

FINAL

2024 Fine Particulate Matter National
Ambient Air Quality Standard Designation
Technical Support Document



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Executive Summary

On February 7, 2024, the U.S. Environmental Protection Agency (EPA) strengthened the National Ambient Air Quality Standard (NAAQS) for fine particulate matter, by lowering the annual primary standard from 12.0 to 9.0 micrograms per cubic meter (2024 PM_{2.5} NAAQS). Following promulgation of a revised NAAQS, EPA is required to designate areas throughout the United States as attaining or not attaining the NAAQS.

As part of the designation process, states and tribes are required to submit designations recommendations to the EPA. States and tribes identify areas or counties as attainment (meets the standard), nonattainment (does not meet the standard), or unclassifiable (cannot be classified based upon available information).

A review of air quality monitoring data from 2021-2023 shows that all of Delaware's particulate matter monitors are well below the new NAAQS. In addition, analysis shows that Delaware is not causing other areas to fail to meet the NAAQS. Therefore, Delaware is recommending a classification of "attainment" for all three Delaware Counties, New Castle, Kent, and Sussex under the 2024 PM_{2.5} NAAQS.

This Technical Support Document was prepared by the Division of Air Quality in the Department of Natural Resources and Environmental Control for the State of Delaware, to illustrate the technical basis for Delaware's recommendation, and to aid EPA in their designation process.

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List of Acronyms

CAA	Clean Air Act
CBSA	Core Based Statistical Area
CBSA+	Core Based Statistical Area Plus
EMP	Emissions Modeling Platform
EPA	Environmental Protection Agency
FR	Federal Register
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
µg/m ³	Micrograms Per Cubic Meter
NAAQS	National Ambient Air Quality Standards
NH ₃	Ammonia
NO _x	Nitric Oxide
PM _{2.5}	Fine Particulate Matter
SIP	State Implementation Plan
SLT	State, Local, and Tribal Authorities
SO ₂	Sulfur Dioxide
VOC	Volatile Organic Compound
VMT	Vehicular Miles Traveled

1.0 Introduction

On February 7, 2024, the U.S. Environmental Protection Agency (EPA) strengthened the National Ambient Air Quality Standard (NAAQS) for fine particulate matter (PM_{2.5}) (2024 PM_{2.5} NAAQS), by lowering the annual primary standard from 12.0 to 9.0 micrograms per cubic meter (µg/m³) [89 Federal Register (FR) 16202].¹ Following promulgation of a revised NAAQS, EPA is required by the Clean Air Act (CAA) to designate areas throughout the United States as attaining or not attaining the NAAQS [CAA Section 107(d)(1)].

As part of the designation process, states and tribes are required to submit designations recommendations to the EPA. States identify areas or counties as attainment (meets the standard), nonattainment (does not meet the standard), or unclassifiable (cannot be classified based upon available information).

In 2012, EPA reviewed and revised the PM_{2.5} NAAQS (2012 PM_{2.5} NAAQS), by strengthening the annual primary standard from 15.0 to 12.0 µg/m³.² For the 2012 PM_{2.5} NAAQS revision, EPA designated all three counties in Delaware as attainment: New Castle, Kent and Sussex (80 FR 2206).³

Designation recommendations for the 2024 PM_{2.5} primary annual standard are due to EPA no later than February 7, 2025. This document supports Delaware's continued recommendation for the designation of New Castle, Kent, and Sussex counties as "attainment" under the 2024 PM_{2.5} NAAQS. Taking into consideration a state's designation recommendation, EPA is required to complete the initial area designations process within 2 years of promulgation of a new or revised NAAQS, in this case February 7, 2026.

¹ Reconsideration of the National Ambient Air Quality Standards for Particulate Matter. EPA Final Rule. 89 FR 16202. March 6, 2024. <https://www.govinfo.gov/content/pkg/FR-2024-03-06/pdf/2024-02637.pdf>

² National Ambient Air Quality Standards for Particulate Matter. EPA Final Rule. 78 FR 3086. January 15, 2013. <https://www.govinfo.gov/content/pkg/FR-2013-01-15/pdf/2012-30946.pdf>

³ Air Quality Designations for the 2012 Primary Annual Fine Particle (PM_{2.5}) National Ambient Air Quality Standards (NAAQS). EPA Final Rule. 80 FR 2206. January 15, 2015. <https://www.govinfo.gov/content/pkg/FR-2015-01-15/pdf/2015-00021.pdf>

On February 7, 2024, EPA issued a memorandum for states and tribes: *Initial Area Designations for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard* (2024 EPA Designation Memorandum).⁴ In this memorandum EPA suggested that states consider the following five factors in making their recommendations for area designations and nonattainment area boundaries:

- Air Quality Data
- Emissions and emissions-related data
- Meteorology
- Geography/Topography
- Jurisdictional Boundaries

Based upon monitoring data, as well as a weight-of-evidence approach described in Attachment 3 of EPA's memorandum, states or tribes should identify areas as attainment, nonattainment, or unclassifiable. Table 1-1 outlines how Delaware has addressed the above listed five EPA elements from the 2024 EPA Designation Memorandum in this document.

⁴ Initial Area Designation for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard. EPA Memorandum. February 7, 2024. https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-designations-memo_2.7.2024-_ig-signed.pdf

Table 1-1: Delaware's 2024 PM_{2.5} Designation Recommendation Outline

EPA Memo, Attachment 3 - EPA Designation Factors: ⁵	Factor Description:	Location in Recommendation:
Air Quality Data (pg.4)	<i>Identify all monitored violations of the revised primary annual PM_{2.5} NAAQS using the most recently available air quality data.</i>	<u>Section 2.0</u> – Air Quality Monitoring Data
Air Quality Data - Design Values (pgs.4-6)	<i>Current PM_{2.5} design values for each air quality monitoring site.</i>	<u>Section 2.1</u> – Delaware's PM _{2.5} Design Values <u>Section 2.2</u> – CBSA Design Values
Emissions and Emissions Related Data (pgs. 8-9)	<i>Examine emissions of direct PM_{2.5} and PM_{2.5} precursors.</i>	<u>Section 3.0</u> – Emissions Inventory of Sources and Emissions Related Data <u>Section 3.1</u> –2022 EPA Emissions Modeling Platform
Emissions and Emissions Related Data - Population (pgs. 9-10)	<i>Population density and degree of urbanization.</i>	<u>Section 3.2</u> – Population Density and Degree of Urbanization
Emissions and Emissions Related Data - Traffic (pg.10)	<i>Total Vehicle Miles Traveled.</i>	<u>Section 3.3</u> – Vehicle Miles Traveled
Meteorology (pg. 11)	<i>Determine the effect on the fate and transport of emissions contributing to PM_{2.5} concentrations and to identify areas potentially contributing to the monitored violations.</i>	<u>Section 4.0</u> – Meteorology <u>Section 4.1</u> – HYSPLIT Trajectories <u>Section 4.2</u> – Wind Roses
Geography/ Topography (pg. 11)	<i>Examination of physical features of the land that might define the airshed and affect the formation and distribution of PM_{2.5} over the area.</i>	<u>Section 5.0</u> – Geography/Topography
Jurisdictional Boundaries (pgs. 11-12)	<i>Jurisdictional boundaries used to identify the planning and organizational structure of an area.</i>	<u>Section 6.0</u> – Jurisdictional Boundaries

⁵ Initial Area Designation for the 2024 Revised Primary Annual Fine Particle National Ambient Air Quality Standard. EPA Memorandum. February 7, 2024. https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-designations-memo_2.7.2024_-ig-signed.pdf

1.1 Delaware PM_{2.5} Monitoring Network Data

The initial area recommendation process begins with an evaluation of available ambient air quality measurements from regulatory monitors to determine the location and magnitude of violations of the standard (if any). The primary goal of the PM_{2.5} monitoring network in Delaware is to determine the status of the ambient air with respect to the 24-hour and annual average PM_{2.5} NAAQS.

Figure 1-1 shows the locations of Delaware's PM_{2.5} monitors. All data from these monitors are measured using EPA approved federal reference methods , or federal equivalent methods . These methods are EPA certified to determine PM_{2.5} in ambient air for comparison with the NAAQS.

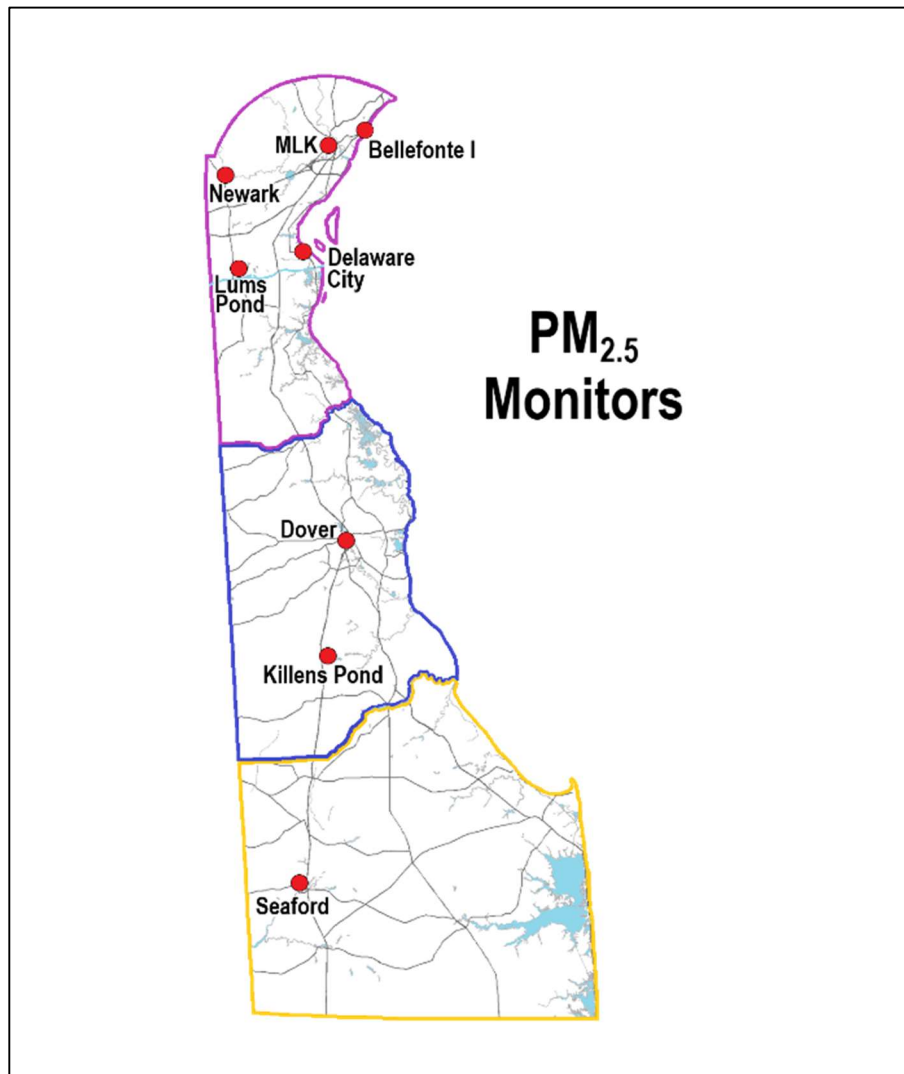


Figure 1-1: Delaware's PM_{2.5} Air Monitors

1.2 Nonattainment Area Analyses and Boundary Determinations

CAA section 107(d) explicitly requires that the EPA designate as nonattainment not only the areas that are violating the standard at issue, but also those nearby areas that contribute to the violation(s). The EPA evaluates the boundaries for each nonattainment area on a case-by-case basis considering the specific facts and circumstances unique to the area.

Individual counties within a state can be associated with nearby metropolitan areas. These areas are called Core Based Statistical Areas (CBSA).⁶ Through the designation process, EPA will identify each regulatory air quality PM_{2.5} monitor or group of monitors that indicate a violation of the standard in a CBSA.

Table 1-2 and Figure 1-2 show the three CBSAs that include Delaware counties. Kent County is part of the Dover, DE CBSA, New Castle County is part of the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD CBSA (Philadelphia CBSA); and Sussex County is part of the Salisbury, MD-DE CBSA.

Table 1-2: Core Based Statistical Areas for Delaware

Core Based Statistical Area (CBSA)	Counties
Dover, DE	Kent, DE
Philadelphia-Camden-Wilmington PA-NJ-DE-MD	New Castle, DE Cecil, MD Burlington, NJ Camden, NJ Gloucester, NJ Salem, NJ Bucks, PA Chester, PA Delaware, PA Montgomery, PA Philadelphia, PA
Salisbury, MD-DE	Sussex, DE Somerset, MD Wicomico, MD Worcester, MD

⁶ The Office of Management and Budget (OMB) adopted standards for delineating metropolitan and micropolitan statistical areas on December 27, 2000 (65 FR 82229). These delineation standards established the term CBSA. On July 16, 2021, OMB published their 2020 standards for delineating metropolitan and micropolitan statistical areas (86 FR 37770).

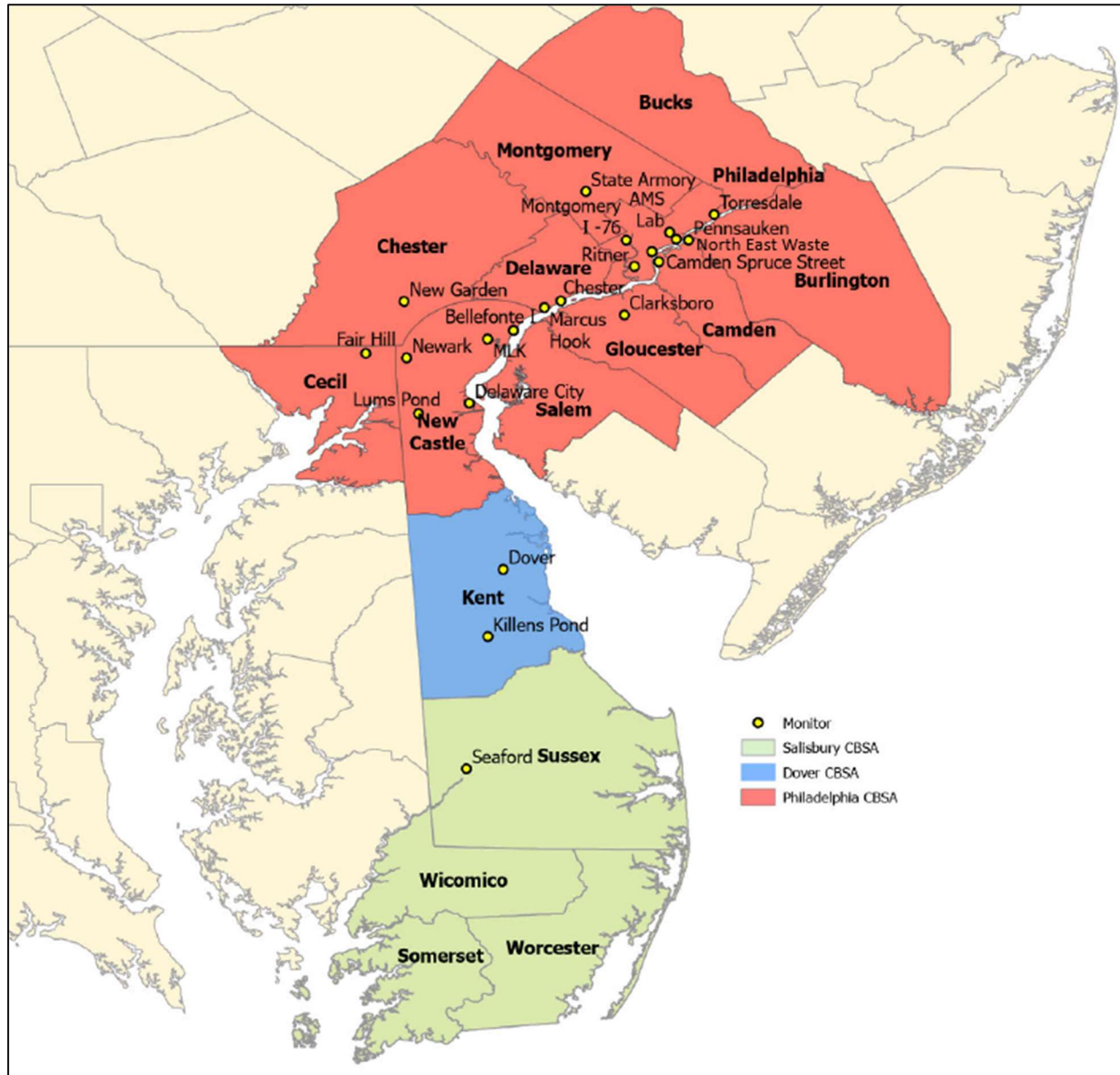


Figure 1-2: Core Based Statistical Areas and PM_{2.5} Monitors

Figure 1-3 shows a detailed map of Philadelphia County within the Philadelphia CBSA, as there are a large number of PM_{2.5} monitors within this area of the CBSA.

