



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

January 31, 2024

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

TO: EPA Docket # EPA-HQ-OAR-2014-0128

FROM: Clint Tillerson, David Mintz, Todd Hawes

THROUGH: Richard A. Wayland, Director, Air Quality Assessment Division

RE: Technical Analyses to Support Alternative Demonstration Approach for Proposed Secondary SO₂ NAAQS under NSR/PSD Program

The PSD program requires individual new or modified stationary sources to carry out an air quality analysis to demonstrate that their proposed emissions increases will not cause or contribute to a violation of any NAAQS. See CAA section 165(a)(3)(B), 40 CFR 51.166(k), 40 CFR 52.21(k). Such a demonstration for the proposed new secondary SO₂ NAAQS could require each PSD applicant to predict, via air quality modeling, the impacts that will result from its proposed emissions in conjunction with an assessment of existing air quality conditions. Under the PSD program, on and after the effective date of a final new or revised NAAQS, the applicant would need to use existing EPA models, guidance, and other tools for making this showing. The EPA anticipates that sources and reviewing authorities will be able to use most of these existing tools to demonstrate compliance with the secondary SO₂ standard, if finalized as proposed. However, some adjustment and updates to these tools may be appropriate. The EPA is also considering an alternative compliance demonstration approach that the Agency may support using to make this PSD permitting demonstration.

This memorandum documents the technical analyses conducted to provide the basis for use of an alternative demonstration approach that could be used by prospective permit applicants that will facilitate a streamlined approach to making the required PSD air quality impact demonstration under the proposed new secondary SO₂ NAAQS. As described here, the EPA conducted a two-pronged technical analysis of the relationships between the proposed secondary standard and the existing 1-hour SO₂ primary NAAQS. Based on this technical analysis, the EPA currently believes that there is sufficient evidence that a demonstration of compliance with the 1-hour SO₂ NAAQS serves as a suitable alternative for directly demonstrating compliance with the proposed secondary annual SO₂ NAAQS under the PSD program. As such, EPA may support many or all sources undergoing PSD review for the revised secondary SO₂ NAAQS, as proposed, relying upon their analysis demonstrating compliance with

the 1-hour primary SO₂ NAAQS to also show compliance with the proposed secondary SO₂ NAAQS, if finalized.

BACKGROUND

PSD applicants are currently required to demonstrate compliance with the existing primary 1-hour and secondary 3-hour SO₂ NAAQS. Under 40 CFR 51.166(l)(1) and 40 CFR 52.21(l)(1), all applications of air quality modeling for purposes of determining whether a new or modified source will cause or contribute to a NAAQS violation must be based upon air quality models specified in appendix W to 40 CFR part 51. This requirement will also apply to the secondary NAAQS for SO₂ if finalized. The PSD program requires individual new or modified stationary sources to carry out an air quality analysis to demonstrate that their proposed emissions increases will not cause or contribute to a violation of any NAAQS. Such a demonstration for the proposed secondary SO₂ NAAQS could require each PSD applicant to predict, via air quality modeling, the impacts that will result from its proposed emissions in conjunction with an assessment of existing air quality conditions. The EPA believes that it may be reasonable to allow the use of an alternative demonstration approach for at least an interim period to facilitate the transition to a full and appropriate PSD permitting approach under the proposed new secondary SO₂ NAAQS.

To support consideration of alternative demonstration approaches that could be used by PSD permit applicants, the EPA conducted a two-pronged technical analysis of the relationships between the proposed secondary standard and the existing 1-hour SO₂ primary NAAQS. The first prong of the analysis addressed aspects of a PSD source impact analysis by evaluating whether an individual source's impact resulting in a small increase in 1-hour SO₂ concentration, as defined by the significant impact level (SIL) for the primary SO₂ NAAQS, would produce a comparably small increase in the annual SO₂ concentration. This analysis included modeled estimates of SO₂ for a range of source types and scenarios. The analysis indicated that small increases in 1-hour SO₂ concentrations caused by individual sources produce similarly small changes in the annual SO₂ concentrations. The second prong of the analysis addressed aspects of a PSD cumulative impact analysis indicating that a demonstration showing attainment of the 1-hour SO₂ standard is expected to also show attainment of the proposed secondary SO₂ standard. This analysis was based on 2017 to 2022 air quality data and compared the current 1-hour SO₂ standard with a level of 75 ppb, and the proposed secondary SO₂ standard with a level of either 10 ppb or 15 ppb. This analysis indicates that all monitoring sites meeting the current primary 1-hour SO₂ standard would also meet the proposed secondary SO₂ standard, even at the low end of the proposed range [10-15 ppb]. Only two monitoring sites violate the proposed secondary SO₂ standard at the low end of the proposed range during the 2017-2019 to 2020-2022 design value periods; however, both sites also violate the current 1-hour primary SO₂ standard at 75 ppb.¹

The EPA believes that the technical analysis described in this memorandum is robust and could have broad application across all areas in the United States. The relationships shown in this memo may also

¹ For this analysis, we did not include monitoring sites located in Hawaii since our focus was on anthropogenic emissions. Yet, had we included those sites with the contribution of nonanthropogenic volcanic emissions, our results and overall conclusions would not have changed.

support relying on this alternative demonstration approach even after adjustment and updates to compliance demonstration tools. Based on this technical analysis, the EPA currently believes that there is sufficient evidence that a demonstration of compliance with the 1-hour SO₂ NAAQS serves as a suitable surrogate for demonstrating compliance with the proposed secondary SO₂ NAAQS under the PSD program. As such, EPA may support many or all sources undergoing PSD review for SO₂ relying upon their analysis demonstrating compliance with the 1-hour primary SO₂ NAAQS to also show compliance with the proposed secondary SO₂ NAAQS, if finalized.

TECHNICAL ANALYSIS

This section examines use of a demonstration of compliance with the 1-hour primary SO₂ NAAQS as a surrogate for showing compliance with the proposed secondary annual SO₂ NAAQS in the context of two aspects of the PSD program. First, in context of a source impact analysis, we examine whether an air quality impact at the significant impact level (SIL) for the 1-hour primary SO₂ NAAQS would correspond to a comparably small value for annual SO₂ concentrations. A SIL may be used in PSD applications for determining whether a source's adverse impact on air quality is considered significant. If a source's impact exceeds the SIL, then a cumulative impact analysis would be needed for that source to determine if its emissions cause or contribute to potential NAAQS violations. The second aspect of the technical basis, in context of a cumulative impact analysis, focuses on the topic of NAAQS compliance by considering whether area compliance would be similar under the proposed secondary SO₂ NAAQS as under the 1-hour primary SO₂ NAAQS.

A Small Increase in 1-hour SO₂ Concentration Produces a Comparably Small Increase in Annual SO₂ Concentrations

For a source impact analysis under the 1-hour primary SO₂ NAAQS to be suitable for demonstration compliance with a secondary annual SO₂ NAAQS, a small increase in a modeled 1-hour SO₂ concentration as defined by the applicable SIL value should produce a comparably small increase in a modeled annual averaged SO₂ concentration. In this analysis, the small increase in an annual SO₂ design concentration is determined by the increase in emissions that would correspond to the level of the 1-hour SO₂ SIL of 3 ppb recommended in EPA guidance. This 1-hour SO₂ SIL of 3 ppb (7.86 µg/m³) is equal to 4% of the primary 1-hour SO₂ NAAQS of 75 ppb. EPA's view is that a PSD permit applicant that demonstrates the increase in the 1-hour SO₂ design concentration resulting from an increase in that new or modifying source's emissions will be less than or equal to the 1-hour SIL value will show in most cases that this increase in emissions will not cause or contribute to a violation of the 1-hour SO₂ NAAQS.²

To demonstrate the association between the primary 1-hour SO₂ NAAQS and a proposed annual SO₂ NAAQS, dispersion modeling was performed using EPA's AERMOD (American Meteorological Society/Environmental Protection Agency Regulatory Model). AERMOD is the EPA's preferred dispersion model for predicting ground-level pollutant concentrations in the nearfield (≤ 50 km) since its promulgation in 2005 into the EPA's *Guideline on Air Quality Models*, commonly referred to as the

² EPA Memorandum: Guidance Concerning the Implementation of the 1-hour SO₂ NAAQS for the Prevention of Significant Deterioration Program. August 23, 2010.

Guideline (Appendix W to 40 CFR Part 51). Thus, AERMOD is the primary air quality model used under the PSD program for new or modifying sources and has been used extensively in the implementation of the primary 1-hour SO₂ NAAQS.

To demonstrate the association of a small increase in the 1-hour SO₂ design concentration with a small increase in a proposed annual SO₂ design concentration, existing AERMOD dispersion modeling performed for the Risk and Exposure Assessment (REA)³ during the most recent review of the 1-hour primary SO₂ NAAQS was adapted for this purpose. The REA modeling assessment included a variety of industrial source types in different areas across the U.S. Three different sites were modeled which included a total of 11 industrial facilities within the following industrial sectors: electric generation, wastewater treatment, engine manufacturing, chemical manufacturing, battery recycling, glass manufacturing, and oil and gas refinement. Table 1 lists the study areas and the industrial sources in each area that were included in the REA modeling. The REA modeling for each of the sources listed in Table 1 was adapted and remodeled for this analysis over the 3-year period of 2011-2013. Refer to the referenced REA for descriptions of the areas, sources, and model setup performed for the REA such as emission and meteorological data that were used. Adaptations to the REA modeling are discussed later in this section. Figure 1 through Figure 3, taken from the referenced REA, show the locations of the modeling domains for each of the study areas and the location of each of the facilities.

³ Risk and Exposure Assessment for the Review of the Primary National Ambient Air Quality Standard for Sulfur Oxides. EPA-452/R-18-003. May 2018.

