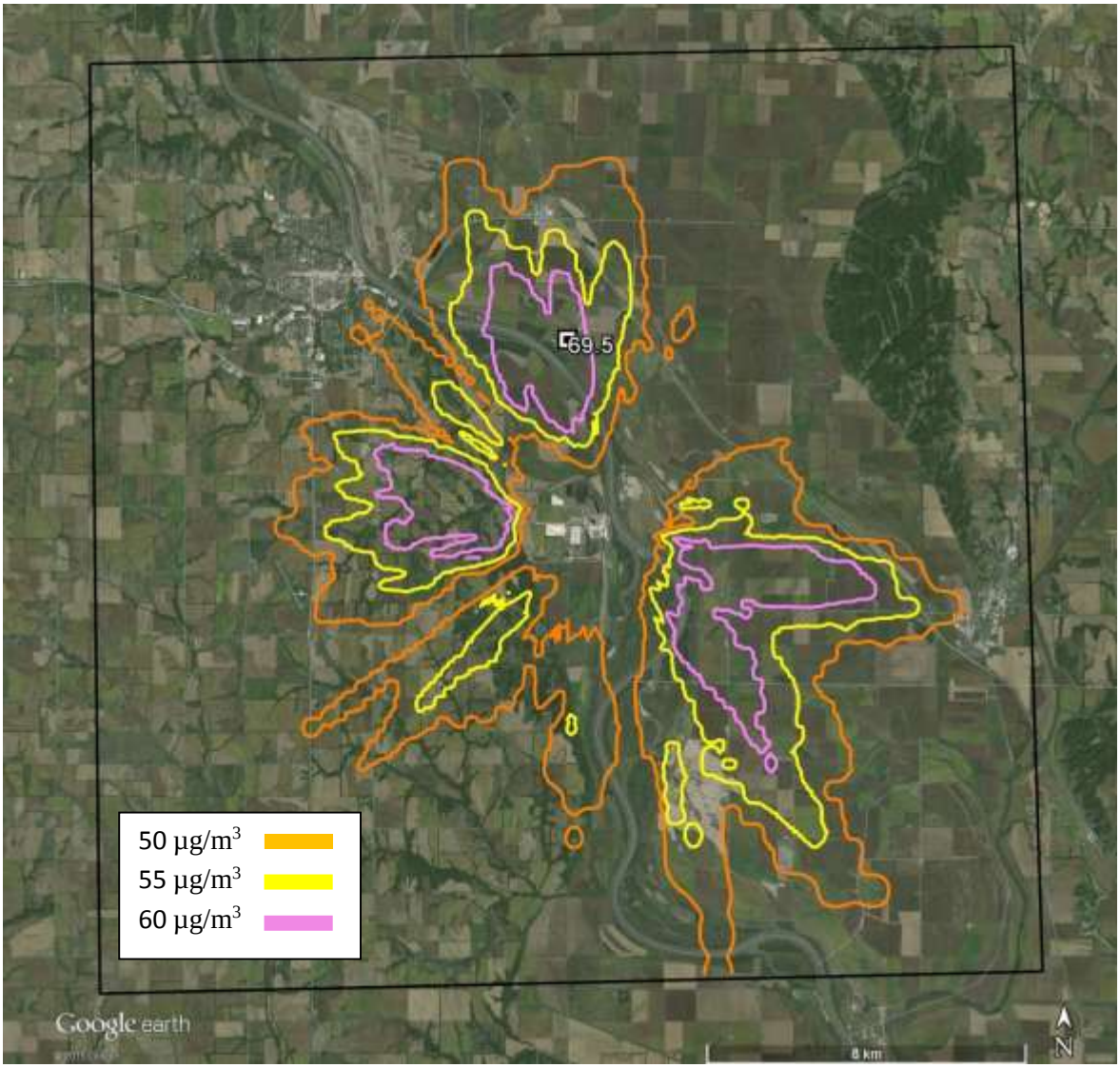
Table 2: Modeled Impacts (with background of 9 $\mu g/m^3$)

Pollutant	Averaging Period	Years	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)	Modeled Concentration ($\mu g/m^3$)	Modeled Plus Background ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
SO_2	1-hour	2012-14	264750	4505000	69.5	78.5	196.5

Figure 4: Modeled Result vs. SO_2 Standard

Figure 5 is a contour plot of the modeled 1-hour design concentrations (not including background), representing the average of the daily maximum 4th high values over the 3 years of meteorological data. The black box surrounding the contour lines indicates the extent of the receptor grid. The contour levels are: Orange: 50 µg/m^3, Yellow: 55 µg/m^3, and Pink: 60 µg/m^3. The location of the maximum 4th high 3-year average modeled (without background) concentration (69.5 µg/m^3) is displayed for reference.

Figure 5: Contour Plot of SO_2 1-Hour Design Concentrations



CONCLUSION

This modeling analysis shows that the SO_2 impact from NCS, when added to the estimated background concentration of 9 µg/m^3, would cause a total maximum impact of 78.5 µg/m^3, which is well below (under 50%) of the SO_2 1-hour NAAQS of 196.5 µg/m3 (75 ppb).