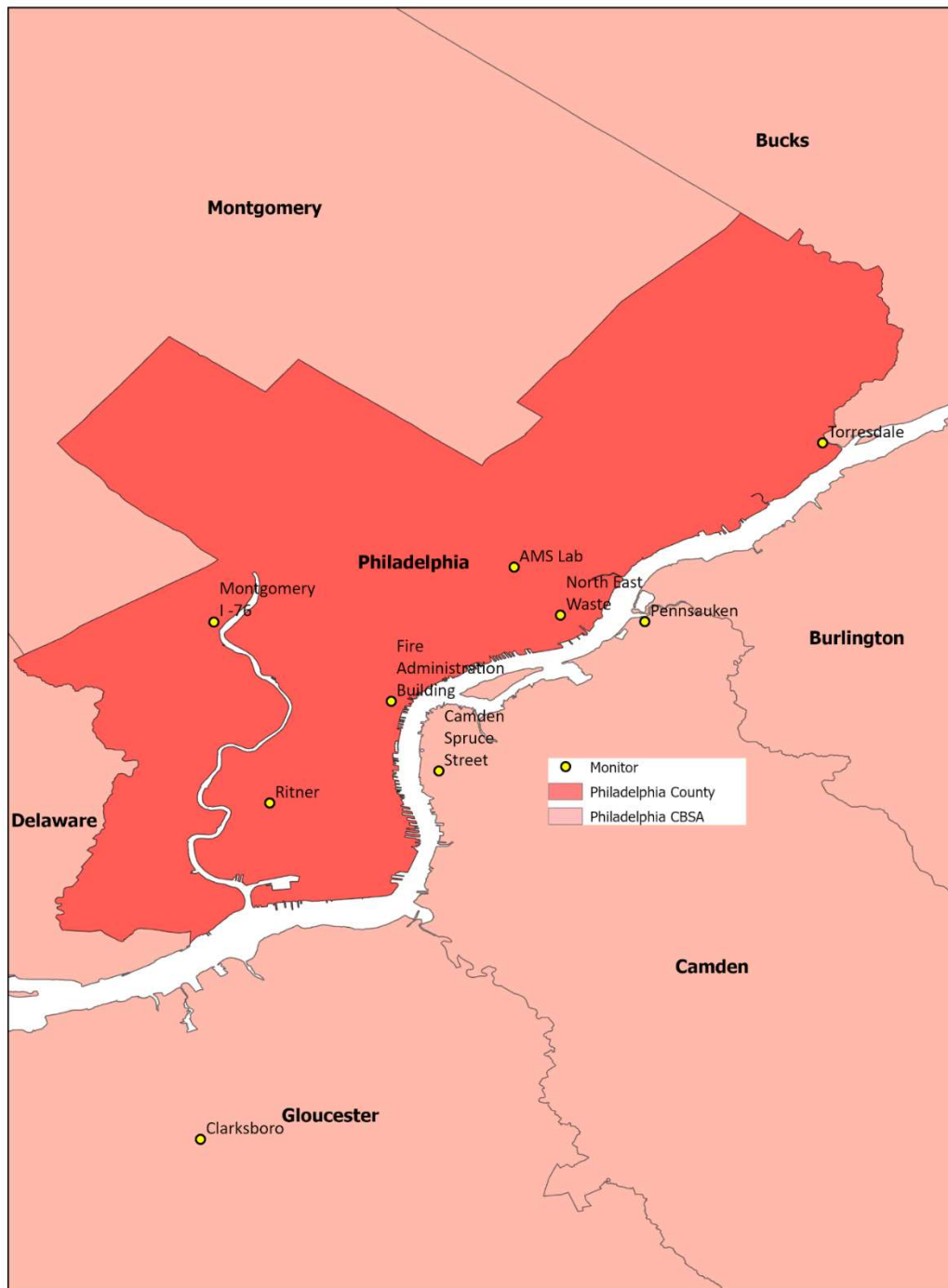


Figure 1-3: Philadelphia County PM_{2.5} Monitors

2.0 Air Quality Monitoring Data

The EPA determines NAAQS designation classifications by considering the “design value” for individual air quality PM_{2.5} monitoring sites. See Figures 1-2 and 1-3 for the location of individual PM_{2.5} monitoring sites within the Dover, Philadelphia, and Salisbury CBSAs. The design values for the PM_{2.5} primary annual NAAQS are calculated using the 3-year average of the annual mean concentrations. For the 2024 PM_{2.5} NAAQS states/tribes are to use the 2021-2023 design value to develop their recommendations, as this is the most recent data available at this time. The EPA will designate as nonattainment all areas with one or more regulatory ambient PM_{2.5} air quality monitors with a design value greater than the annual standard of 9.0 µg/m³.

2.1 Delaware PM_{2.5} Design Values

Delaware’s annual mean PM_{2.5} concentrations and site information for 2021-2023 are provided in Table 2-1. All Delaware monitoring sites are monitoring PM_{2.5} concentrations that are well below the 9.0 µg/m³ 2024 PM_{2.5} NAAQS. Therefore, Delaware is recommending that all three counties in Delaware, New Castle, Kent and Sussex, be designated as “attainment”.

It should be noted that the increases in the annual mean concentration in 2023 are linked to exceedances that occurred due to transport of wildfire smoke from outside of the state or outside of the United States. Approximately 270 individual wildfires burned across Saskatchewan, Alberta southern Northwest Territories and northeast British Columbia in west-central Canada, starting in mid-May of 2023.

This smoke affected air quality in many areas of the United States, including Delaware and can be considered “exceptional events” by EPA. Exceptional Events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that tribal, state or local air agencies may implement in order to attain and maintain the NAAQS.

Although this smoke significantly affected air quality in Delaware, because the data continues to show attainment, these events are not eligible for consideration as exceptional events, per the EPA’s Exceptional Events Rule (81 FR 68216).⁷ It is still important to consider that the data are elevated as the result of the transported wildfire smoke, even though they do not violate the NAAQS.

⁷ Treatment of Data Influenced by Exceptional Events. EPA Final Rule. 81 FR 68216. October 3, 2016.
https://www.epa.gov/sites/default/files/2018-10/documents/exceptional_events_rule_revisions_2060-as02_final.pdf

Table 2-1: Delaware PM_{2.5} Annual Mean Concentrations and 2021-2023 Design Values

County	CBSA	Site Name and ID Number	2021-2023 Design Value	2021	2022	2023
Kent	Dover, DE	Dover 100010003	6.46	5.27	6.08	8.04
		Killens Pond 100010002	6.89	6.47	5.62	8.57
New Castle	Philadelphia, PA-MD-NJ-DE	Bellefonte 100031003	7.25	6.92	5.55	9.29
		MLK 100032004	7.53	7.49	6.68	8.42
		Newark 100031012	8.20	7.39	6.11	11.10
		Lums Pond 100031007	7.47	7.25	6.43	8.73
		Delaware City 100030008	7.02	6.61	5.81	8.56
Sussex	Salisbury, MD-DE	Seaford 100010002	7.59	7.82	5.92	9.04

2.2 CBSA Design Values

As two of the three CBSAs with Delaware counties include counties in other states; Delaware is also presenting PM_{2.5} monitoring data for each individual CBSA (see Sections 2.2.1 - 2.2.3 below). The Delaware PM_{2.5} monitors are highlighted in yellow.

2.2.1 Dover CBSA

There are two PM_{2.5} monitors located in Kent County Delaware that are associated with the Dover CBSA (see Table 2-2). These PM_{2.5} monitors are measuring well below the 9.0 µg/m³ 2024 PM_{2.5} NAAQS.

Table 2-2: Dover CBSA - PM_{2.5} Annual Mean Concentrations and 2021-2023 Design Values

State	County	Site Name and ID Number	2021-2023 Design Value	2021	2022	2023
DE	Kent	Dover 100010003	6.46	5.27	6.08	8.04
		Killens Pond 100010002	6.89	6.47	5.62	8.57

2.2.2 Philadelphia CBSA

There are nineteen PM_{2.5} monitors located in the Philadelphia CBSA (see Table 2-3). Design values for violating PM_{2.5} monitors are shown in red. One monitor in New Jersey (Camden Spruce Street) and four monitors in Pennsylvania (AMS Lab, North East Waste, Ritner, and Torresdale) were in violation of the 9.0 µg/m³ 2024 PM_{2.5} NAAQS. All five of the violating PM_{2.5} monitors are near the City of Philadelphia. Delaware does not know if the State, Local, and Tribal Authorities (SLTs) for these violating PM_{2.5} monitors will be submitting exceptional events demonstrations to EPA. Neither is Delaware able to discern if it is appropriate for the SLT's to submit demonstrations.

The remaining PM_{2.5} monitors in the Philadelphia CBSA have design values below the 9.0 µg/m³ 2024 PM_{2.5} NAAQS. For a more detailed analysis regarding the violating monitors in the Philadelphia CBSA, please see Section 2.3. It should be noted that while Burlington NJ, Salem NJ, and Bucks PA counties are part of the CBSA, they do not have any PM_{2.5} air quality monitors.

Table 2-3: Philadelphia CBSA - PM_{2.5} Annual Mean Concentrations and 2021-2023 Design Values

State	County	Site Name and ID Number	2021-2023 Design Value	2021	2022	2023
DE	New Castle	Bellefonte I 100031003	7.25	6.92	5.55	9.29
		Delaware City 100030008	7.02	6.61	5.81	8.56
		Lums Pond 100031007	7.47	7.25	6.43	8.73
		MLK 100032004	7.53	7.49	6.08	8.42
		Newark 100031007	8.20	7.39	6.11	11.10
MD	Cecil	Fair Hill 240150003	7.38	8.08	6.84	7.21
NJ	Camden	Camden Spruce Street 340070002	9.78	9.93	8.89	10.50
		Pennsauken 340071007	7.73	8.55	6.45	8.20
	Gloucester	Clarksboro 340150002	7.44	7.78	6.22	8.32
PA	Chester	New Garden 420290100	8.13	8.09	6.88	9.41
	Delaware	Chester 420450002	8.51	8.42	7.57	9.55
		Marcus Hook 420450109	8.46	8.04	7.20	10.13
	Montgomery	State Armory 100031012	8.14	8.29	6.70	9.43
	Philadelphia	AMS Lab 421010004	9.60	8.60	7.85	12.35
		Fire Administration Building 421010057	8.78	8.70	6.91	10.72
		Montgomery I -76 421010076	8.54	8.06	7.31	10.42
		North East Waste 421010048	9.67	8.50	8.64	11.87
		Ritner 421010055	9.32	9.13	6.92	11.90
		Torresdale Station421010075	10.05	8.73	8.15	13.27

2.2.3 Salisbury CBSA

There is only one PM_{2.5} monitor located in the Salisbury CBSA, the Seaford monitor in Delaware. The 2021-2023 Design Value for Seaford was 7.59 µg/m³, which is below the 9.0 µg/m³ 2024 PM_{2.5} NAAQS. It should be noted that although Somerset, Wicomico, and Worcester counties in Maryland are part of the CBSA, they do not have any PM_{2.5} air quality monitors.

Table 2-4: Salisbury CBSA - PM_{2.5} Annual Mean Concentrations and 2021-2023 Design Values

State	County	Site Name and ID and Number	2021-2023 Design Value	2021	2022	2023
DE	Sussex	Seaford 100010002	7.59	7.82	5.92	9.04

2.3 Philadelphia CBSA/CBSA+

CAA section 107(d)(1) requires that the EPA designate as nonattainment not only the area that is violating the standard at issue, but also the nearby areas that contribute to violation(s). The EPA evaluates the boundaries for each nonattainment area on a case-by-case basis considering the specific facts and circumstances unique to the area. The EPA also intends to evaluate any counties adjacent to the CBSA, that have the potential to contribute to violating PM_{2.5} monitors.

In addition to the 11 counties within the Philadelphia CBSA, Delaware identified an additional 15 counties that are adjacent to the Philadelphia CBSA. The Delaware counties are highlighted in yellow in Table 2-5. Throughout this document, these adjacent counties are referred to as the Philadelphia Core Based Statistical Area Plus (Philadelphia CBSA+). Table 2-5 lists the counties that are part of (CBSA) and adjacent to (CBSA+) the Philadelphia CBSA.

Table 2-5: Philadelphia CBSA/CBSA+ Counties*

State	County	Area	State	County	Area
DE	New Castle	CBSA	DE	Kent	CBSA+
MD	Cecil	CBSA	MD	Kent	CBSA+
NJ	Burlington	CBSA	MD	Harford	CBSA+
NJ	Camden	CBSA	NJ	Atlantic	CBSA+
NJ	Gloucester	CBSA	NJ	Cumberland	CBSA+
NJ	Salem	CBSA	NJ	Hunterdon	CBSA+
PA	Bucks	CBSA	NJ	Mercer	CBSA+
PA	Chester	CBSA	NJ	Monmouth	CBSA+
PA	Delaware	CBSA	NJ	Ocean	CBSA+
PA	Montgomery	CBSA	NJ	Warren	CBSA+
PA	Philadelphia	CBSA	PA	Berks	CBSA+
			PA	Lancaster	CBSA+
			PA	Lehigh	CBSA+
			PA	Northampton	CBSA+
			PA	York	CBSA+

2.3.1 Philadelphia CBSA/CBSA+ PM_{2.5} Design Values

Table 2-6 shows the 2021-2023 annual PM_{2.5} design values rankings for monitors in counties within the Philadelphia CBSA/CBSA+. The values are ranked by highest to lowest design value. Design values for violating PM_{2.5} monitors are shown in red (rankings of 1-7 out of 37 total CBSA/CBSA+ monitors). All seven of Delaware's PM_{2.5} air quality monitors, shown in yellow, were well below the NAAQS limit of 9.0 µg/m³.