Table 1. Study Areas and Industrial Sources Modeled

Study Area	Facility Name	NEI ID
Fall River, MA	Brayton Point Energy (EGU)	5058411
Indianapolis, IN	Belmont Advanced Wastewater Treatment Plant (water treatment)	4885211
	Citizens Thermal (EGU)	4885311
	IPL – Harding Street Generation Station (EGU)	7255211
	Rolls Royce Corporation (combustion engine manufacture)	7972011
	Vertellus Specialties (chemical manufacturing)	7972111
	Quemetco (lead battery recycling)	8235411
Tulsa, OK	Public Service Co. of Oklahoma (PSO) Northeastern Power Station (EGU)	8212411
	Sapulpa Glass Plant (glass manufacturing)	7320611
	Tulsa Refinery West (oil/gas refinery)	8402711
	Tulsa Refinery East (oil/gas refinery)	8003911

Fall River, MA

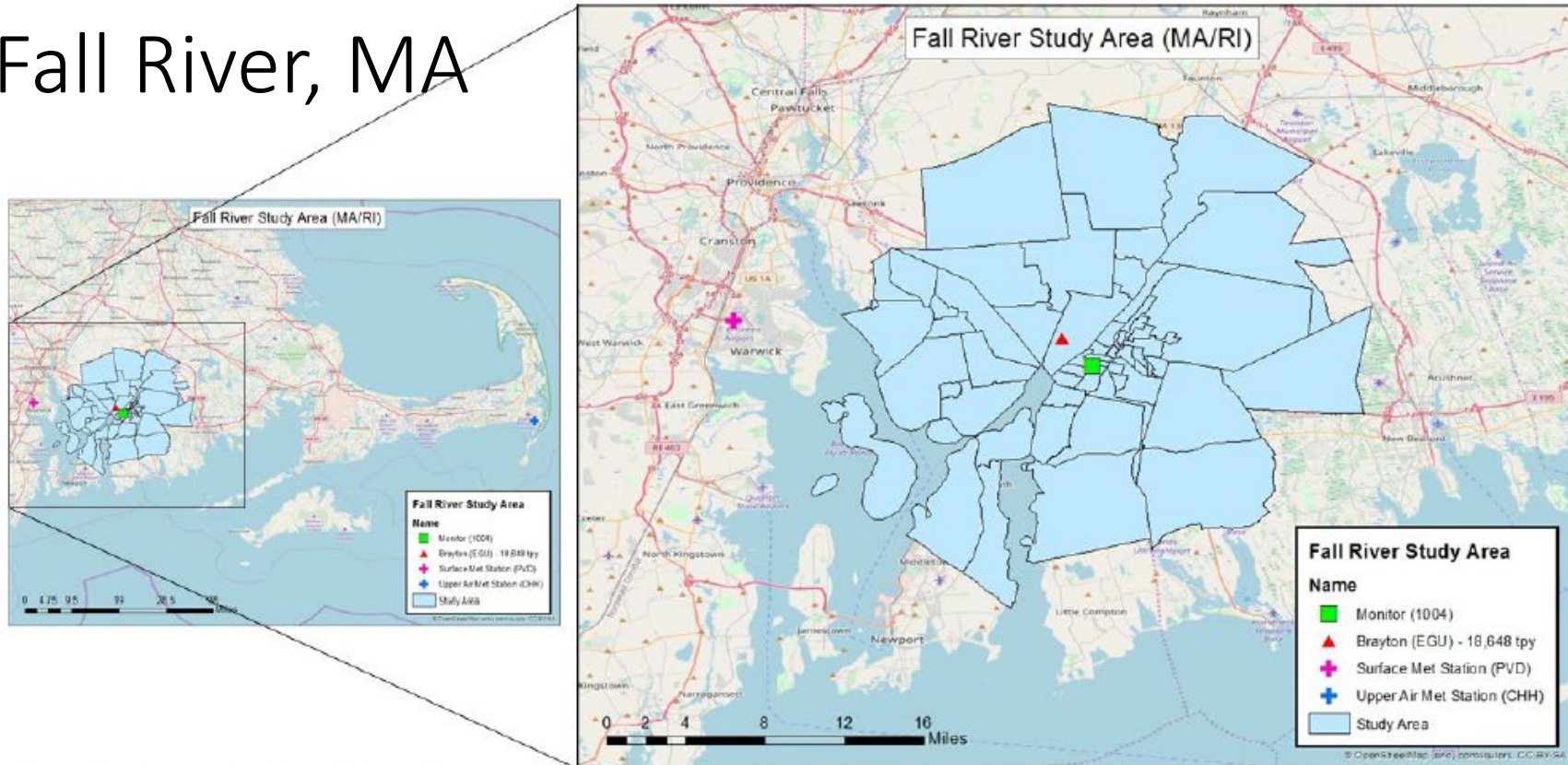


Figure 1. Fall River, MA Study Area and Modeling Domain

From Risk and Exposure Assessment for the Review of the Primary National Ambient Air Quality Standard for Sulfur Oxides, EPA-452/R-18-003, May 2018.

Indianapolis, IN

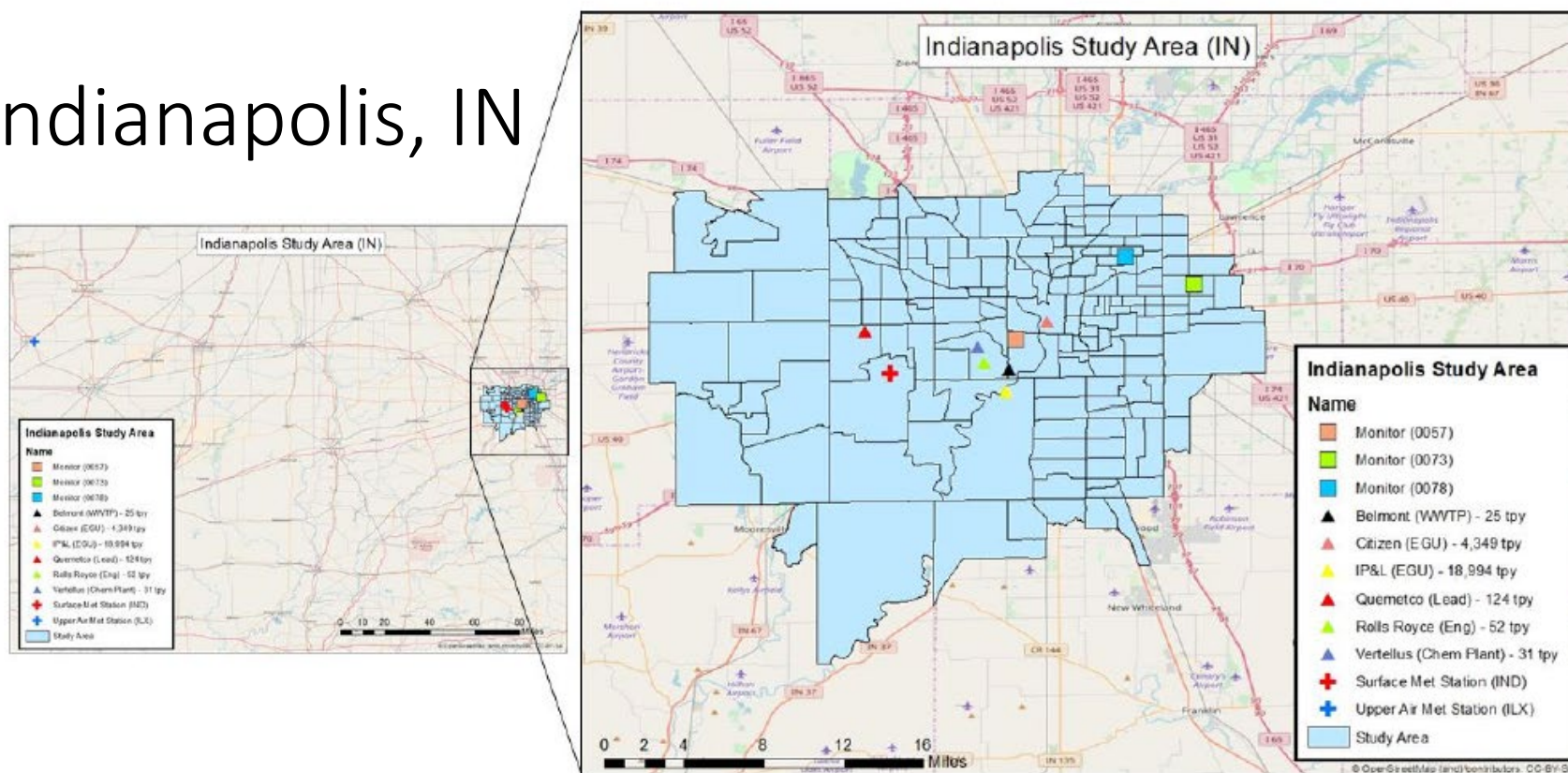


Figure 2. Indianapolis, IN Study Area and Modeling Domain

From Risk and Exposure Assessment for the Review of the Primary National Ambient Air Quality Standard for Sulfur Oxides, EPA-452/R-18-003, May 2018.

Tulsa, OK

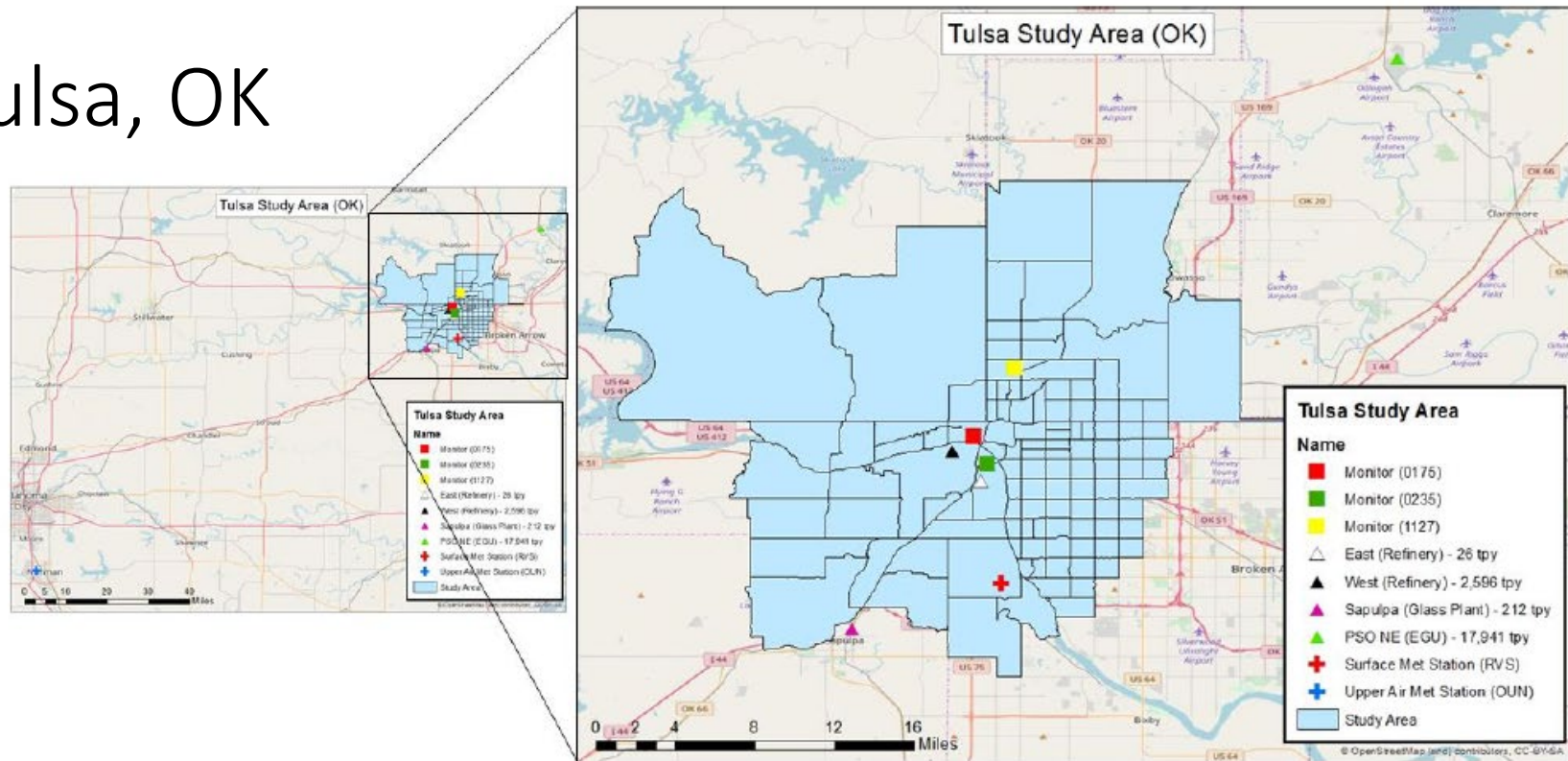


Figure 3. Tulsa, OK Study Area and Modeling Domain

From Risk and Exposure Assessment for the Review of the Primary National Ambient Air Quality Standard for Sulfur Oxides, EPA-452/R-18-003, May 2018.