In addition, Delaware's PM_{2.5} air quality monitors ranked well below those of the seven violating monitors: Newark - 19th, MLK - 24th, Lums Pond - 25th, Bellefonte I - 30th, Delaware City - 33rd, Killens Pond - 34th, and Dover - 36th. These lower design values indicate that Delaware is not contributing to violating PM_{2.5} monitors. This supports Delaware's recommendation to maintain the previous EPA decision for the 2012 PM_{2.5} NAAQS to designate all three Delaware counties as "attainment".

It should be noted that five of the seven violating PM_{2.5} monitors are near the City of Philadelphia: Camden Spruce Street in New Jersey and AMS Lab, North East Waste, Ritner, and Torresdale in Pennsylvania. The two remaining violating monitors, in Lancaster and York counties, are upwind of Delaware (see Section 4.2); which limits the contribution of Delaware emissions sources to those two violating monitors. This further demonstrates that all three Delaware counties should be designated as "attainment".

Table 2-6: 2021-2023 Design Values for the Philadelphia CBSA/CBSA+

Rank	2021-2023 Annual Design Value (µg/m ³)	Local Site Name	County	State	AQS Site ID	CBSA/CBSA+
1	10.05	Torresdale Station	Philadelphia	PA	421010075	CBSA
2	9.78	Camden Spruce Street	Camden	NJ	340070002	CBSA
3	9.67	North East Waste	Philadelphia	PA	421010048	CBSA
4	9.60	AMS Lab	Philadelphia	PA	421010004	CBSA
5	9.52	Lancaster Downwind	Lancaster	PA	420710012	CBSA+
6	9.32	Ritner	Philadelphia	PA	421010055	CBSA
7	9.26	Hill Street	York	PA	421330008	CBSA+
2024 PM _{2.5} NAAQS 9.0 µg/m ³						
8	8.85	Lancaster	Lancaster	PA	420710007	CBSA+
9	8.79	Trenton	Mercer	NJ	340210008	CBSA+
10	8.78	Fire Administration Building	Philadelphia	PA	421010057	CBSA
11	8.76	Rider University	Mercer	NJ	340210005	CBSA+
12	8.54	Montgomery I -76	Philadelphia	PA	421010076	CBSA
13	8.51	Chester	Delaware	PA	420450002	CBSA
14	8.50	Reading Airport	Berks	PA	420110011	CBSA+
15	8.46	Marcus Hook	Delaware	PA	420450109	CBSA
16	8.42	Allentown	Lehigh	PA	420770004	CBSA+
17	8.35	Columbia	Warren	NJ	340410007	CBSA+
18	8.33	Freemansburg	Northampton	PA	420950025	CBSA+
19	8.20	Newark	New Castle	DE	100031012	CBSA
20	8.14	State Armory	Montgomery	PA	420910013	CBSA
21	8.13	New Garden	Chester	PA	420290100	CBSA
22	8.06	Flemington	Hunterdon	NJ	340190001	CBSA+
23	7.73	Pennsauken	Camden	NJ	340071007	CBSA
24	7.53	MLK	New Castle	DE	100032004	CBSA
25	7.47	Lums Pond	New Castle	DE	100031007	CBSA
26	7.44	Clarksboro	Gloucester	NJ	340150002	CBSA
27	7.38	Fair Hill	Cecil	MD	240150003	CBSA
28	7.37	Toms River	Ocean	NJ	340292002	CBSA+
29	7.29	Edgewood	Harford	MD	240251001	CBSA+
30	7.25	Bellefonte I	New Castle	DE	100031003	CBSA
31	7.21	Atlantic City	Atlantic	NJ	340011006	CBSA+
32	7.04	Millville	Cumberland	NJ	340110007	CBSA+
33	7.02	Delaware City	New Castle	DE	100031008	CBSA
34	6.89	Killens Pond	Kent	DE	100010002	CBSA+
35	6.72	Brigantine	Atlantic	NJ	340010006	CBSA+
36	6.46	Dover	Kent	DE	100010003	CBSA+
37	6.05	Millington	Kent	MD	240290002	CBSA+

3.0 Emissions Inventory of Sources and Emissions Related Data

Ambient PM_{2.5} is formed through complex atmospheric processes with contributions from direct emissions of particles and from secondarily formed particles that result from multiple PM_{2.5} precursors. For initial area designations associated with the 2024 revised primary annual PM_{2.5} NAAQS, the EPA intends to examine emissions of identified sources of direct PM_{2.5}, precursor pollutants. The main precursor gases associated with fine particle formation are, ammonia (NH₃), oxides of nitrogen (NO_x), sulfur dioxide (SO₂), and volatile organic compounds (VOC).

In the designations process, for each metropolitan area with a violating PM_{2.5} monitor, the EPA evaluates the emissions data from counties to assess each county's contribution to PM_{2.5} concentrations at the violating monitor or monitors in the area under evaluation.

3.1 2022 EPA Emissions Modeling Platform (2022 EMPv1)

For the state recommendations for the 2024 revised primary annual PM_{2.5} NAAQS, the EPA recommended states use the draft 2022 emissions modeling platform (EMP) inventory version 1 ("2022 EMPv1"). It is the most recent emissions inventory information available at the beginning of this designations process. Air pollution sources are broken down into the following emissions source categories:

- Point sources represent large sources of emissions located at a discrete geographic point. Examples include power plants, factories, industries, and large institutional facilities.
- Nonpoint sources (also called area sources) are those that are too widespread or numerous to be accounted for individually. There are many nonpoint subcategories, but a handful of examples include residential fuel combustion, consumer solvent use, commercial cooking, animal husbandry, and agricultural tilling.
- Nonroad sources are equipment and vehicles that do not primarily travel on roadways. Examples include construction equipment, recreational vehicles, and lawn & garden equipment.
- Onroad sources are vehicles that primarily travel on roadways such as cars, trucks, buses, and motorcycles.

Sections 3.1.1 – 3.1.5 show annual emissions data for PM_{2.5} and the four precursor gases, in tons; for the counties within the three CBSAs and the Philadelphia CBSA+ counties that are adjacent to the Philadelphia CBSA (30 counties). Tables 3-1 through 3-5 show the ranking of Delaware counties in annual emissions for individual pollutants, compared with counties in other states. Section 3.1.6 summarizes the overall rankings of the three Delaware counties.

3.1.1 PM_{2.5} Emissions

New Castle County ranks 12th, Sussex 18th, and Kent 20th out the 30 counties for annual tons of PM_{2.5} emissions.

Table 3-1: 2022 EMPv1 PM_{2.5} Annual Emissions (Tons)

Rank	PM _{2.5} (Tons)	State	County	CBSA/CBSA+
1	7,715	NJ	Atlantic	Philadelphia CBSA+
2	4,038	PA	Lancaster	Philadelphia CBSA+
3	3,839	PA	Montgomery	Philadelphia CBSA
4	3,681	PA	York	Philadelphia CBSA+
5	3,316	PA	Bucks	Philadelphia CBSA
6	3,234	NJ	Burlington	Philadelphia CBSA
7	3,121	PA	Berks	Philadelphia CBSA+
8	2,951	PA	Philadelphia	Philadelphia CBSA
9	2,906	PA	Chester	Philadelphia CBSA
10	2,755	NJ	Ocean	Philadelphia CBSA+
11	2,560	PA	Northampton	Philadelphia CBSA+
12	2,391	DE	New Castle	Philadelphia CBSA
13	2,283	PA	Delaware	Philadelphia CBSA
14	1,978	PA	Lehigh	Philadelphia CBSA+
15	1,433	NJ	Monmouth	Philadelphia CBSA+
16	1,167	MD	Harford	Philadelphia CBSA+
17	1,079	NJ	Camden	Philadelphia CBSA
18	1,058	DE	Sussex	Salisbury CBSA
19	860	NJ	Gloucester	Philadelphia CBSA
20	760	DE	Kent	Dover CBSA
21	728	NJ	Cumberland	Philadelphia CBSA+
22	726	NJ	Mercer	Philadelphia CBSA+
23	643	MD	Cecil	Philadelphia CBSA
24	516	MD	Wicomico	Salisbury CBSA
25	494	NJ	Hunterdon	Philadelphia CBSA+
26	422	MD	Worcester	Salisbury CBSA
27	403	NJ	Salem	Philadelphia CBSA
28	340	NJ	Warren	Philadelphia CBSA+
29	262	MD	Kent	Philadelphia CBSA+
30	176	MD	Somerset	Salisbury CBSA

3.1.2 SO₂ Emissions

New Castle County ranks 3rd, Sussex 7th, and Kent 23rd out the 30 counties for SO₂ emissions. Though, it should be noted that there is a large break between the top two counties, Northampton and York, PA and the remaining 28 counties. The difference between the number 2 and 3 counties is 3,550 tons; which makes it difficult to accurately compare counties by rank. Northampton and York counties have several types of industrial facilities that have the potential to emit SO₂, including, but not limited to coal fired Electric Generating Units, Cement Manufacturing, and brick manufacturing.

Table 3-2: 2022 EMPv1 SO₂ Annual Emissions (Tons)

Rank	SO ₂ (Tons)	State	County	CBSA/CBSA+
1	4,702	PA	Northampton	Philadelphia CBSA+
2	4,245	PA	York	Philadelphia CBSA+
3	695	DE	New Castle	Philadelphia CBSA
4	588	PA	Bucks	Philadelphia CBSA
5	574	PA	Delaware	Philadelphia CBSA
6	532	PA	Berks	Philadelphia CBSA+
7	501	DE	Sussex	Salisbury CBSA
8	435	PA	Lehigh	Philadelphia CBSA+
9	415	NJ	Atlantic	Philadelphia CBSA+
10	398	PA	Montgomery	Philadelphia CBSA
11	363	MD	Harford	Philadelphia CBSA+
12	341	NJ	Salem	Philadelphia CBSA
13	331	PA	Lancaster	Philadelphia CBSA+
14	323	PA	Philadelphia	Philadelphia CBSA
15	255	PA	Chester	Philadelphia CBSA
16	243	NJ	Gloucester	Philadelphia CBSA
17	226	NJ	Cumberland	Philadelphia CBSA+
18	220	MD	Cecil	Philadelphia CBSA
19	203	NJ	Burlington	Philadelphia CBSA
20	172	NJ	Ocean	Philadelphia CBSA+
21	145	MD	Wicomico	Salisbury CBSA
22	140	NJ	Camden	Philadelphia CBSA
23	103	DE	Kent	Dover CBSA
24	77	NJ	Monmouth	Philadelphia CBSA+
25	62	MD	Worcester	Salisbury CBSA
26	46	MD	Kent	Philadelphia CBSA+
27	45	NJ	Mercer	Philadelphia CBSA+
28	35	MD	Somerset	Salisbury CBSA
29	31	NJ	Warren	Philadelphia CBSA+
30	17	NJ	Hunterdon	Philadelphia CBSA+

3.1.3 NO_x Emissions

New Castle County ranks 7th, Sussex 16th, and Kent 21st out the 30 counties for NO_x emissions.

Table 3-3: 2022 EMPv1 NO_x Annual Emissions (Tons)

Rank	NO _x (Tons)	State	County	CBSA/CBSA+
1	13,481	PA	York	Philadelphia CBSA+
2	11,049	PA	Philadelphia	Philadelphia CBSA
3	10,499	MD	Worcester	Salisbury CBSA
4	10,496	PA	Montgomery	Philadelphia CBSA
5	10,259	MD	Wicomico	Salisbury CBSA
6	9,467	PA	Lancaster	Philadelphia CBSA+
7	9,117	DE	New Castle	Philadelphia CBSA
8	8,859	PA	Delaware	Philadelphia CBSA
9	8,112	PA	Berks	Philadelphia CBSA+
10	8,017	PA	Bucks	Philadelphia CBSA
11	6,799	PA	Chester	Philadelphia CBSA
12	6,692	PA	Northampton	Philadelphia CBSA+
13	6,359	MD	Somerset	Salisbury CBSA
14	5,597	NJ	Monmouth	Philadelphia CBSA+
15	5,310	PA	Lehigh	Philadelphia CBSA+
16	5,180	DE	Sussex	Salisbury CBSA
17	4,993	NJ	Ocean	Philadelphia CBSA+
18	4,234	NJ	Camden	Philadelphia CBSA
19	4,126	NJ	Burlington	Philadelphia CBSA
20	4,024	NJ	Gloucester	Philadelphia CBSA
21	3,583	DE	Kent	Dover CBSA
22	3,157	NJ	Mercer	Philadelphia CBSA+
23	2,828	NJ	Atlantic	Philadelphia CBSA+
24	2,559	MD	Harford	Philadelphia CBSA+
25	2,267	NJ	Cumberland	Philadelphia CBSA+
26	2,258	MD	Cecil	Philadelphia CBSA
27	1,928	NJ	Hunterdon	Philadelphia CBSA+
28	1,513	NJ	Salem	Philadelphia CBSA
29	1,476	NJ	Warren	Philadelphia CBSA+
30	723	MD	Kent	Philadelphia CBSA+

3.1.4 VOC Emissions

Sussex County ranks 5th, New Castle 11th, and Kent 14th out the 30 counties for VOC emissions.

Table 3-4: 2022 EMPv1 VOC Annual Emissions (Tons)

Rank	VOC (Tons)	State	County	CBSA/CBSA+
1	27,856	PA	Lancaster	Philadelphia CBSA+
2	24,061	PA	York	Philadelphia CBSA+
3	23,673	NJ	Atlantic	Philadelphia CBSA+
4	23,367	PA	Berks	Philadelphia CBSA+
5	22,762	DE	Sussex	Salisbury CBSA
6	21,317	NJ	Burlington	Philadelphia CBSA
7	19,937	PA	Chester	Philadelphia CBSA
8	19,150	PA	Montgomery	Philadelphia CBSA
9	18,267	NJ	Ocean	Philadelphia CBSA+
10	17,222	PA	Bucks	Philadelphia CBSA
11	16,305	DE	New Castle	Philadelphia CBSA
12	15,910	PA	Philadelphia	Philadelphia CBSA
13	15,844	NJ	Monmouth	Philadelphia CBSA+
14	15,426	DE	Kent	Dover CBSA
15	13,872	MD	Harford	Philadelphia CBSA+
16	12,541	PA	Lehigh	Philadelphia CBSA+
17	11,972	NJ	Cumberland	Philadelphia CBSA+
18	11,765	NJ	Gloucester	Philadelphia CBSA
19	11,521	PA	Delaware	Philadelphia CBSA
20	11,166	NJ	Camden	Philadelphia CBSA
21	11,072	MD	Cecil	Philadelphia CBSA
22	10,604	PA	Northampton	Philadelphia CBSA+
23	10,499	MD	Worcester	Salisbury CBSA
24	10,259	MD	Wicomico	Salisbury CBSA
25	8,846	NJ	Mercer	Philadelphia CBSA+
26	8,504	NJ	Warren	Philadelphia CBSA+
27	8,469	NJ	Salem	Philadelphia CBSA
28	8,167	NJ	Hunterdon	Philadelphia CBSA+
29	6,698	MD	Kent	Philadelphia CBSA+
30	6,359	MD	Somerset	Salisbury CBSA

3.1.5 NH₃ Emissions

Sussex County ranks 2nd, Kent 5th, and New Castle 14th out the 30 counties for NH₃ emissions.

Table 3-5: 2022 EMPv1 NH₃ Annual Emissions (Tons)

Rank	NH ₃ (Tons)	State	County	CBSA/CBSA+
1	13,545	PA	Lancaster	Philadelphia CBSA+
2	8,124	DE	Sussex	Salisbury CBSA
3	7,767	PA	Northampton	Philadelphia CBSA+
4	4,365	PA	Berks	Philadelphia CBSA+
5	3,110	DE	Kent	Dover CBSA
6	3,067	PA	York	Philadelphia CBSA+
7	2,984	MD	Somerset	Salisbury CBSA
8	2,386	MD	Wicomico	Salisbury CBSA
9	2,231	MD	Worcester	Salisbury CBSA
10	1,863	PA	Chester	Philadelphia CBSA
11	1,351	PA	Bucks	Philadelphia CBSA
12	1,337	PA	Montgomery	Philadelphia CBSA
13	1,069	NJ	Atlantic	Philadelphia CBSA+
14	1,069	DE	New Castle	Philadelphia CBSA
15	997	PA	Philadelphia	Philadelphia CBSA
16	992	NJ	Burlington	Philadelphia CBSA
17	891	MD	Cecil	Philadelphia CBSA
18	786	PA	Lehigh	Philadelphia CBSA+
19	781	MD	Kent	Philadelphia CBSA+
20	766	NJ	Ocean	Philadelphia CBSA+
21	734	NJ	Monmouth	Philadelphia CBSA+
22	674	MD	Harford	Philadelphia CBSA+
23	661	PA	Delaware	Philadelphia CBSA
24	597	NJ	Gloucester	Philadelphia CBSA
25	579	NJ	Cumberland	Philadelphia CBSA+
26	575	NJ	Salem	Philadelphia CBSA
27	530	NJ	Hunterdon	Philadelphia CBSA+
28	474	NJ	Warren	Philadelphia CBSA+
29	381	NJ	Mercer	Philadelphia CBSA+
30	351	NJ	Camden	Philadelphia CBSA

3.1.6 Emissions Inventory Summary

When taking into consideration the rankings for PM_{2.5} and the four precursor pollutants, on average Kent County ranks 17th, New Castle 9th, and Sussex 10th out of 30 total counties. While New Castle and Sussex Counties rank in the top 10 for SO₂; as detailed in Section 3.1.2, it should be noted that there is a large break (3,550 tons) between the top two counties, Northampton and York PA and the remaining 28 counties. This makes it difficult to accurately compare counties by rank for SO₂. When SO₂ is removed from the calculated ranking average, Kent County ranks 15th, New Castle 11th, and Sussex 10th.

Further, in Delaware's most recent Regional Haze State Implementation Plan (SIP) for the Second Implementation Period⁸ Delaware's modeled contribution of sulfates and nitrates to local Class I areas (which include certain national parks and wilderness areas), was extremely low. Out of 36 states in the eastern United States, the highest modeled contribution for Delaware was only 0.6% for Brigantine National Wildlife Refuge (Brigantine) in New Jersey; a ranking of 31 out of 36 states. For comparison, Pennsylvania's modeled contribution to Brigantine was 19.9%, the highest out of the 36 states.

3.2 Population Density and Degree of Urbanization

The EPA recommends that states consider the population density and the degree of urbanization in areas included versus excluded from the nonattainment area as one of the factors in determining appropriate nonattainment area boundaries. Population and densities for the three CBSAs and Philadelphia CBSA+ are presented in Table 3-6. Kent County ranks 21st, New Castle 7th and Sussex 19th out of 30 counties.

⁸ Approval and Promulgation of Air Quality Implementation Plan; Delaware; Regional Haze State Implementation Plan for the Second Implementation Period. EPA Final Rule. 89 FR 84288. October 22, 2024.
<https://www.govinfo.gov/content/pkg/FR-2024-10-22/pdf/2024-24196.pdf>

Table 3-6: 2020 County Level Population Statistics

Rank	2020 Population	State	County	CBSA/CBSA+	Sq. Miles	2020 Population Density
1	1,603,797	PA	Philadelphia	Philadelphia CBSA	136	11,824
2	856,553	PA	Montgomery	Philadelphia CBSA	487	1,758
3	646,538	PA	Bucks	Philadelphia CBSA	620	1,042
4	643,615	NJ	Monmouth	Philadelphia CBSA+	475	1,354
5	637,229	NJ	Ocean	Philadelphia CBSA+	634	1,005
6	576,830	PA	Delaware	Philadelphia CBSA	185	3,117
7	570,719	DE	New Castle	Philadelphia CBSA	432	1,322
8	552,984	PA	Lancaster	Philadelphia CBSA+	984	562
9	534,413	PA	Chester	Philadelphia CBSA	759	704
10	523,485	NJ	Camden	Philadelphia CBSA	224	2,333
11	461,860	NJ	Burlington	Philadelphia CBSA	814	567
12	456,438	PA	York	Philadelphia CBSA+	911	501
13	428,849	PA	Berks	Philadelphia CBSA+	866	495
14	387,340	NJ	Mercer	Philadelphia CBSA+	229	1,693
15	374,557	PA	Lehigh	Philadelphia CBSA+	348	1,076
16	312,951	PA	Northampton	Philadelphia CBSA+	377	830
17	302,294	NJ	Gloucester	Philadelphia CBSA	328	923
18	274,534	NJ	Atlantic	Philadelphia CBSA+	563	488
19	237,378	DE	Sussex	Salisbury CBSA	942	252
20	260,924	MD	Harford	Philadelphia CBSA+	441	591
21	181,851	DE	Kent	Dover CBSA	594	306
22	154,152	NJ	Cumberland	Philadelphia CBSA+	499	309
23	128,947	NJ	Hunterdon	Philadelphia CBSA+	437	295
24	109,632	NJ	Warren	Philadelphia CBSA+	363	302
25	103,725	MD	Cecil	Philadelphia CBSA	353	294
26	103,588	MD	Wicomico	Salisbury CBSA	380	273
27	64,837	NJ	Salem	Philadelphia CBSA	340	191
28	24,620	MD	Somerset	Salisbury CBSA	324	76
29	19,198	MD	Kent	Philadelphia CBSA+	283	68
30	5,460	MD	Worcester	Salisbury CBSA	473	12

3.3 Vehicle Miles Traveled

Traffic data can help assess the influence of mobile source emissions in a given area. The EPA recommends that analyses examine information on traffic volume in and around the area containing a violating PM_{2.5} monitor. This includes examining the total Vehicle Miles Traveled (VMT) for each county. Areas with higher VMT can be an indicator of the location of mobile source emissions that may contribute to PM_{2.5} concentrations at the violating monitor. VMTs for the three CBSAs and Philadelphia CBSA+ are presented in Table 3-7. New Castle County ranks 4th, Sussex 18th, and Kent 22nd out the 30 counties for VMTs.

Further, Delaware's recently finalized Regional Haze Progress report for the Second Planning Period, which provides updated based on our approved Regional Haze SIP for the Second Planning Period, provides extensive analysis of the PM_{2.5} in Delaware. The largest component, making up 79% of Delaware's PM_{2.5}, is from nonpoint sources. By contrast, onroad sources only contribute 4% of Delaware's PM_{2.5}. The small fraction of Delaware's PM_{2.5} that is attributable to onroad sources shows that this does not contribute to nonattainment in Philadelphia County.

Table 3-7: 2022 Vehicle Miles Traveled (VMT)

Rank	2022 VMT (million)	State	County	CBSA/CBSA+
1	6,394	PA	Montgomery	Philadelphia CBSA
2	6,325	NJ	Monmouth	Philadelphia CBSA+
3	6,061	PA	Philadelphia	Philadelphia CBSA
4	5,529	DE	New Castle	Philadelphia CBSA
5	4,910	NJ	Ocean	Philadelphia CBSA+
6	4,851	NJ	Burlington	Philadelphia CBSA
7	4,634	PA	Bucks	Philadelphia CBSA
8	4,520	PA	Lancaster	Philadelphia CBSA+
9	4,237	PA	Chester	Philadelphia CBSA
10	4,021	NJ	Camden	Philadelphia CBSA
11	3,489	PA	Berks	Philadelphia CBSA+
12	3,488	NJ	Mercer	Philadelphia CBSA+
13	3,281	PA	York	Philadelphia CBSA
14	3,271	PA	Lehigh	Philadelphia CBSA+
15	3,200	PA	Delaware	Philadelphia CBSA
16	3,103	NJ	Gloucester	Philadelphia CBSA
17	2,658	NJ	Atlantic	Philadelphia CBSA+
18	2,564	DE	Sussex	Salisbury CBSA
19	2,517	MD	Harford	Philadelphia CBSA+
20	2,311	PA	Northampton	Philadelphia CBSA+
21	1,809	NJ	Hunterdon	Philadelphia CBSA+
22	1,779	DE	Kent	Dover CBSA
23	1,492	NJ	Warren	Philadelphia CBSA+
24	1,300	MD	Cecil	Philadelphia CBSA
25	1,211	NJ	Cumberland	Philadelphia CBSA+
26	977	MD	Wicomico	Salisbury CBSA
27	871	MD	Worcester	Salisbury CBSA
28	834	NJ	Salem	Philadelphia CBSA+
29	272	MD	Somerset	Salisbury CBSA
30	202	MD	Kent	Philadelphia CBSA+

4.0 Meteorology

The evaluation of meteorological data helps to determine the effect on the fate and transport of emissions contributing to PM_{2.5} concentrations and to identify areas potentially contributing to the monitored violations. The following Sections detail the meteorological analyses that EPA recommended states evaluate in their February 7, 2024 memorandum.

4.1 HYSPLIT Trajectories - Violating PM_{2.5} Monitors

Air parcel trajectory models can help understanding of complex transport situations in an area. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling system is useful for illustrating the three-dimensional paths traveled by air parcels over time to a violating monitor.

For these designations, EPA plotted HYSPLIT trajectories for each violating monitor, for all days within the design value period, as well as for the subset of all days within the design value period that have a 24-hr PM_{2.5} average exceeding the annual standard. Backward trajectories may illustrate potential source regions for the air that affected the monitor on high concentration days. HYSPLITS can indicate where the pollutants that are being measured/monitored at a site are likely to originate from. However, in its guidance memo EPA stated HYSPLIT trajectories alone do not conclusively indicate the contribution to a measured high concentration of PM_{2.5} and that HYSPLIT should not be used in isolation to determine an area boundary.

Start times for backward trajectories were chosen to best coincide with times of maximum PM_{2.5} concentrations. Backward trajectories were initiated at these times for each day of the 2000-2022 period, with a trajectory length of 24 hours.

Trajectories were computed with a starting elevation of 500 meters above ground level. Which provides a good balance between remaining within the mixed layer at most times while avoiding terrain influences at lower elevations.

Figures 4-1 through 4-12 show EPA's HYSPLIT density maps⁹ for the violating PM_{2.5} monitors in the Philadelphia CBSA/CBSA+, 0800 (AM) and 2200 (PM) local standard time. EPA's Integrated Science Assessment¹⁰ showed 0800 and 2200 as the two typical periods of PM_{2.5} maximum concentration. Maps were not available for the AMS Lab monitor in Philadelphia County, PA, as PM_{2.5} monitoring data was not available for the first three quarters of 2021.

⁹ Particle Pollution Designations Memorandum and Data for the 2024 Revised Annual PM_{2.5} NAAQS. EPA Website. Accessed December 30, 2024. <https://www.epa.gov/particle-pollution-designations/particle-pollution-designations-memorandum-and-data-2024-revised>

¹⁰ Integrated Science Assessment for Particulate Matter. EPA Notice of Availability. 85 FR 4655. January 27, 2020. <https://www.govinfo.gov/content/pkg/FR-2020-01-27/pdf/2020-01223.pdf>

PM_{2.5} densities, for all 12 of the maps for the violating monitors, are concentrated near the violating monitor. Six maps show the prevailing PM_{2.5} density either from northwest (Camden Spruce Street – AM, North East Waste – AM, Ritner – AM, Lancaster Downwind – AM, Hill Street – AM, and Hill Street – PM). Four are from the west (Torresdale – PM, Camden Spruce Street – PM, North East Waste – PM, and Lancaster Downwind – PM). One is from the North (Torresdale – AM), and the final map is from the Southwest (Ritner – PM).

With the exception of the Ritner – PM map, all maps show the PM_{2.5} density mapped away from the State of Delaware. This suggests that the predominant sources of PM_{2.5} emissions for each violating monitor are primarily originating from Pennsylvania, not Delaware.