For this analysis, each facility in Table 1 was modeled separately from all others to observe the increase in ground-level annual SO₂ concentrations associated with that facility's emissions increase that yields a small increase in the 1-hour concentrations. In addition, three of the sources within the Indianapolis area - IPL, Vertellus Specialties, and Quemetco - were also modeled as though they were in the Fall River area to observe the change in the annual design concentrations in a different topographical and meteorological environment. Note that the relative locations of the release points of these three facilities when modeled in the Fall River environment were not maintained. Rather, the source characteristics of the Fall River Brayton facility were replaced with the source characteristics of the Indianapolis sources. Because Vertellus and Quemetco are relatively small sources, they were modeled together as a single source in the Fall River area while IPL was modeled separately. Background concentrations were not included in this modeling demonstration so that emission rates and concentrations could be scaled as needed. Two of the sources in Tulsa, OK - Public Service Co. of Oklahoma (PSO) Northeastern Power Station and the Sapulpa Glass Plant - are located outside of the receptor grid used for the REA modeling. For this demonstration, the receptor grid for each of these sources was extended to ensure the area of maximum concentration was captured modeling for these sources.

The original REA modeling for each of the facilities listed in Table 1 was adapted and modeled as follows:

1. Variable emissions rates (e.g., hourly, monthly) used in the REA modeling were averaged for each emission point separately for each year, that resulted in a single constant year-specific emission rate for each emission point within each source (i.e., a constant emission rate was used each year for each emission point, and emission rates only varied by year).
2. Each facility was modeled to get a base annual design concentration. The annual design concentration was computed as the highest of the 3-year averages of the yearly annual concentrations across all receptors, consistent with the form of the proposed secondary standard.
3. Each facility was modeled to get a 1-hour concentration to compare to the EPA-recommended 1-hour SO₂ SIL value of 3 ppb (7.86 µg/m³). The 1-hour concentration for comparison to the SIL was computed as the maximum of the 3-year average of the highest 1-hour concentrations, across all receptors.
4. For each facility, the ratio of the 1-hour result from #3 to the EPA-recommended SIL concentration was computed and used to scale the annual concentrations from #1 for each year at each receptor to get the difference in the concentrations based on the increase in emissions that would result in a modeled concentration equal to the 1-hour SIL value.
5. The increase in each receptor concentration for each year, from #4, was added to each modeled receptor concentration each year, from #1, to get an increased concentration at each receptor for each year.
6. A new annual design concentration was then computed based on the increased modeled annual concentration, and the difference was computed between the

new annual design concentration and the original modeled design concentration from #2.

Table 2 shows the modeling results for each facility including the average annual emissions before and after the emissions increase, the amount of the emissions increase, the annual design concentration before and after the emissions increase, and the amount of increase in the annual design concentration (last column on the right). For most of the facilities modeled, the amount of increase in the annual design concentration is less than or equal to 1.0% of an annual standard 10 ppb and 0.7 % of an annual standard of 15 ppb. For all but two facilities the increase in the annual design concentration is less than or equal to 2.0% of a proposed annual standard of 10 ppb and less than or equal to 1.3% of a proposed annual standard of 15 ppb. The largest increase modeled is 3.5% of an annual standard of 10 ppb and 2.3% of an annual standard of 15 ppb.

The contour plots in Figure A1 through Figure A13 in the Appendix to this document show the location of the emission releases for each facility modeled and the amount of the increase in the annual SO₂ modeled design concentration based on a small increase in the 1-hour SO₂ modeled design concentration, reflective of the 1-hour SIL value. For each of the facilities modeled, the area of the peak ground-level SO₂ concentration and where the increase in the modeled annual design concentrations is the greatest occurs very near to the facility, within about 2 km for all facilities and less than 1 km, at or near the fence line for most of the facilities. Thus, the greatest increase in the modeled annual design concentrations is localized near the facility rather than some distance downwind of the facility. Overall, results in Table 2 and Figure A1 through Figure A13 in the Appendix suggest that a small increase in 1-hour SO₂ concentration produces a comparably small increase in annual SO₂ concentrations and thereby provides support that demonstrating compliance for the 1-hour primary SO₂ NAAQS is suitable for demonstrating compliance for the proposed secondary SO₂ NAAQS under the PSD program.

Table 2. AERMOD Modeling Results for Annual SO₂ Design Concentration Changes by Study Area and Source Type

Site - Facility	Annual Emissions (before increase) <i>TPY</i>	Emissions Increase <i>TPY</i>	Annual Emissions (after increase) <i>TPY</i>	Annual Design Concentration (before increase) <i>μg/m³ (ppb)</i>	Annual Design Concentration (after increase) <i>μg/m³ (ppb)</i>	Increase in Design Concentration <i>μg/m³ (ppb)</i>	Increase as % of Proposed Annual Std <i>10 ppb / 15 ppb</i>
Fall River, MA							
- Brayton Point Energy	8,733	483	9,216	2.25 (0.86)	2.37 (0.91)	0.12 (0.05)	0.5% / 0.03%
- Vertellus Specialties and Quemetco*	142	9	151	4.02 (1.54)	4.28 (1.63)	0.26 (0.10)	1.0% / 0.7%
- Citizen's Thermal*	4,009	90	4,099	4.86 (1.86)	4.97 (1.90)	0.11 (0.04)	0.4% / 0.3%
Indianapolis, IN							
- Belmont Advanced Wastewater Treatment Plant	23	2	25	1.92 (0.73)	2.10 (0.80)	0.18 (0.07)	0.7% / 0.5%
- Citizen's Thermal	4,009	158	4,167	5.19 (1.98)	5.39 (2.06)	0.20 (0.08)	0.8% / 0.5%
- IPL - Haring Street Generating Station	22,837	239	23,076	23.40 (8.93)	23.64 (9.03)	0.25 (0.09)	0.9% / 0.6%
- Rolls Royce Corporation	42	2	44	4.14 (1.58)	4.33 (1.65)	0.19 (0.07)	0.7% / 0.5%
- Vertellus Specialties	27	3	30	2.71 (1.04)	3.03 (1.16)	0.32 (0.12)	1.2% / 0.8%
- Quemetco	115	30	145	0.95 (0.36)	1.19 (0.45)	0.24 (0.09)	0.9% / 0.6%
Tulsa, OK							
- Public Service Co. of OK	17,941	5,63	17,846	5.69 (2.17)	5.88 (2.25)	0.19 (0.07)	0.7% / 0.5%
- Sapulpa Gas Plant	222	41	263	2.98 (1.14)	3.53 (1.35)	0.55 (0.21)	2.1% / 1.4%
- Tulsa Refinery West	1,892	79	1,971	22.05 (8.42)	22.97 (8.77)	0.92 (0.35)	3.5% / 2.3 %
- Tulsa Refinery East	24	97	121	0.13 (0.05)	0.66 (0.25)	0.53 (0.20)	2% / 1.3%
* Indianapolis, IN source releases also modeled at the Fall River, MA site.							

Monitoring Sites that Meet the 1-hour Primary SO₂ NAAQS Also Meet the Proposed Secondary SO₂ NAAQS

For a cumulative impact analysis under the 1-hour primary SO₂ NAAQS to be suitable for a secondary annual SO₂ NAAQS, the areas that meet the 1-hour primary SO₂ NAAQS should also meet proposed annual concentration levels for the secondary SO₂ NAAQS. In this section, we describe an ambient data analysis for monitored areas across the U.S. that evaluates the relationship between the current primary 1-hour SO₂ NAAQS and the proposed secondary SO₂ NAAQS. The analysis demonstrates that all monitoring sites that meet the current primary 1-hour SO₂ NAAQS also meet the proposed secondary SO₂ NAAQS.

The analysis is summarized in the scatter plot shown in Figure 4 that compares site-level ambient SO₂ concentrations based on the current primary SO₂ NAAQS and the concentration levels for proposed secondary SO₂ NAAQS. This figure shows that all monitoring sites meeting the current primary SO₂ NAAQS of 75 ppb also meet the proposed levels for the secondary SO₂ NAAQS of 10 and 15 ppb. Further, only two monitoring sites violate the proposed secondary SO₂ standard at the low end of the proposed range (10-15 ppb) during the 2017-2019 to 2020-2022 DV periods. Both sites are in New Madrid County, MO and also violate the current 1-hour primary SO₂ standard at 75 ppb. Thus, all monitoring sites that meet the current primary 1-hour SO₂ NAAQS also meet the levels for the proposed secondary SO₂ NAAQS.

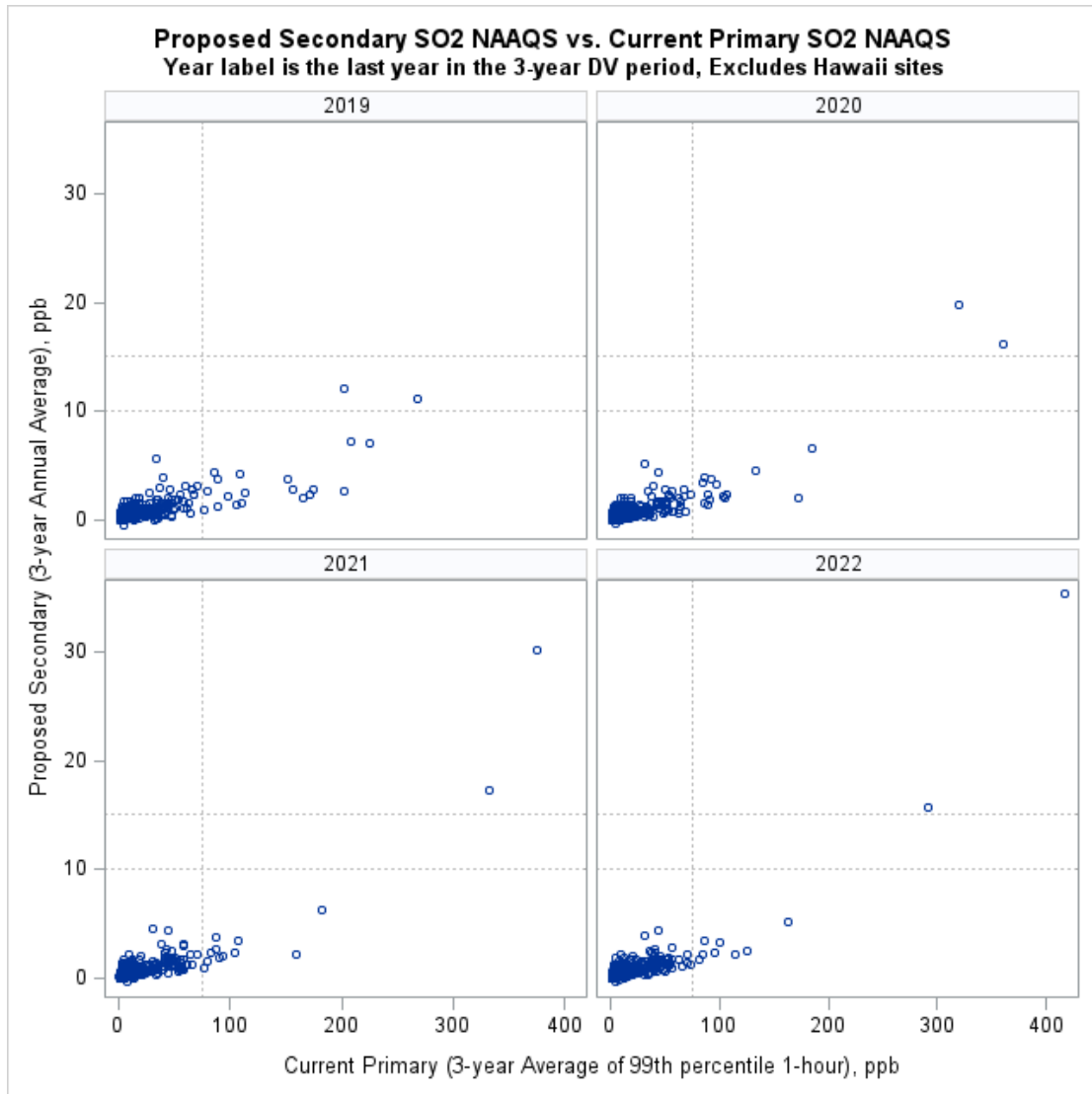


Figure 4. Scatter plot of site-level concentrations for the proposed secondary SO₂ NAAQS compared to the current primary SO₂ NAAQS: 2019-2022 Design Values

Overall, design values based on 2017-2019 to 2020-2022 data show that sites meeting the current primary 1-hour SO₂ NAAQS would also meet the levels for the proposed secondary SO₂ NAAQS. Therefore, the results indicate that a cumulative impact analysis that demonstrates compliance with the current primary 1-hour SO₂ NAAQS would generally be suitable for demonstrating compliance with the proposed secondary SO₂ NAAQS for PSD applications.

APPENDIX

Contour Plots Showing Amount of Increase in Modeled Design Concentration for Proposed Annual SO₂ Standard

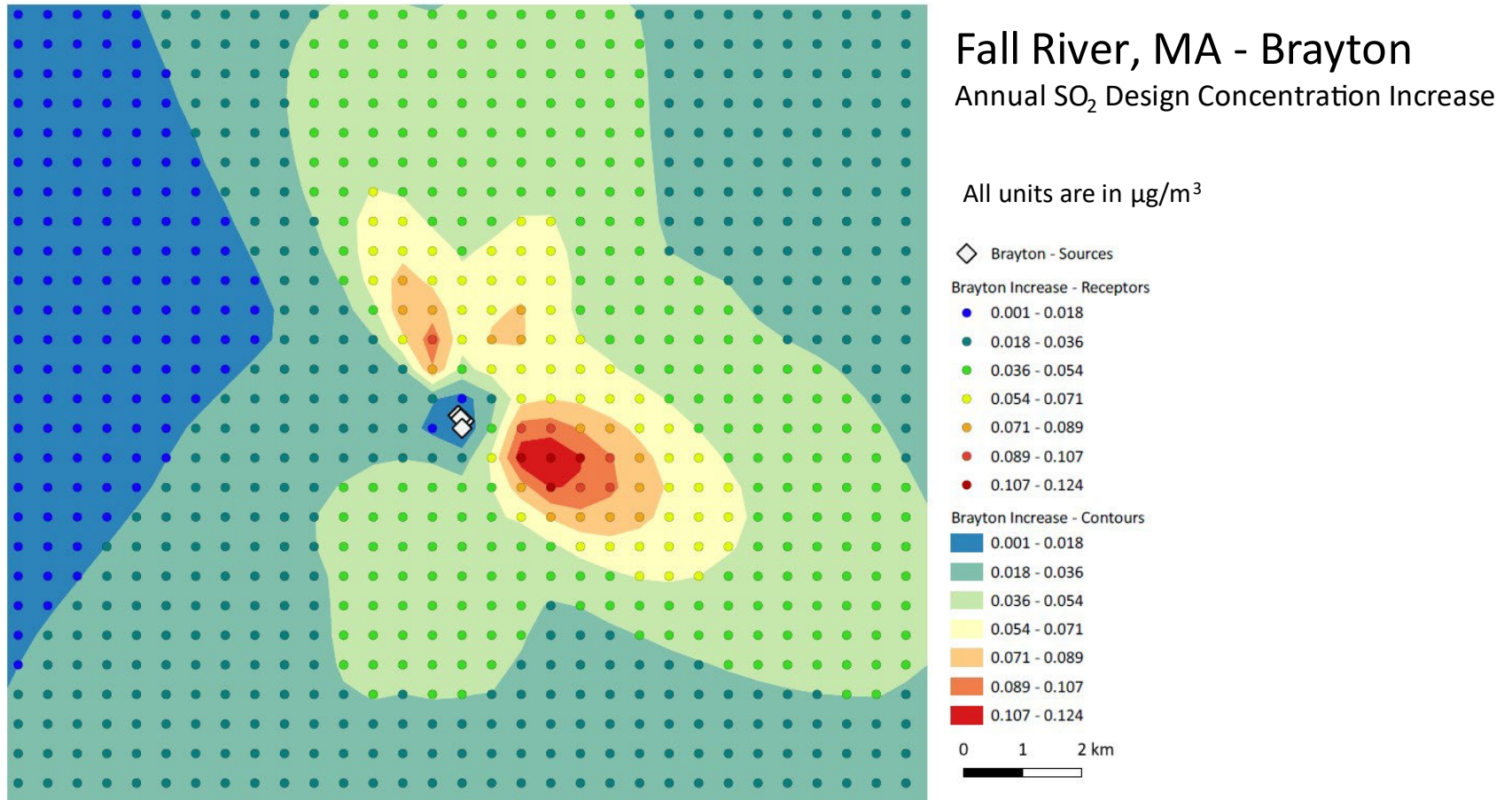


Figure A1. Increase in Annual SO₂ Design Concentration for Brayton Facility at Fall River, MA.

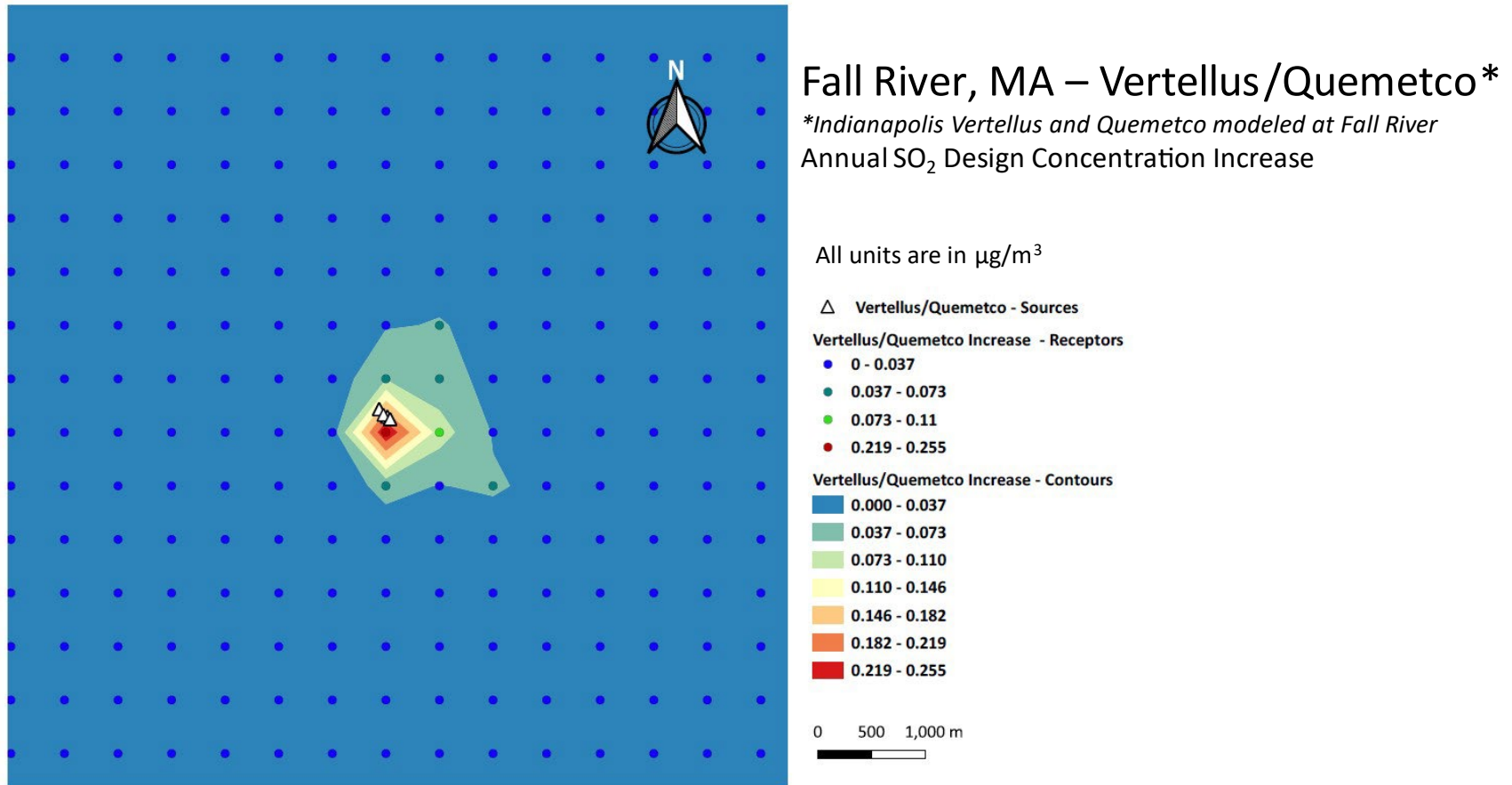


Figure A2. Increase in Annual SO₂ Design Concentration for Vertellus and Quemetco Sources Modeled with Fall River, MA, Terrain and Meteorology.