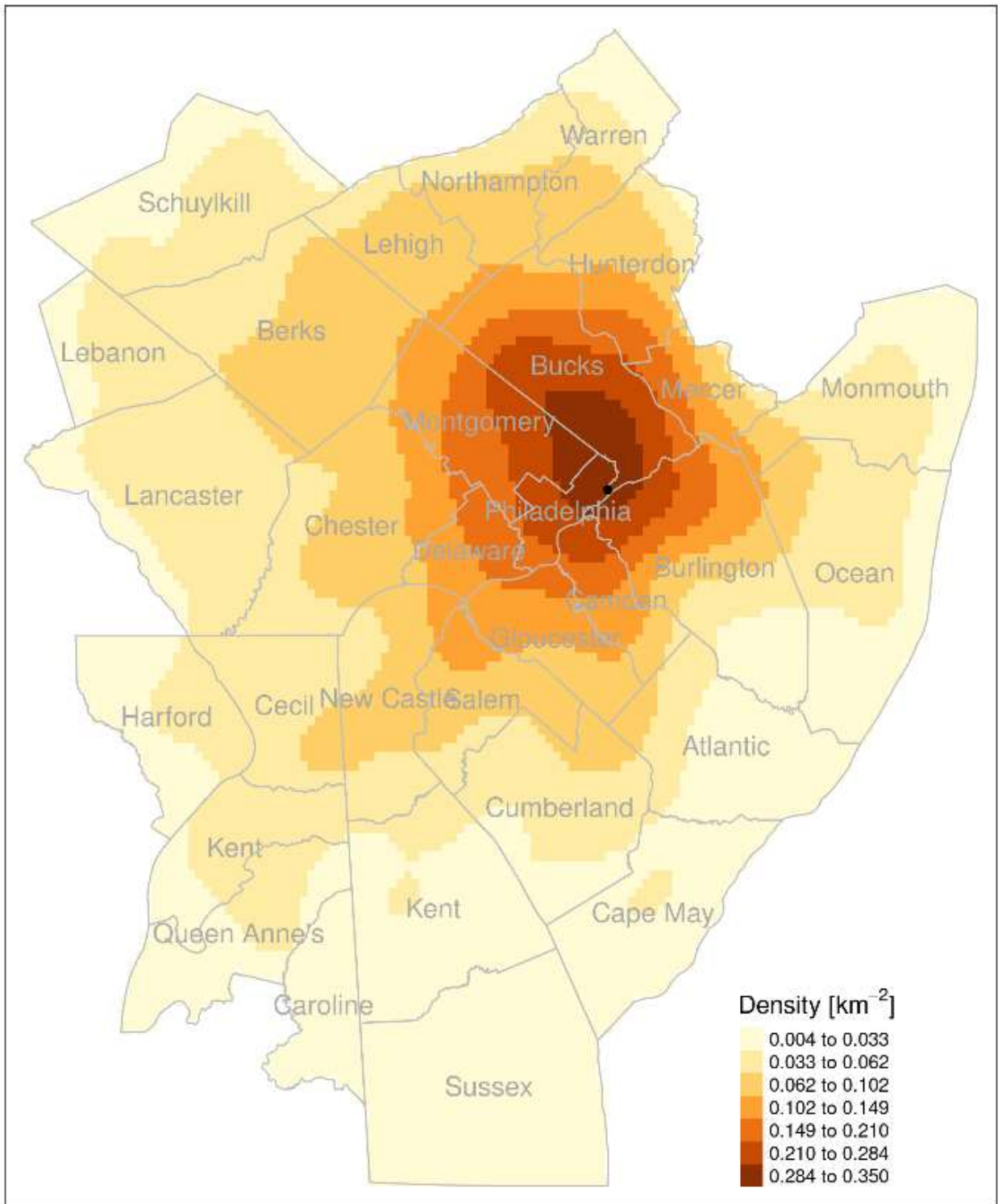


Figure 4-1: Torresdale HYSPLIT AM – 0800 LST

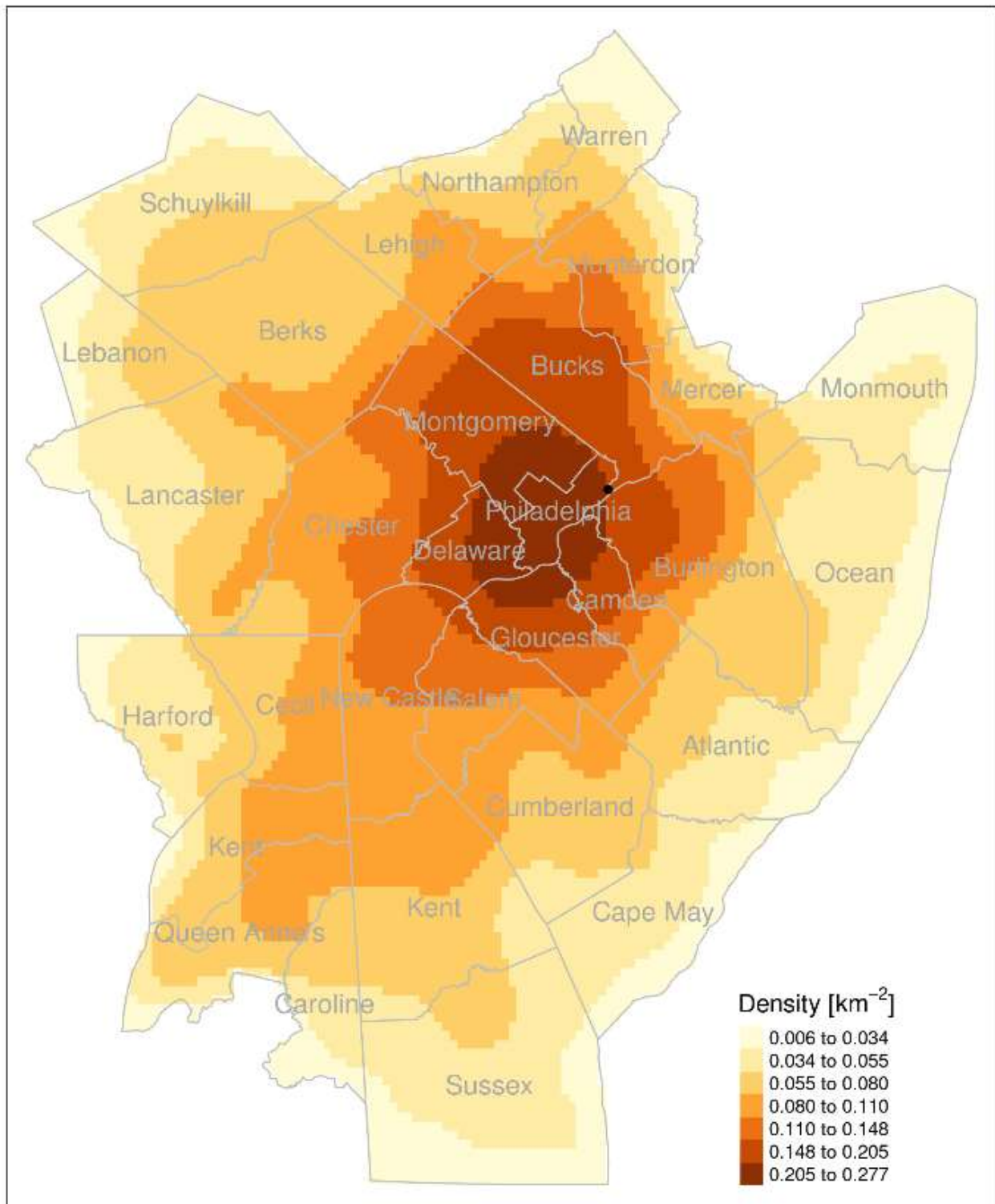


Figure 4-2: Torresdale HYSPLIT PM – 2200 LST

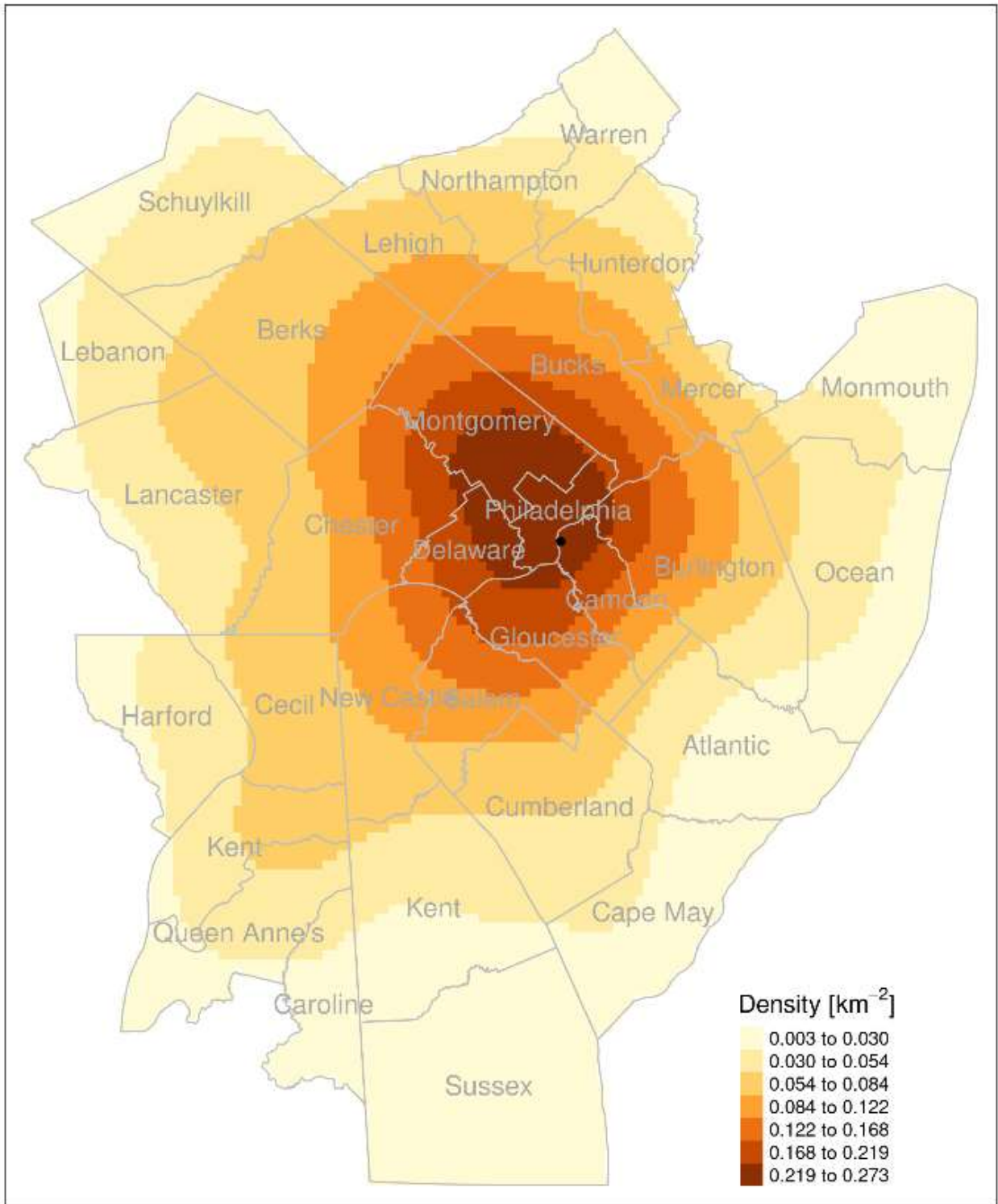


Figure 4-3: Camden Spruce Street HYSPLIT AM – 0800 LST

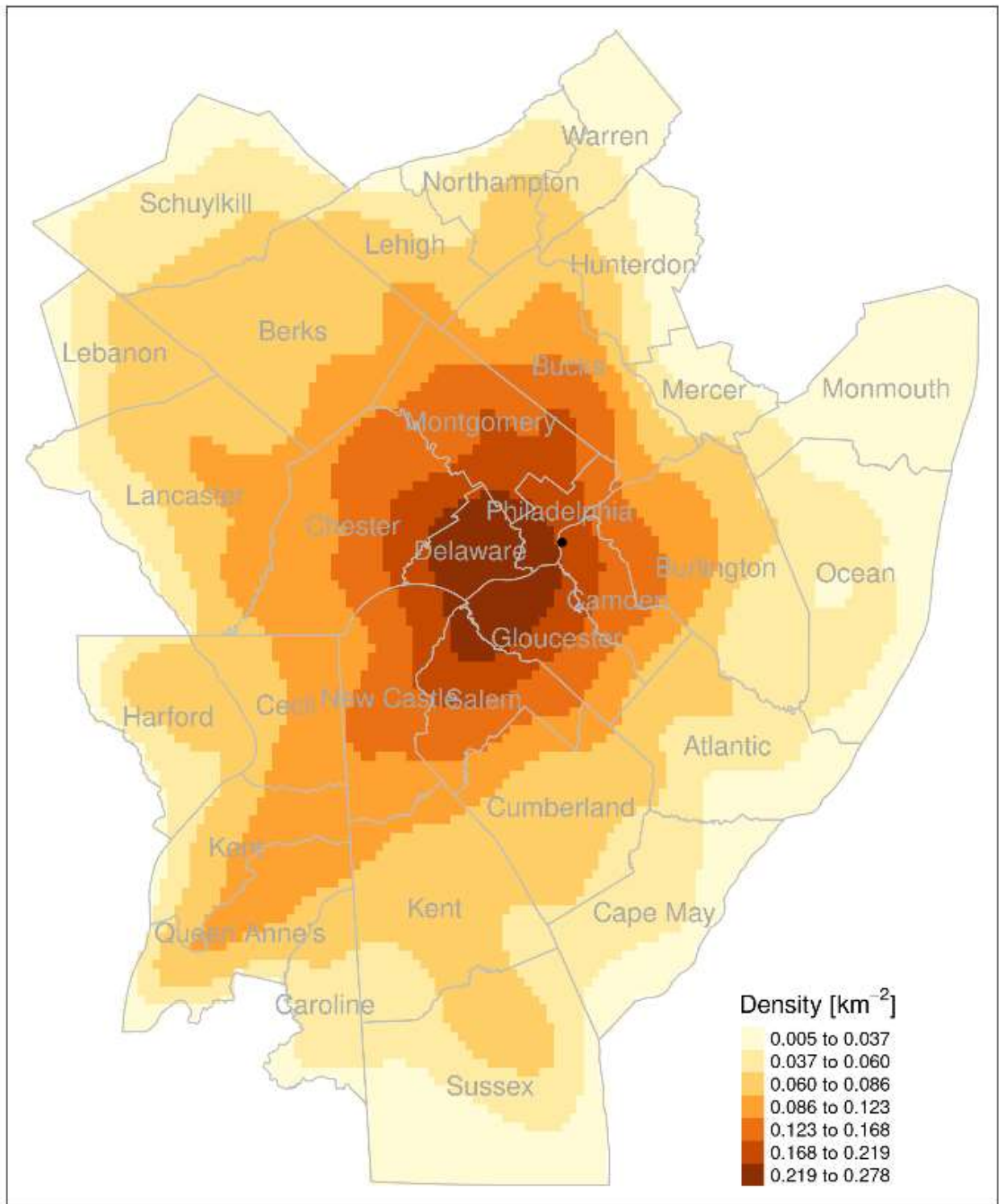


Figure 4-4: Camden Spruce Street HYSPLIT PM – 2200 LST

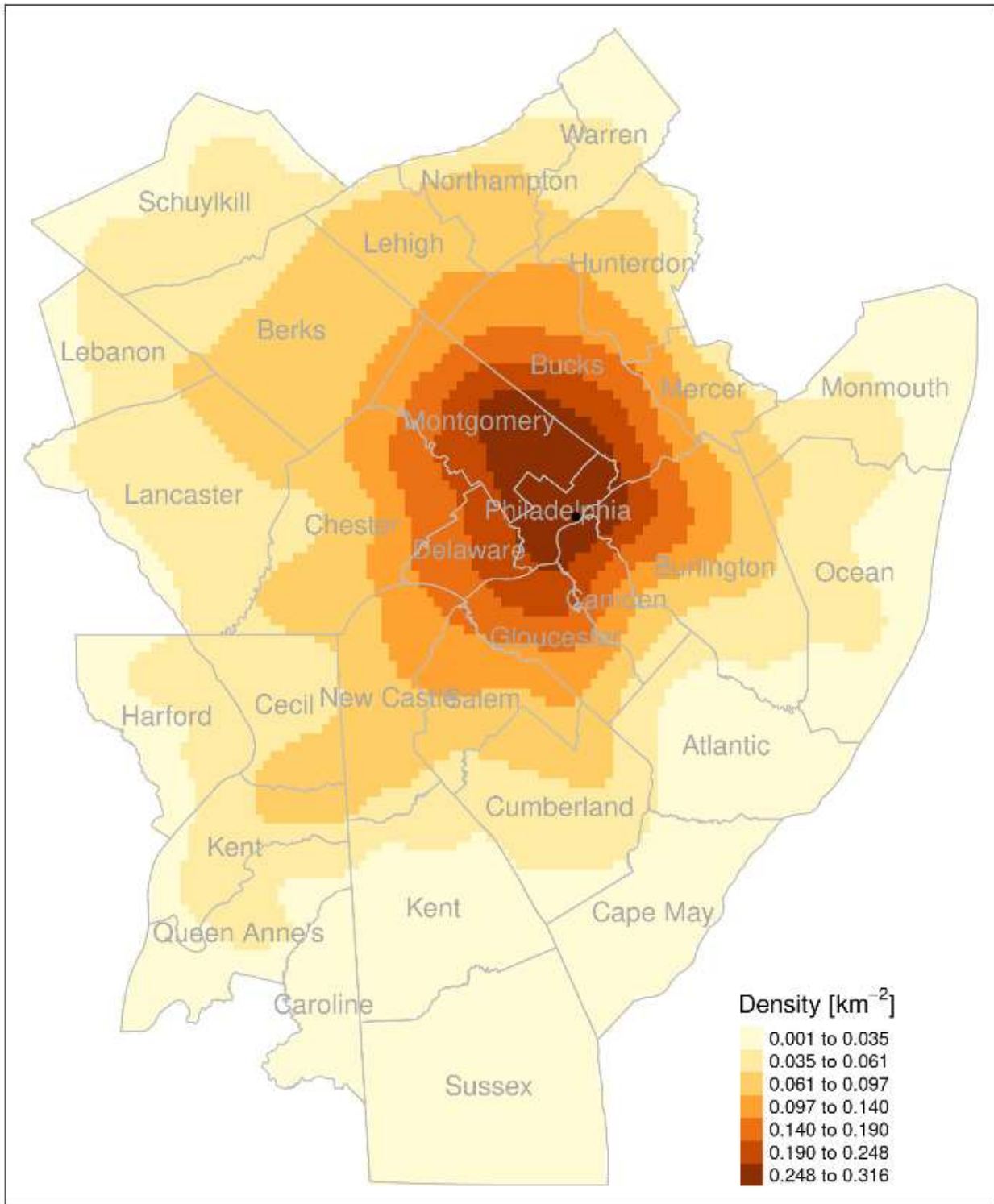


Figure 4-5: North East Waste HYSPLIT AM – 0800 LST

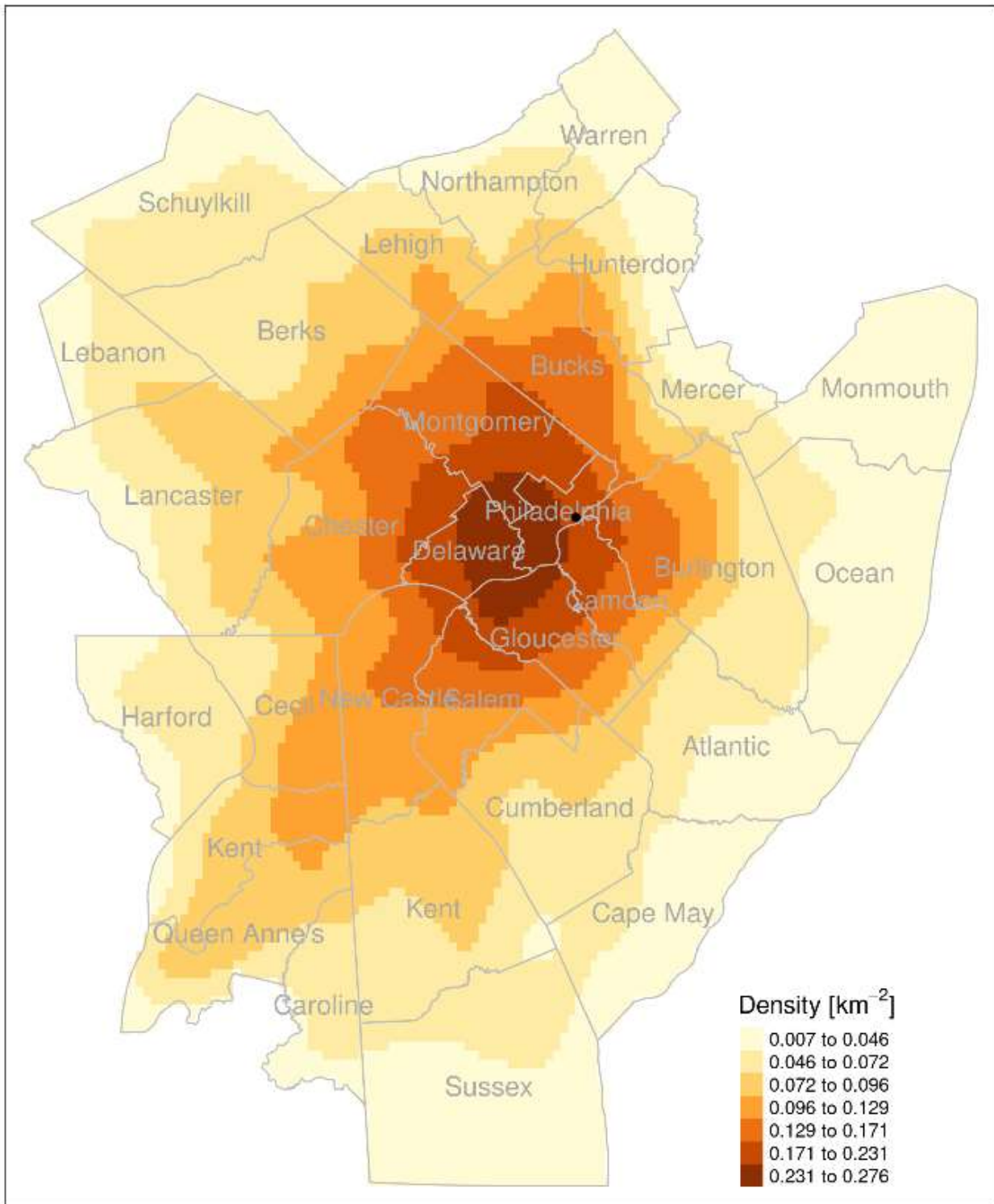


Figure 4-6: North East Waste HYSPLIT PM – 2200 LST

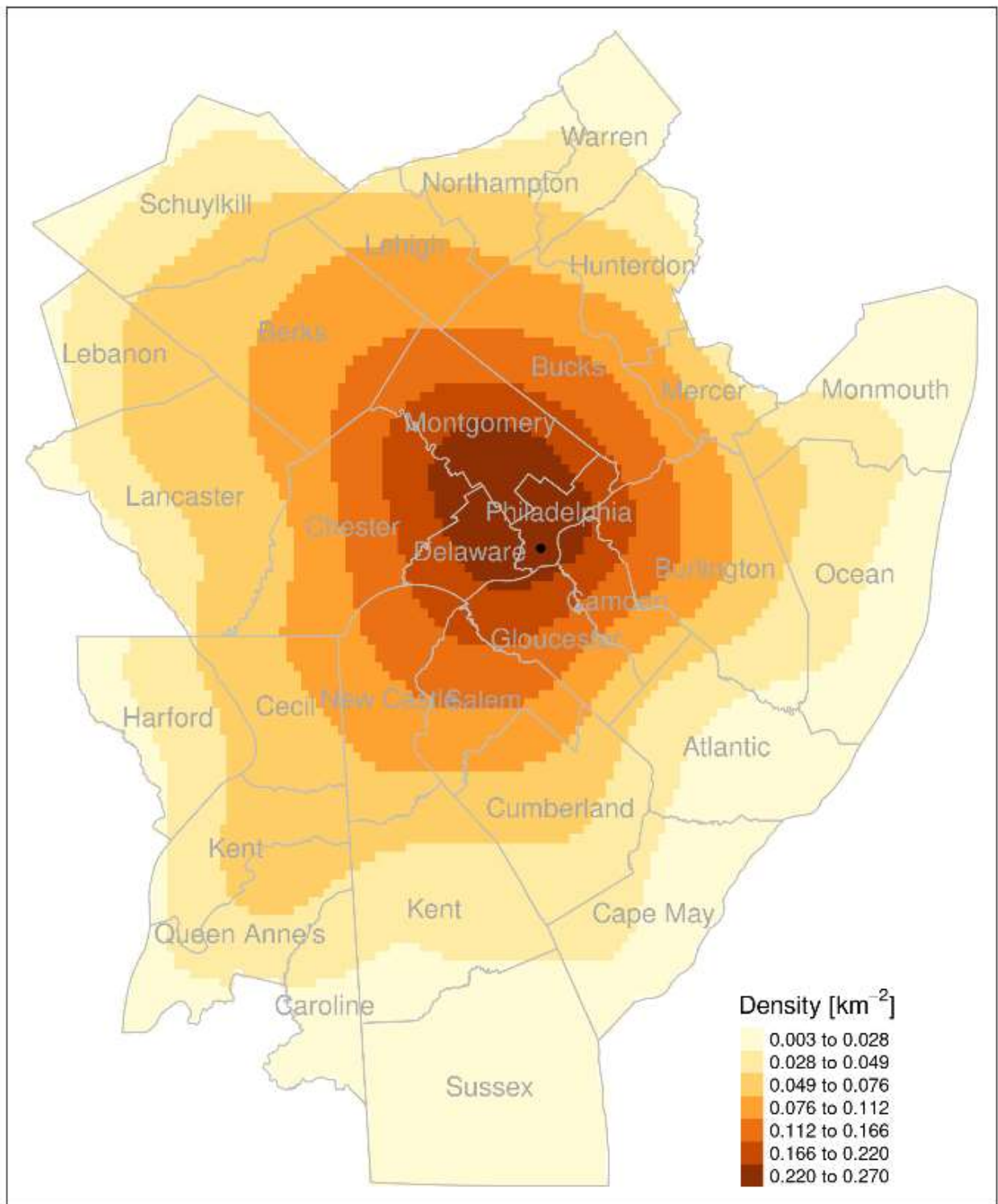


Figure 4-7: Ritner HYSPLIT AM – 0800 LST

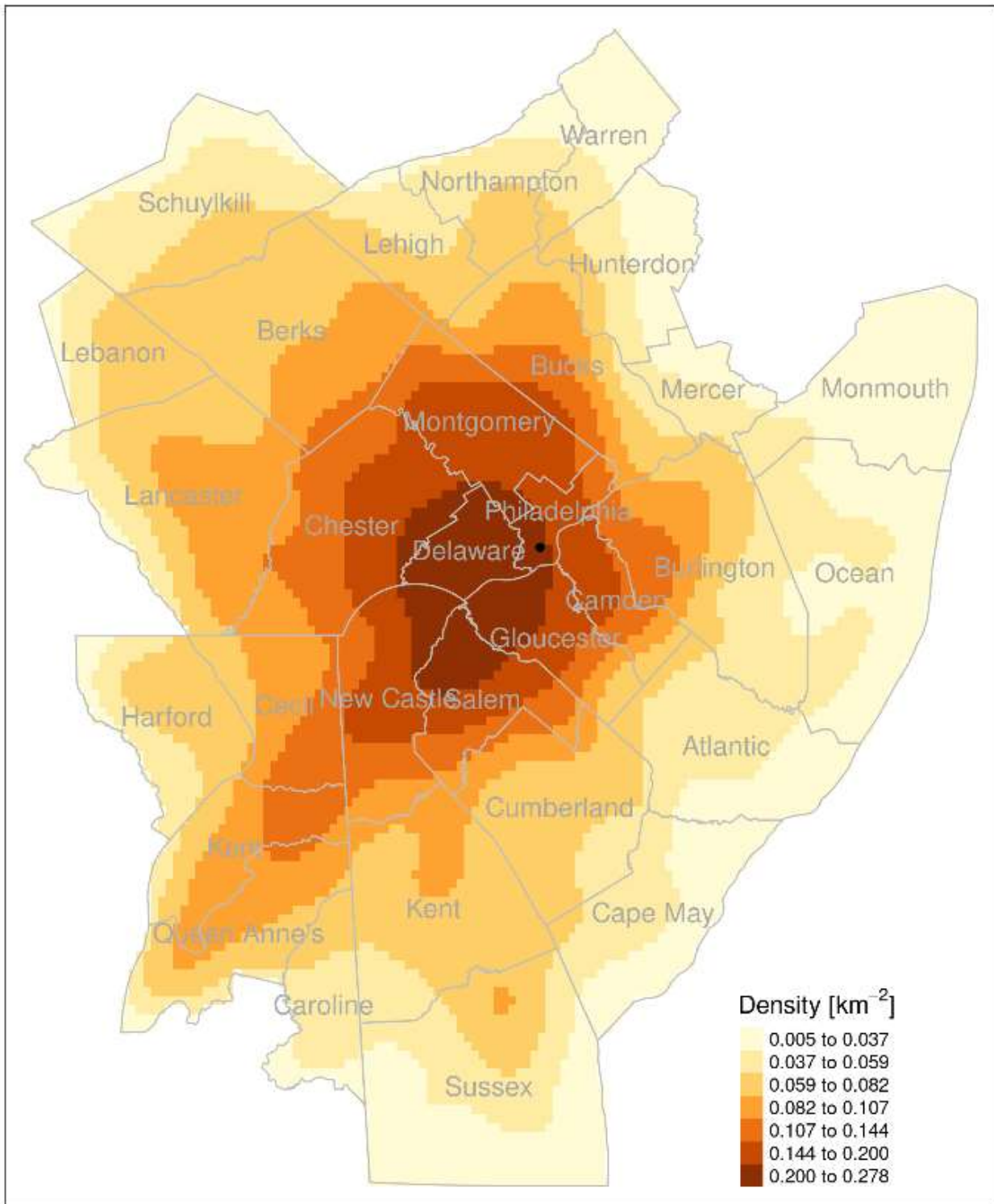


Figure 4-8: Ritner HYSPLIT PM – 2200 LST

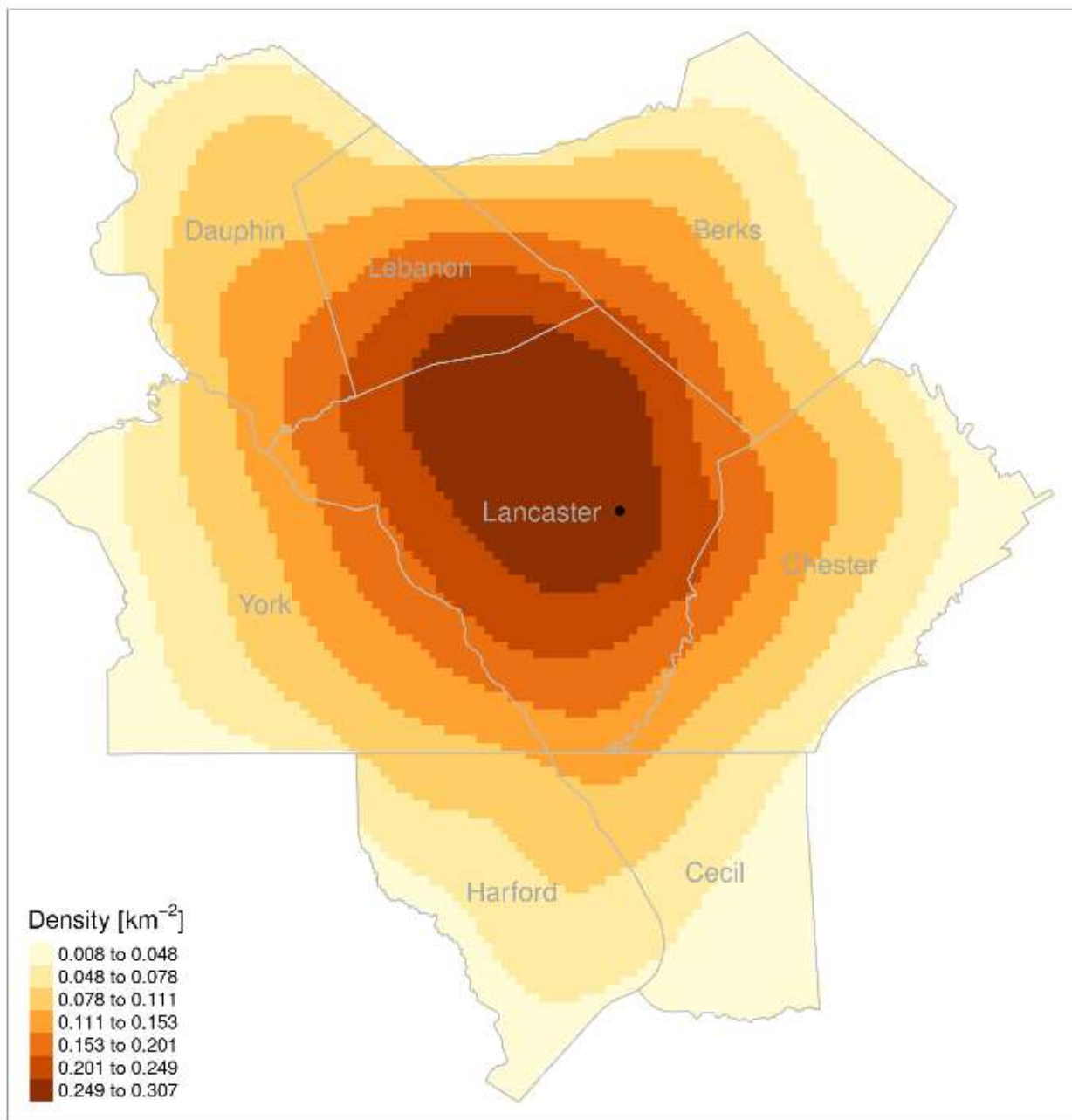


Figure 4-9: Lancaster Downwind HYSPLIT AM – 0800 LST

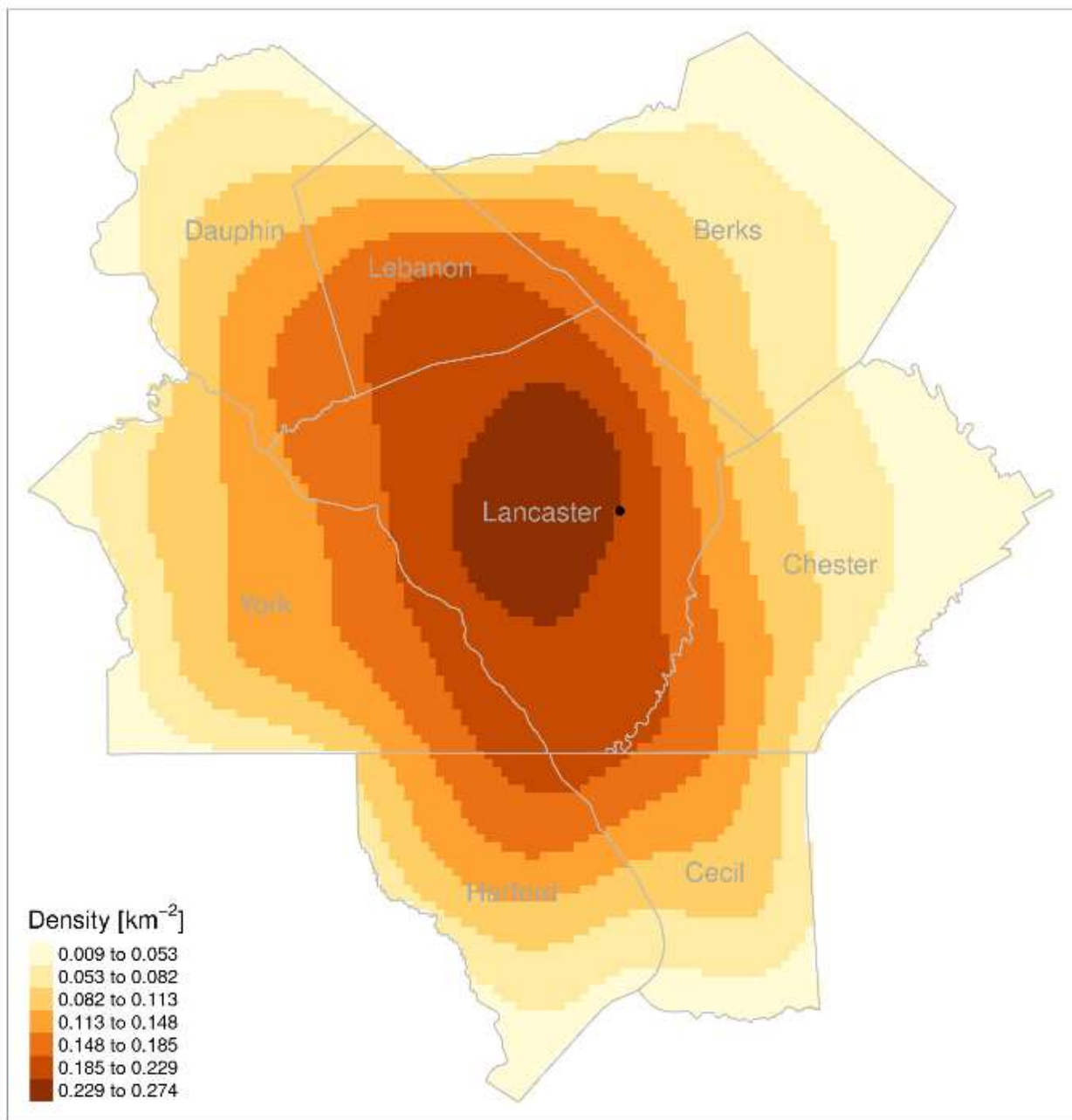


Figure 4-10: Lancaster Downwind HYSPLIT PM – 2200 LST

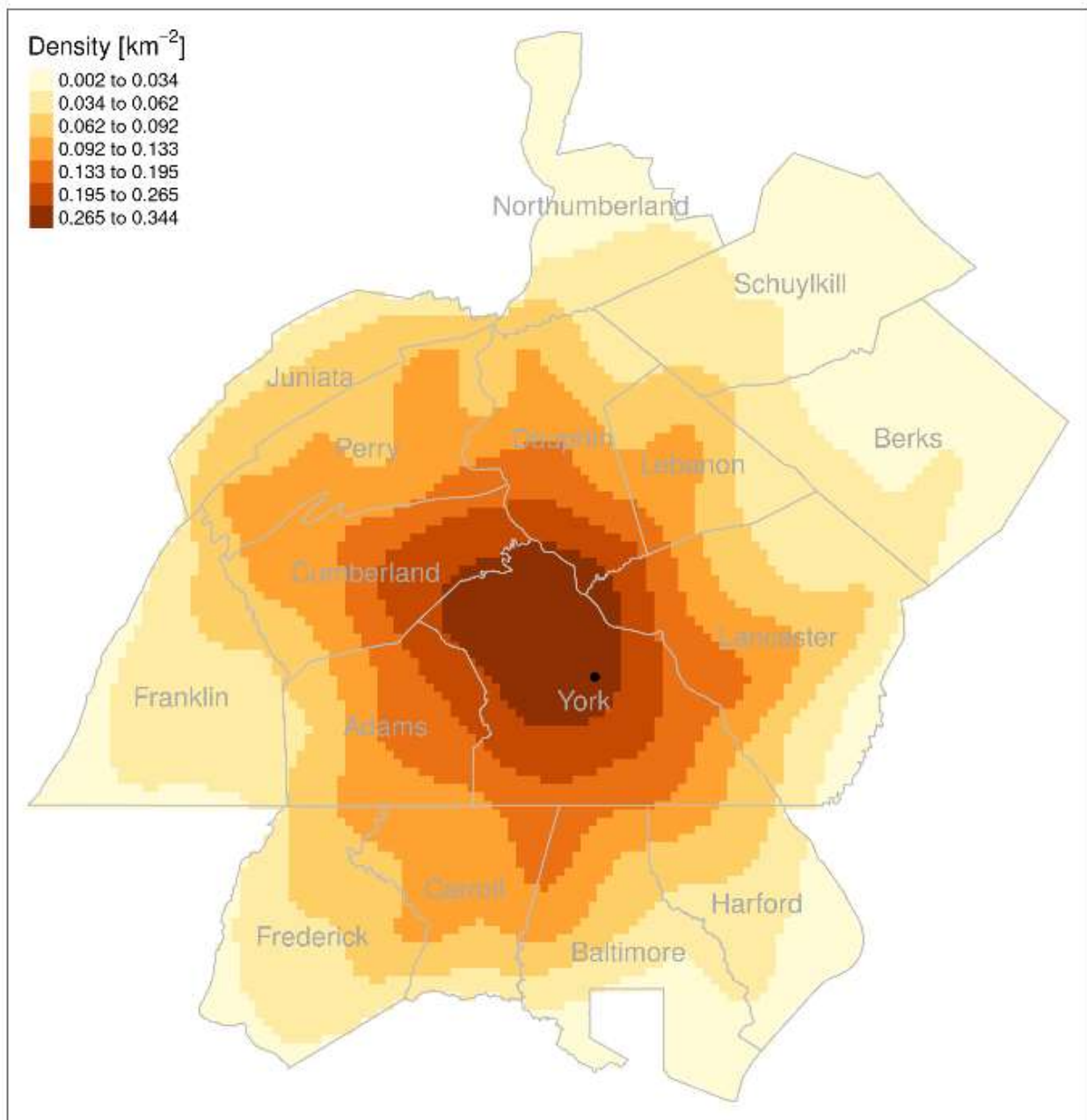