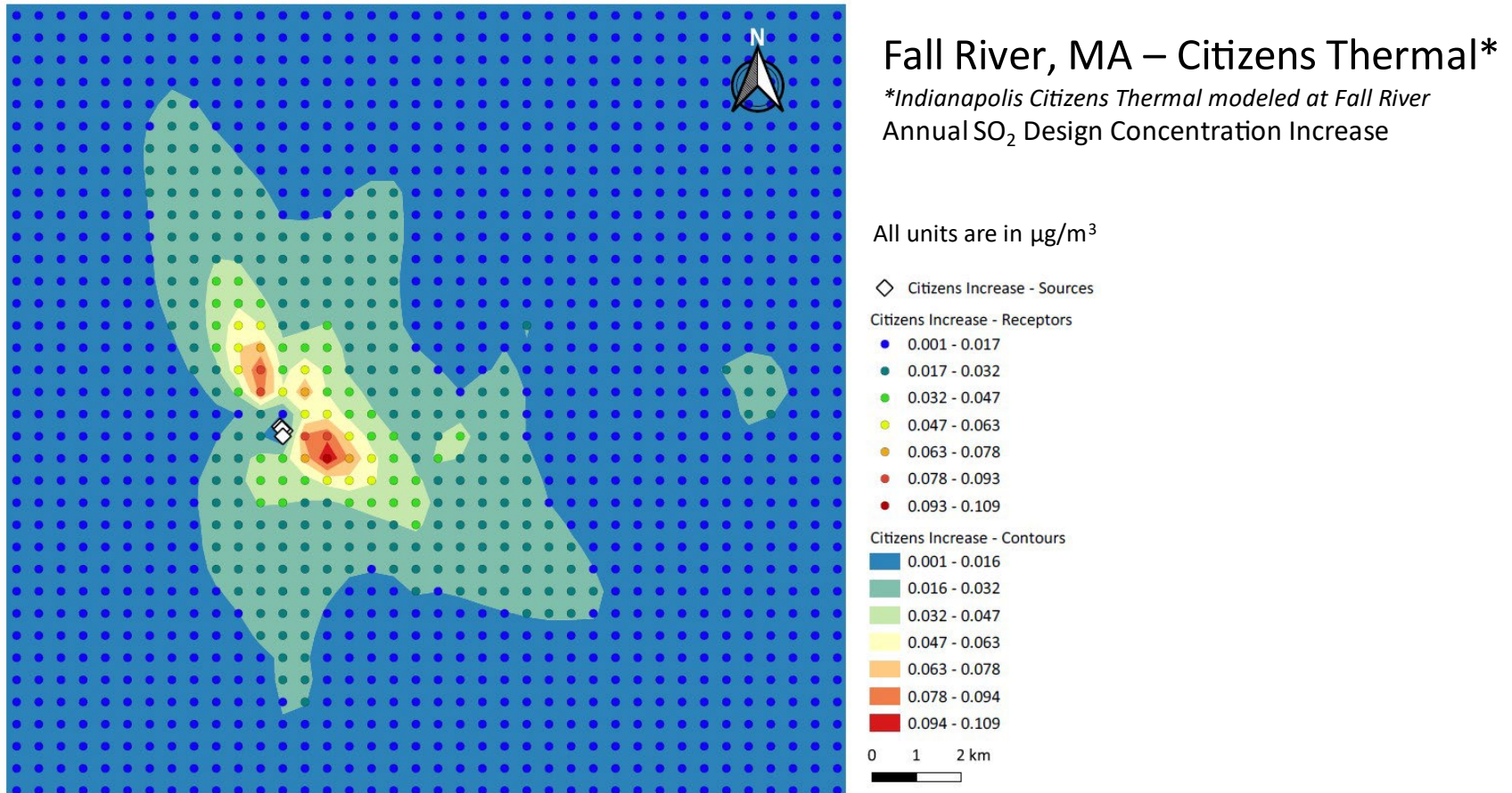


Figure A3. Increase in Annual SO₂ Design Concentration for Citizens Thermal Sources Modeled with Fall River, MA, Terrain and Meteorology.

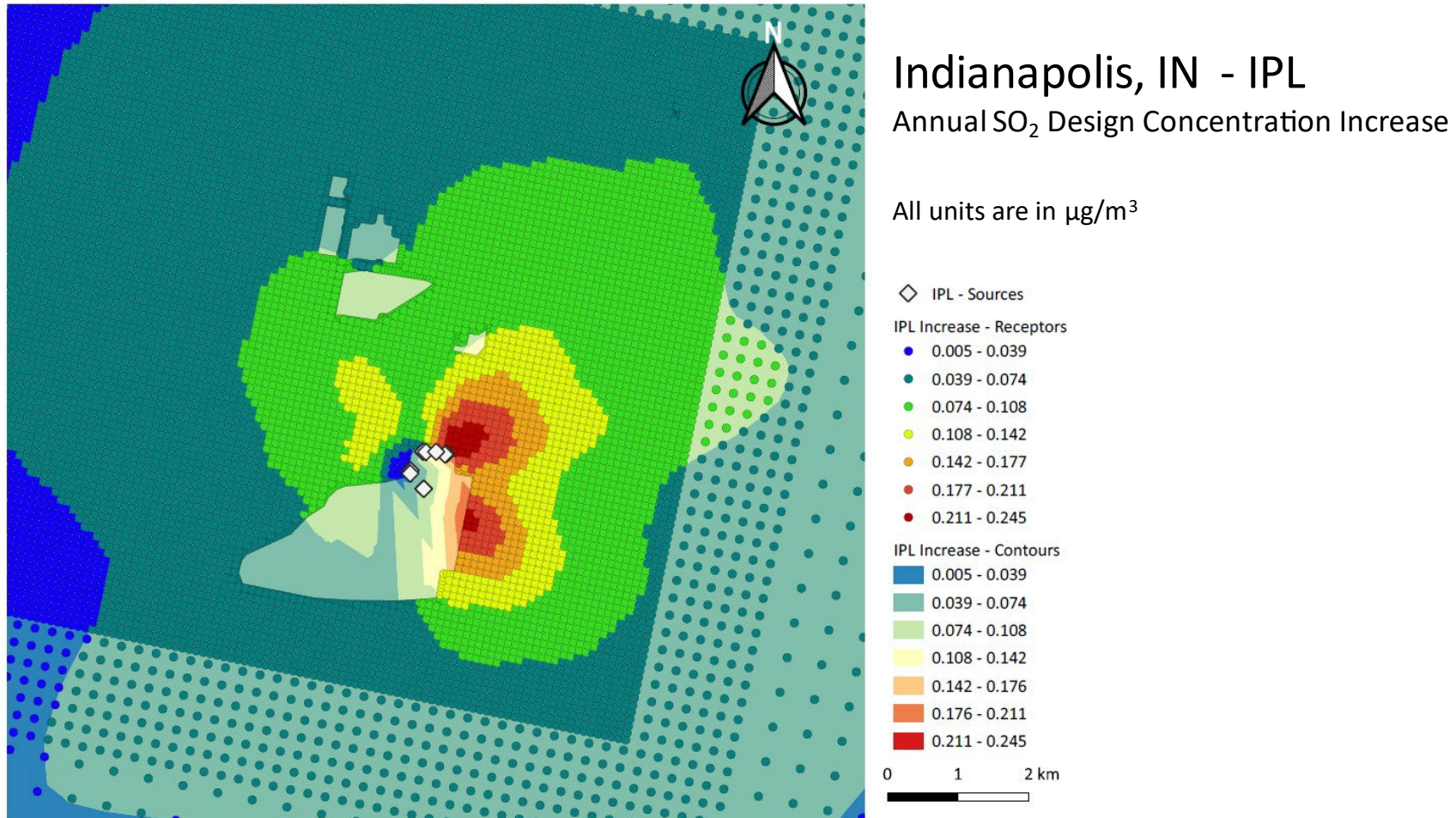


Figure A4. Increase in Annual SO₂ Design Concentration for IPL Facility in Indianapolis, IN.

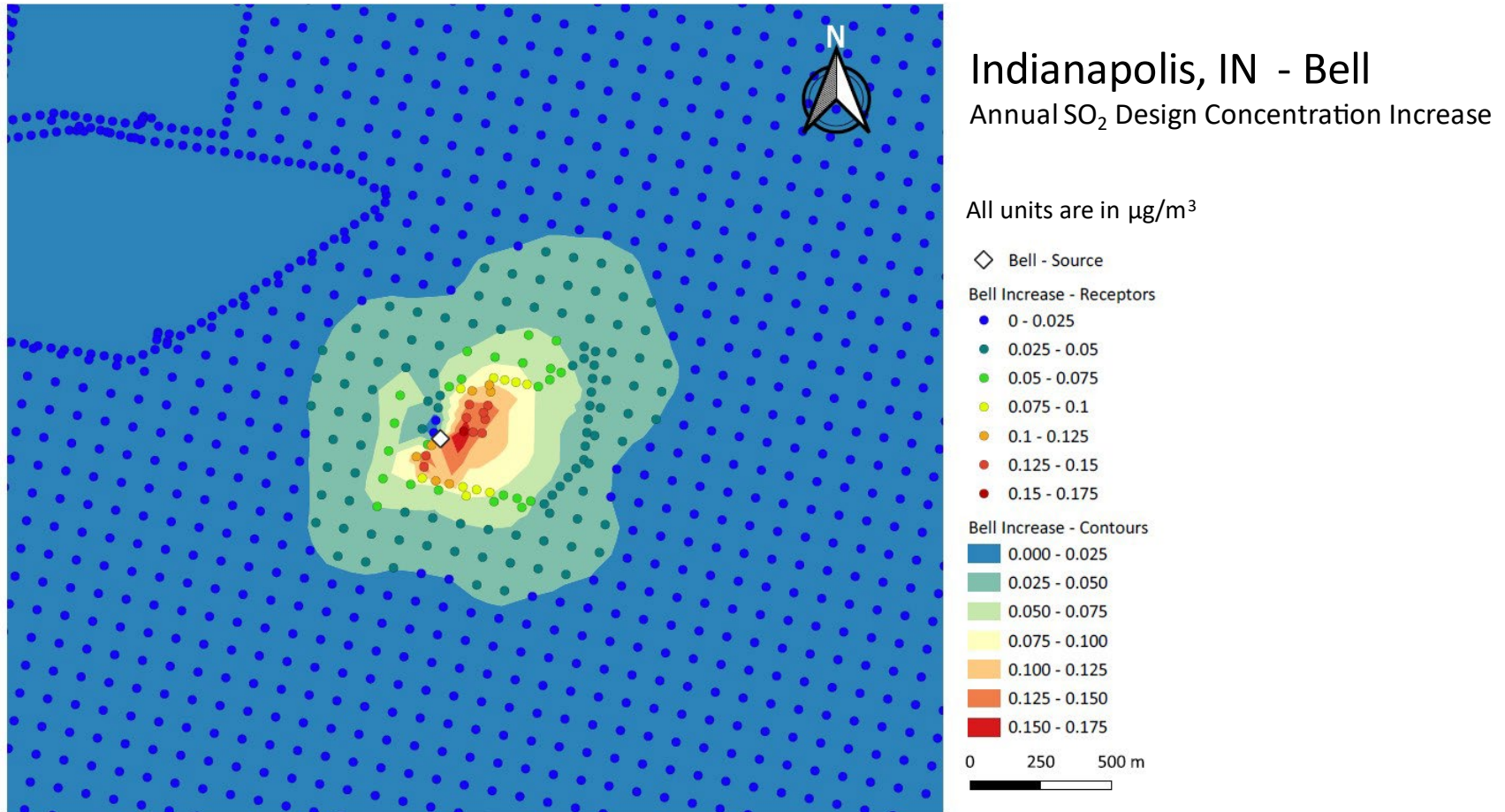


Figure A5. Increase in Annual SO₂ Design Concentration for Belmont Advanced Wastewater Treatment Facility in Indianapolis, IN.

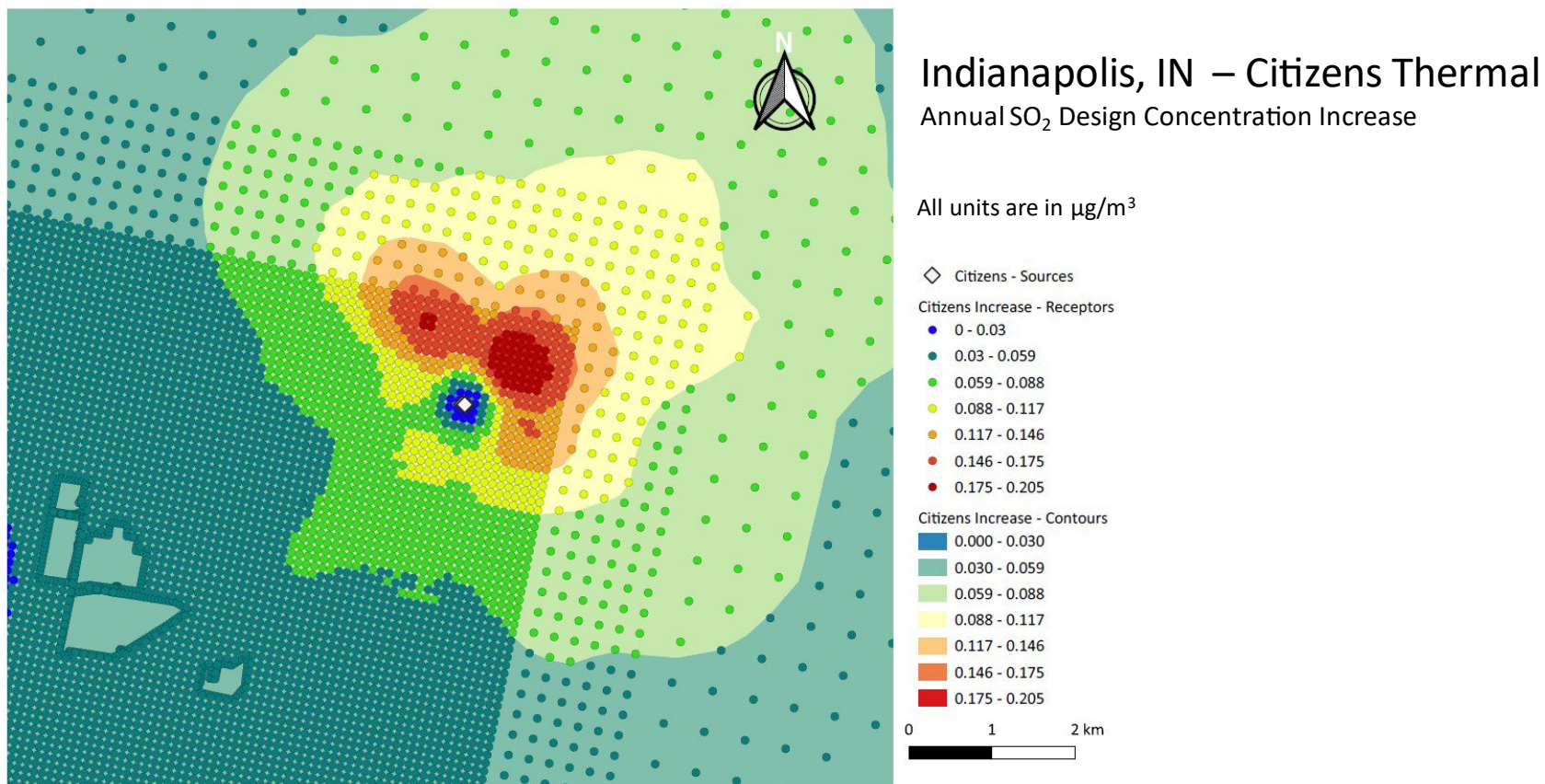


Figure A6. Increase in Annual SO₂ Design Concentration for Citizens Thermal Facility in Indianapolis, IN.

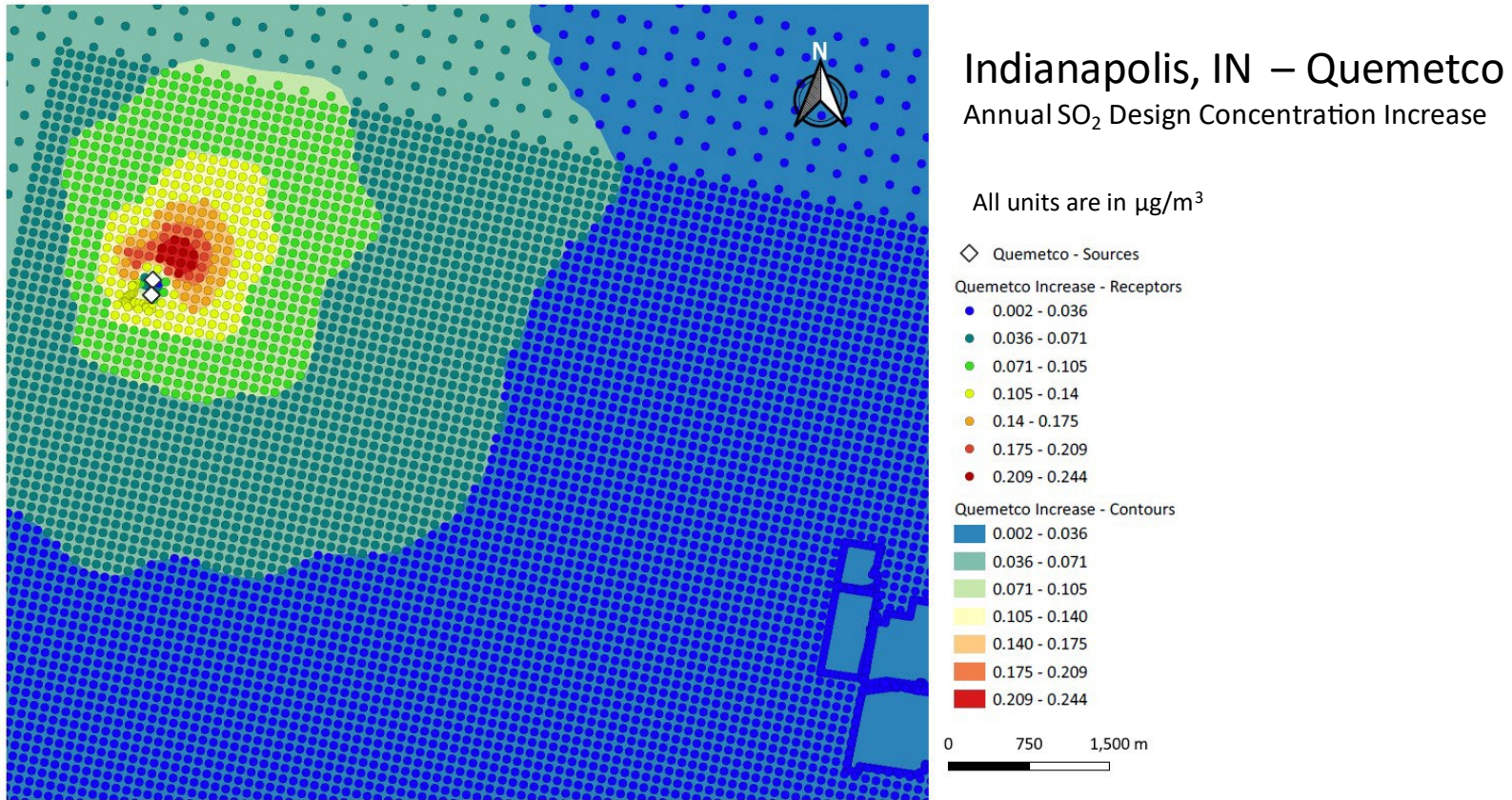


Figure A7. Increase in Annual SO₂ Design Concentration for Quemetco Facility in Indianapolis, IN.