Figure 4-11: Hill Street HYSPLIT AM – 0800 LST

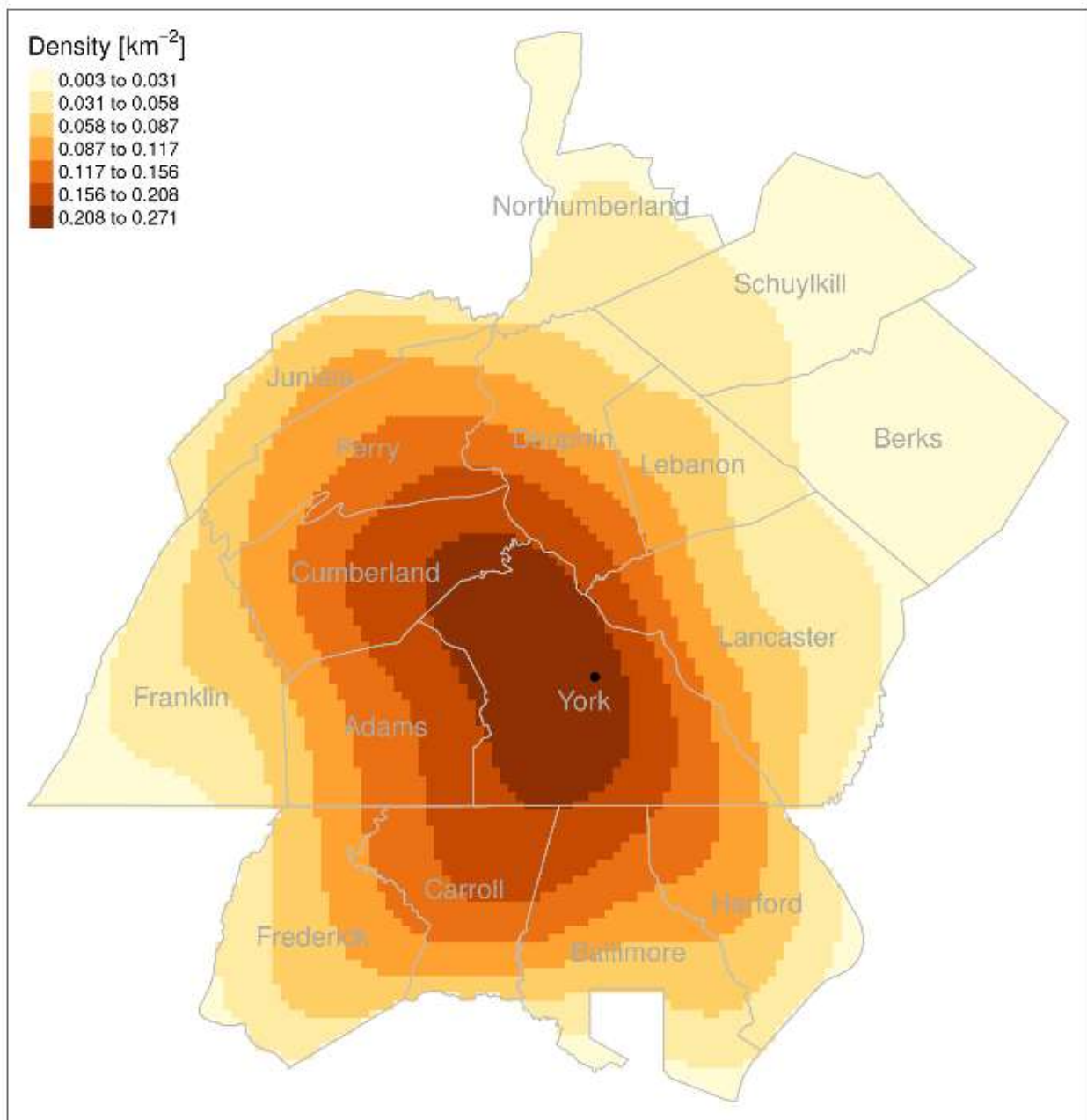


Figure 4-12: Hill Street HYSPLIT PM – 2200 LST

4.2 Wind Roses

One type of meteorological analysis that can be helpful in determining pollution transport involves assessing potential source-receptor relationships in the area using summaries of wind speed and wind direction data. EPA made available wind roses, through its PM_{2.5} Designations Mapping Tool,¹¹ to assist with the analysis of wind speed and direction.

Wind roses are graphical charts that characterize the speed and direction of winds at a location. Presented in a circular format, the length of each "spoke" around the circle indicates the amount of time that the wind blows from a particular direction. Colors along the spokes indicate categories of wind speed. EPA used hourly wind data from 2021-2023 to create the wind roses.

Figure 4-13 shows the wind roses for the region that encompasses the three CBSAs. With the exception of the wind rose for Philadelphia County, the majority of wind roses in the region show that the predominant directions from which the wind is blowing are from the northwest and west. This indicates that the wind mostly travels over Pennsylvania, potentially pulling in pollutants from emission sources in Pennsylvania. The wind rose for Philadelphia County is significantly different than other wind roses in the region. The Philadelphia County wind rose indicates light wind speeds in all directions and shows a disproportionately higher frequencies of winds from the southwest and northwest. This wind rose also only displays data for one year (2021) rather than three years. It is possible that the Philadelphia County wind monitor is surrounded by significantly taller obstructions which dampen the wind speeds overall. Three years of wind data is available for the Philadelphia Airport wind monitor. This data shows a distribution similar to other wind roses in the CBSA.