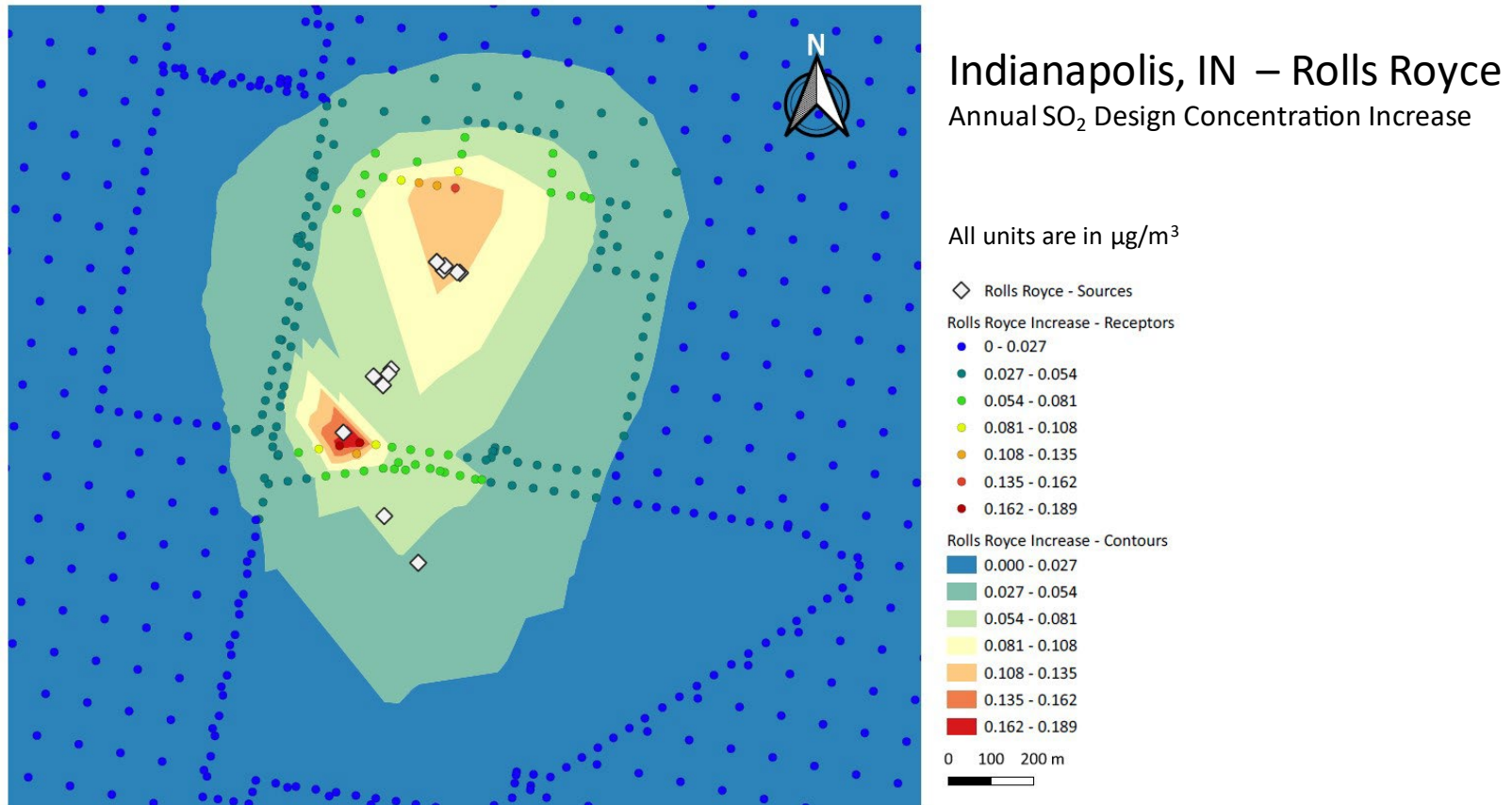


Figure A8. Increase in Annual SO₂ Design Concentration for Rolls Royce Facility in Indianapolis, IN.

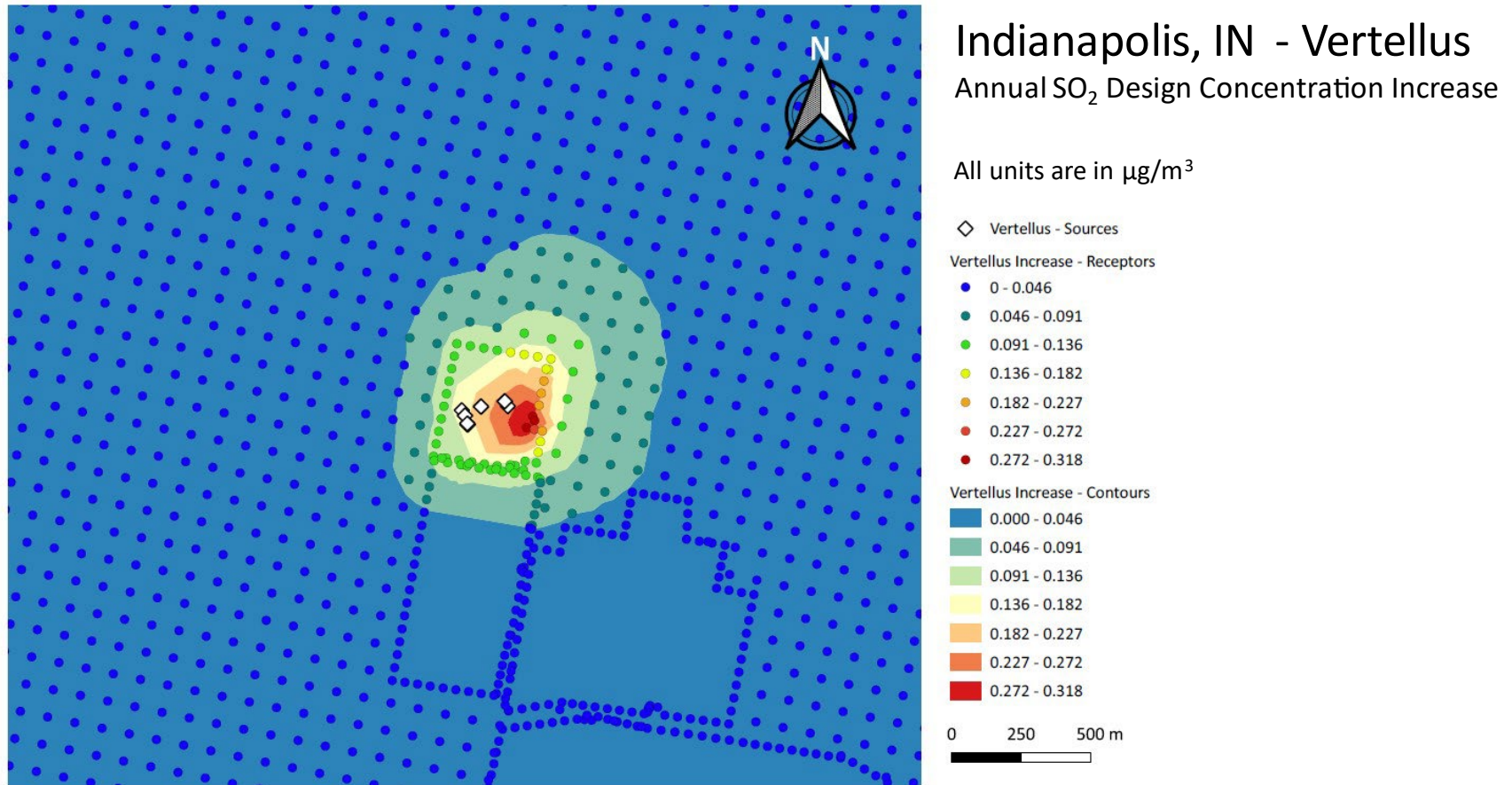


Figure A9. Increase in Annual SO₂ Design Concentration for Vertellus Facility in Indianapolis, IN.

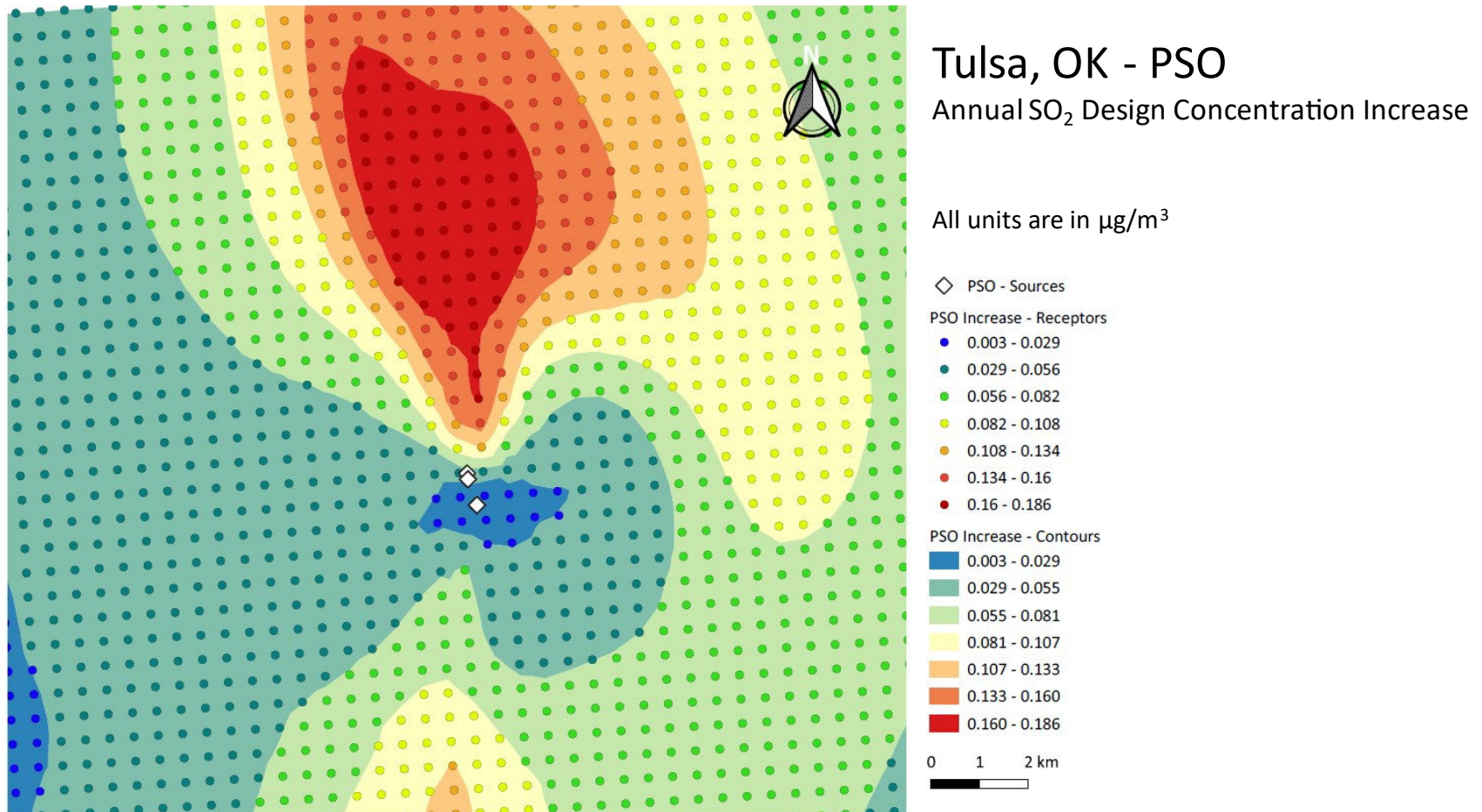


Figure A10. Increase in Annual SO₂ Design Concentration for PSO Facility in Tulsa, OK.

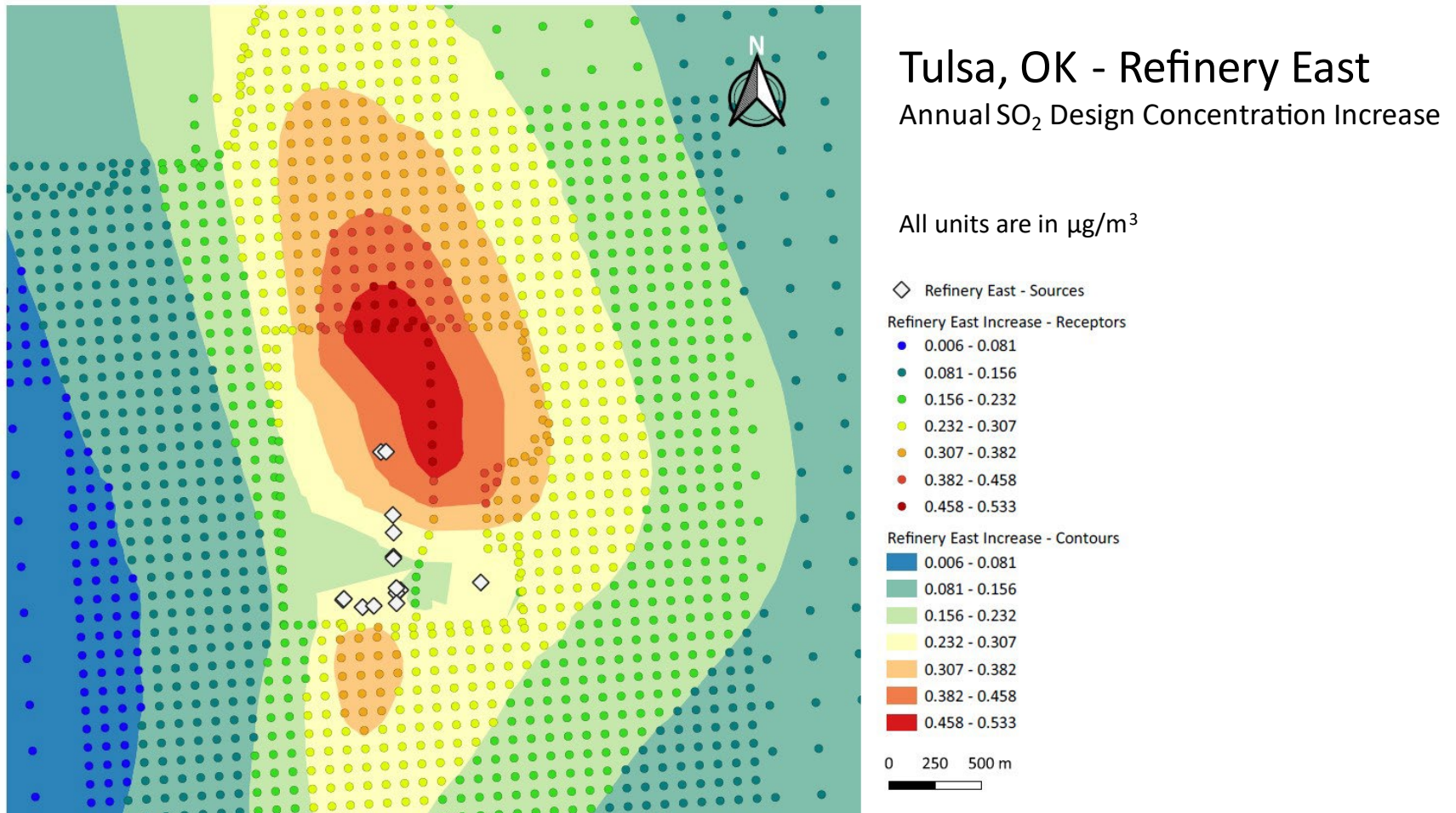
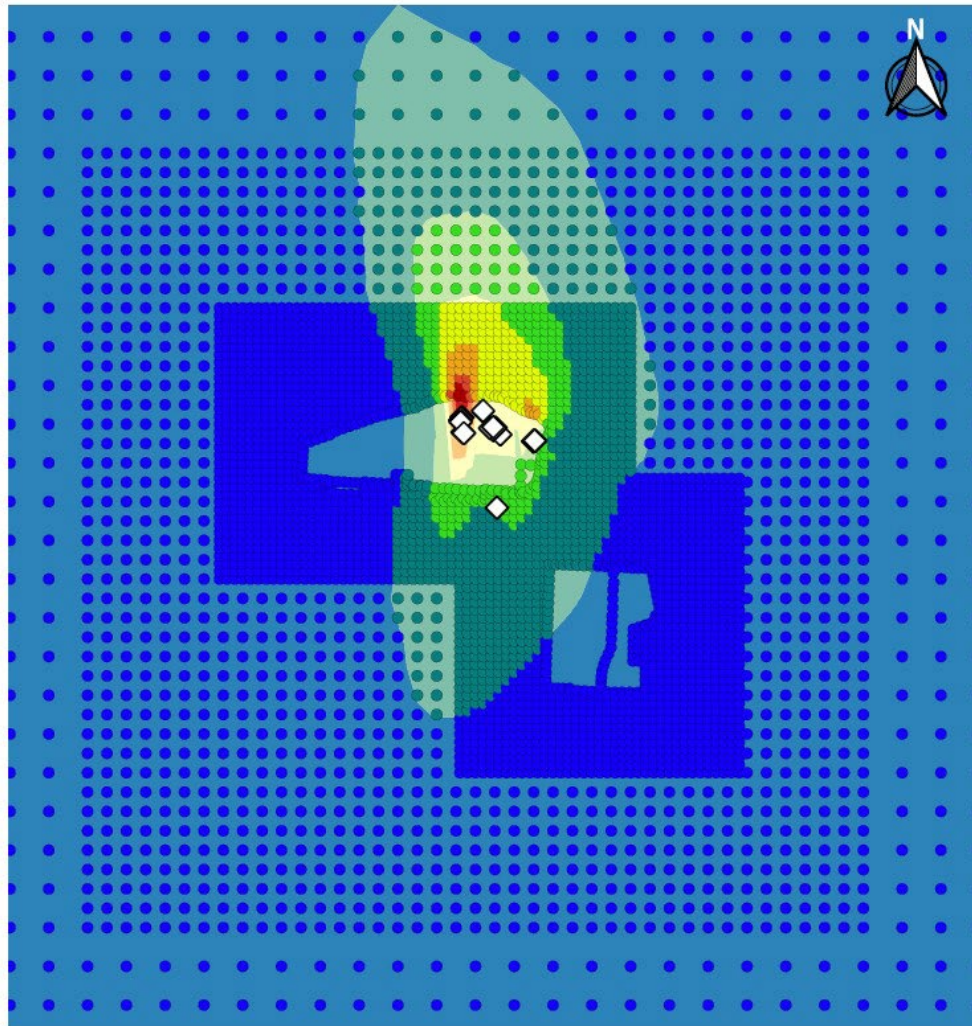


Figure A11. Increase in Annual SO₂ Design Concentration for Refinery East Facility in Tulsa, OK.



Tulsa, OK - Refinery West

Annual SO₂ Design Concentration Increase

All units are in $\mu\text{g}/\text{m}^3$

◇ Refinery West - Sources

Refinery West Increase - Receptors

- 0.01 - 0.14
- 0.14 - 0.27
- 0.27 - 0.4
- 0.4 - 0.53
- 0.53 - 0.66
- 0.66 - 0.79
- 0.79 - 0.92

Refinery West Increase - Contours

- 0.005 - 0.136
- 0.136 - 0.267
- 0.267 - 0.398
- 0.398 - 0.529
- 0.529 - 0.660
- 0.660 - 0.791
- 0.791 - 0.922

0 1 2 km

Figure A12. Increase in Annual SO₂ Design Concentration for Refinery West Facility in Tulsa, OK

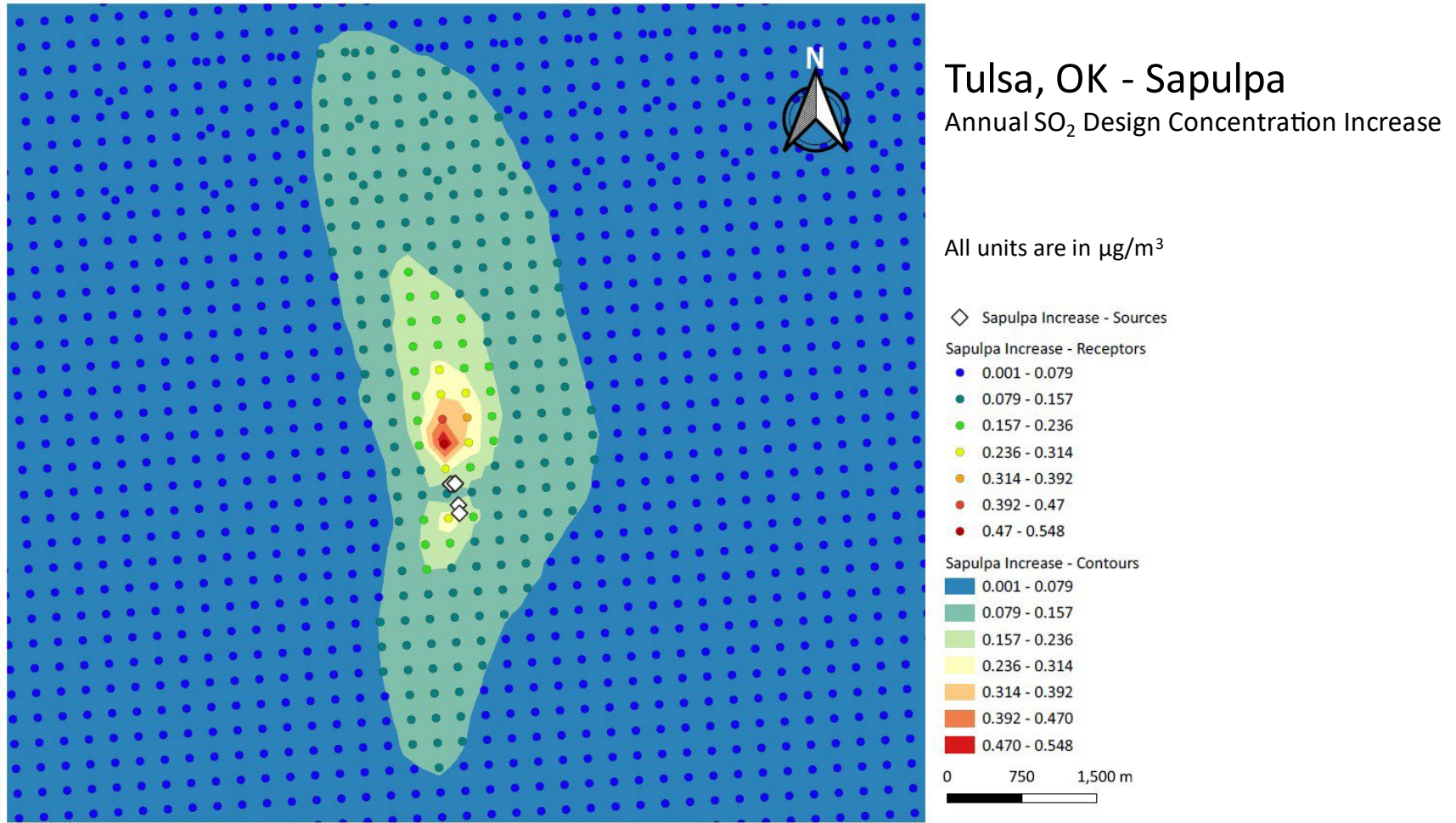


Figure A13. Increase in Annual SO₂ Design Concentration for Sapulpa Facility in Tulsa, OK