Figures 4-14 through 4-16 show the wind roses for the three Delaware Counties. In Kent County the winds are predominantly from the West and South. For New Castle County, the winds are predominantly from the Northwest. Finally for Sussex County, the winds are predominantly from the Southwest.

With the exception of the southerly winds from Kent County and southern wind from Sussex County, the predominant winds for each county in Delaware would move pollutants away from violating PM_{2.5} monitors that are located near the City of Philadelphia. Regarding Kent and Sussex Counties, the HYSPLIT maps in Section 4.1 generally show minimal density of PM_{2.5} originating from Kent and Sussex Counties. Which indicates that the pollutants are less likely to be transported from Kent and Sussex Counties than from Pennsylvania counties, either because of the distance to the violating PM_{2.5} monitors or a smaller magnitude of emission sources in Kent and Sussex Counties.

¹¹ EPA's PM_{2.5} Designations Mapping Tool
<https://experience.arcgis.com/experience/a2ca272ce9fc4019a88ce35b863e2cab>

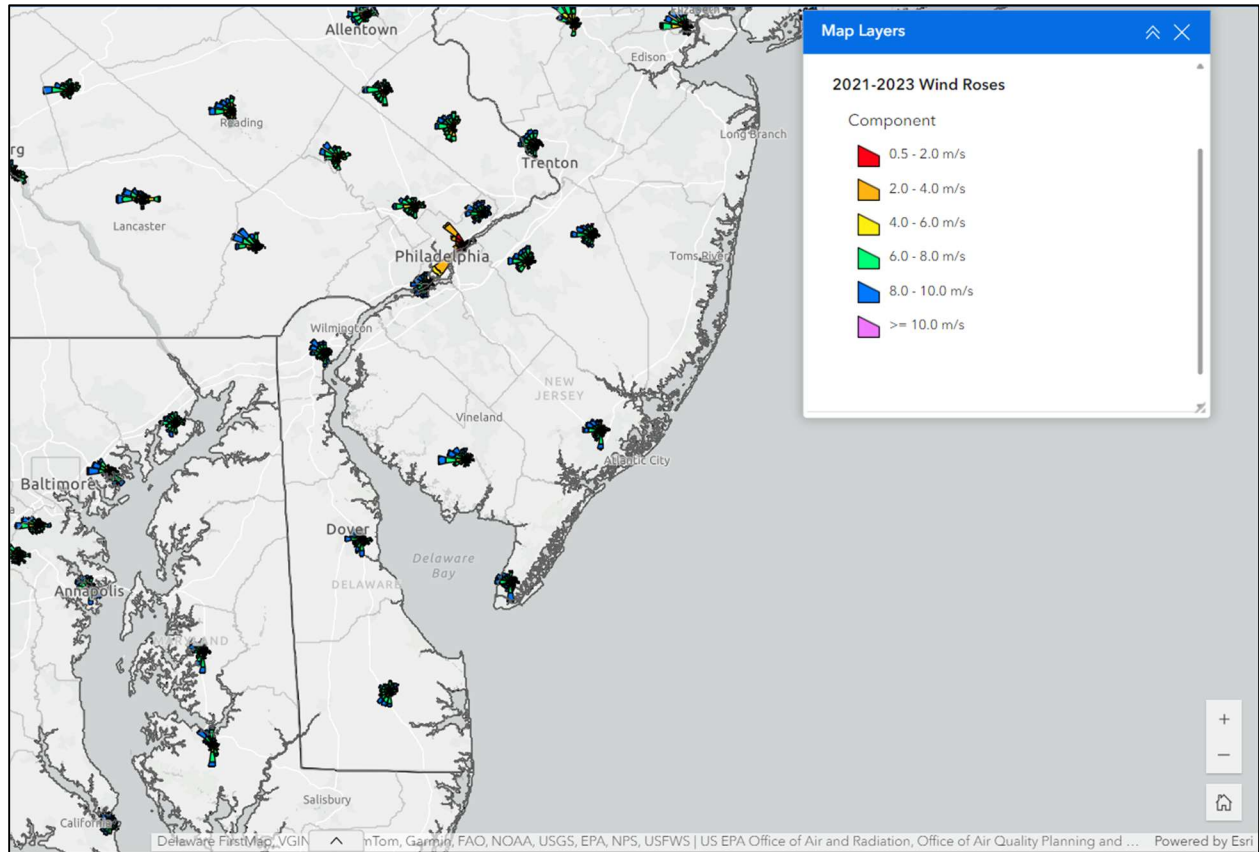


Figure 4-13: Regional Wind Roses

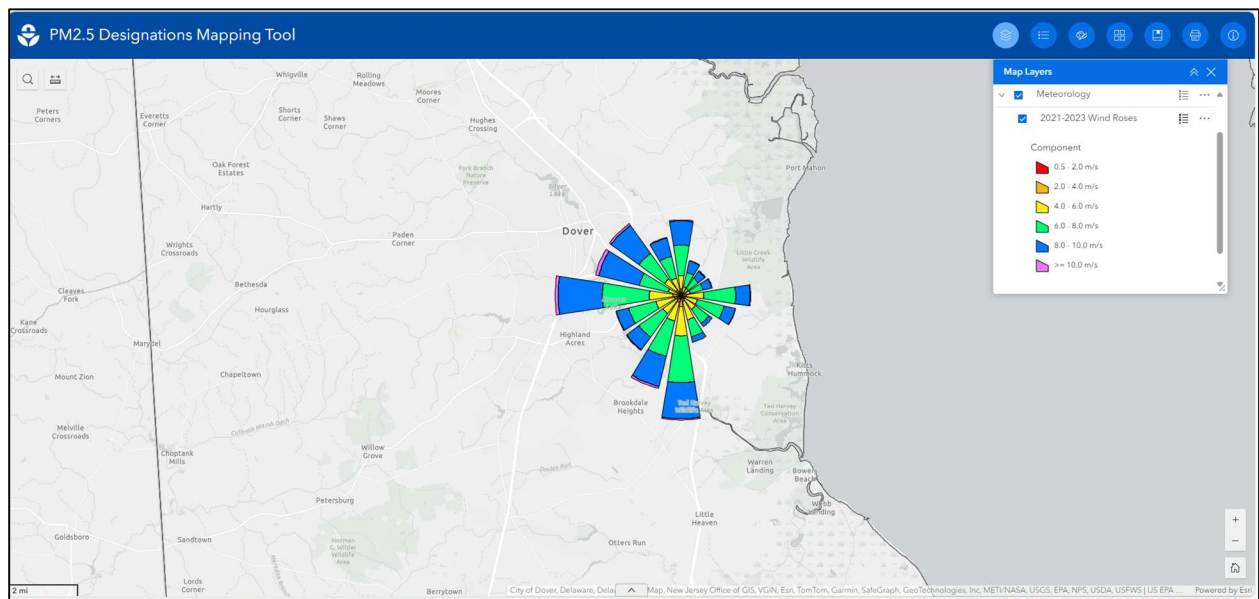


Figure 4-14: Kent County, DE - Wind Rose

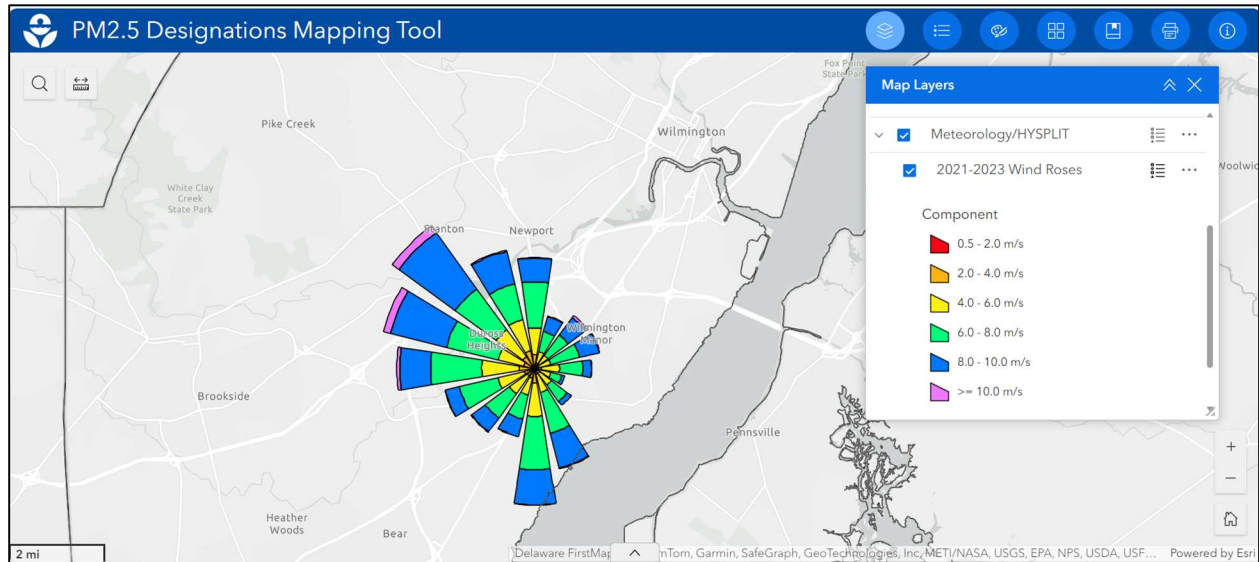


Figure 4-15: New Castle County, DE - Wind Rose

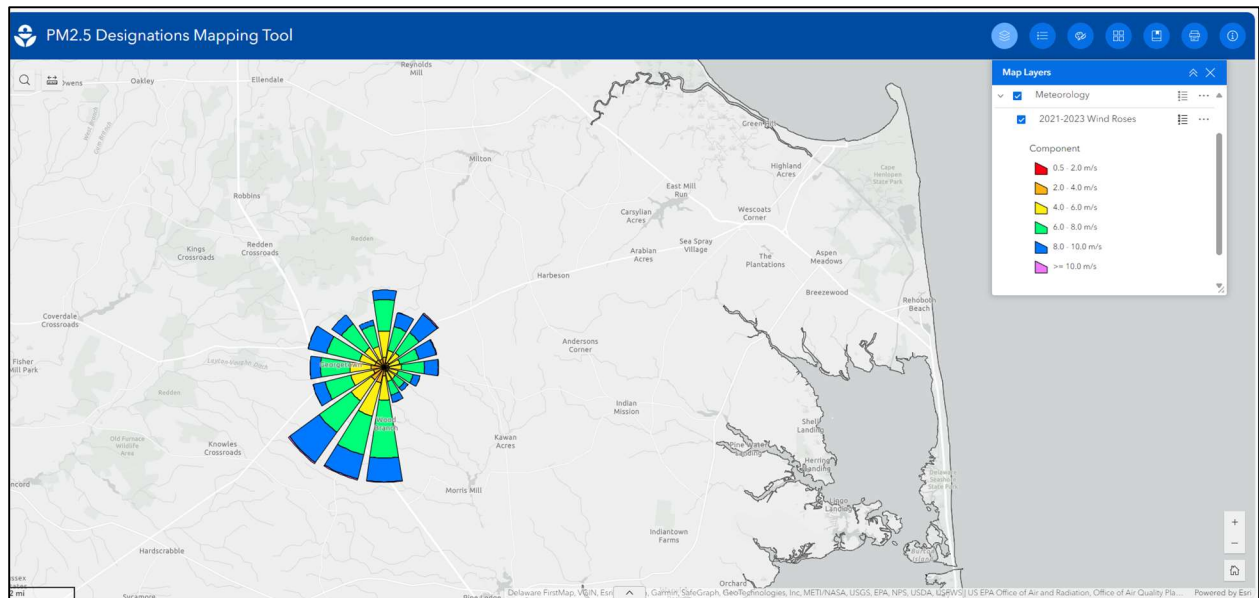


Figure 4-16: Sussex County, DE - Wind Rose

5.0 Geography/ Topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. The EPA recommends that analyses examine the physical features of the land that might define the airshed and, therefore, affect the formation and distribution of PM_{2.5} concentrations over an area.

Delaware is on a level plain, with the lowest mean elevation of any state in the nation. It is bounded to the north by Pennsylvania; to the east by the Delaware River, Delaware Bay, part of New Jersey, and the Atlantic Ocean; and to the west and south by Maryland. Beyond Maryland to the west of Delaware is the Chesapeake Bay. The distance between the Chesapeake Bay and the Delaware River is less than 20 miles across Maryland and Delaware at the narrowest land area around the Chesapeake & Delaware Canal (C&D Canal). New Castle County is separated from New Jersey by about 1 mile of water at its closest and about 5 miles of water at its furthest (at the southern most boundary of New Castle County).

Together, Delaware's geography and the land, water, and air interactions play an important part in Delaware's air quality. The two bays on either side of Delaware potentially segregate local and transported emissions, by both blocking some emissions yet concentrating other emissions. Delaware is unique in this aspect, in that it is the only state which is almost entirely surrounded by water, thus making it geographically different from the Philadelphia region.

Land, sea, mountain and valley breezes, can have an important influence on local air quality. These local winds are driven by a difference in temperature that produces a difference in pressure. For example, the sea breeze forms in the afternoon when the land is considerably hotter than the ocean or bay. Air then flows from the high pressure over the ocean toward the low pressure over land. At night, the opposite may happen as the land cools to below the ocean's temperature, and a land breeze blows out to sea.

6.0 Jurisdictional Boundaries

All of Delaware's air quality management is under the jurisdictional authority of the State of Delaware. Air quality issues are handled by a single agency, the Division of Air Quality within the Delaware Department of Natural Resources and Environmental Control.

7.0 Summary of Recommendation

Delaware recommends a classification of “attainment” for all three counties, New Castle, Kent, and Sussex, under the 2024 PM_{2.5} NAAQS. This recommendation is due to two compelling lines of evidence. 1) All Delaware PM_{2.5} air quality monitor design values are well under the 2024 PM_{2.5} NAAQS level of 9.0 µg/m³ (see Section 2.1). 2) Delaware does not appear to contribute to nonattainment of any adjacent or nearby county, as this document demonstrates.

In regard to Delaware’s contribution, a number of points support Delaware’s position:

- Regional Haze modeling has shown that Delaware’s contribution to local Class I areas is low (Section 3.1.6).
- EPA’s HYSPLIT maps indicate that Delaware is not having a large contribution to violating PM_{2.5} monitors (Section 4.1).
- Wind Roses for Delaware counties generally show that the predominant winds would move pollutants away from violating PM_{2.5} monitors that are located near the City of Philadelphia (Section 4.2).

Delaware is also recommending that all three counties continue to be evaluated for designation status independently. Particularly, it is Delaware’s position that New Castle County continues to be a separate and distinct from any nonattainment in the Philadelphia CBSA/CBSA+. This is consistent with EPA’s decision for the 2012 PM_{2.5} NAAQS designation.