Wisconsin

Milwaukee Area, Sheboygan County Area, Manitowoc County Area, Door County Area

Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD) for Counties Remanded to EPA

1.0 Summary

On October 1, 2015, the EPA promulgated revised primary and secondary ozone national ambient air quality standards (NAAQS (80 FR 6592, October 26, 2015)). In that action, the EPA strengthened both standards to a level of 0.070 parts per million (ppm), while retaining their indicators, averaging times, and forms. The EPA revised the ozone standards based on an integrated assessment of an extensive body of new scientific evidence, which substantially strengthens our knowledge regarding ozone-related health and welfare effects, the results of exposure and risk analyses, the advice of the Clean Air Scientific Advisory Committee and consideration of public comments.

Following promulgation of a new or revised NAAQS, the Clean Air Act (CAA) requires EPA to determine if areas in the country meet the new standards. Accordingly, EPA designated all areas of the country as to whether they met, or did not meet, the NAAQS. EPA designated areas for the 2015 Ozone NAAQS in 3 rounds, resulting in 52 nonattainment areas. These are described below:

- Round 1- November 6, 2017: EPA designated 2,646 counties, 2 separate tribal areas and 5 territories as Attainment/Unclassifiable. We also designated 1 Unclassifiable area.
- Round 2- April 30, 2018: EPA designated 51 Nonattainment areas, 1 Unclassifiable area, and all remaining areas as Attainment/Unclassifiable, except for the 8 counties in the San Antonio, TX area.
- Round 3- July 17, 2018: EPA designated 1 county in the San Antonio area as Nonattainment and the other 7 counties as Attainment/Unclassifiable.

Challenges to EPA's Designations

Multiple petitioners (several environmental and public health advocacy groups, 3 local government agencies, and the state of Illinois) filed six petitions for review challenging the EPA's 2015 ozone NAAQS designations promulgated on April 30, 2018. The District of Columbia Circuit Court consolidated the petitions into a single case, *Clean Wisconsin v. EPA* (No. 18-1203).

- Collectively, the petitioners challenged aspects of EPA's final designations associated with 9 nonattainment areas and involving 17 counties.
- Petitioners primarily argued that EPA improperly designated counties (in whole or part) as attainment that should have been designated as nonattainment based on contributions to nearby counties with violating monitors.
- In its brief, EPA requested voluntary remand of the final designation decisions for 10 counties associated with 4 nonattainment areas to further review those designations.

Court Decision

On July 10, 2020, the District of Columbia Circuit Court issued its decision on the April 30, 2018, designations. The Court granted EPA's request for voluntary remand, as well as remanding a number of other areas to the Agency. In total, the Court remanded 16 counties in 9 nonattainment areas back to EPA. The Court did not vacate the existing designations but required EPA to "issue revised designations as expeditiously as practicable."

The Court remanded Door County. The Court found that EPA "utterly failed to explain why it believes violating design values vanish at the boundaries of a state park." In light of the Court decision, EPA re-evaluated the existing technical record for Door County for data and information that was used for the initial April 2018 designations. Based on EPA's technical re-analysis as described in this TSD, the EPA does intend to modify the initial air quality designation for Door County. Table 1 shows EPA's 2018 designation and any final modification to that designation. The EPA must designate an area nonattainment if it has an air quality monitor that is violating the standard or if it has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Detailed descriptions of the nonattainment boundary for Door County are found in the supporting technical analysis below.

The Court granted EPA's request for voluntary remand for Manitowoc County. In light of the Court decision, EPA re-evaluated the existing technical record for Manitowoc County for data and information that was used for the initial April 2018 designations. Based on EPA's technical re-analysis as described in this TSD, the EPA does intend to modify the initial air quality designation for Manitowoc County. Table 1 shows EPA's 2018 designation and any final modification to that designation. The EPA must designate an area nonattainment if it has an air quality monitor that is violating the standard or if it has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Detailed descriptions of the nonattainment boundary for Manitowoc County are found in the supporting technical analysis below.

The Court remanded Sheboygan County. The Court found that EPA's final designation is not supported by the record. First, the court noted a gap in logic between EPA's reliance on Wisconsin's 'lake breeze analysis' and EPA's statement elsewhere that this analysis alone is "not mutually exclusive with a determination that an area may also contribute to its own ozone violations." Second, EPA's uncritical reliance on 'zero-out modeling' was not sufficient to bridge that gap. The court also found that EPA did not describe why it trusted Wisconsin's zero-out modeling and inland penetration analysis, but not the source-apportionment, distance from shoreline, or ten-percent emissions-reduction modeling, and did not differentiate between them in the final TSD. Note that some of these aspects are addressed here in this TSD and the rest are addressed in the Response to Comments associated with this action. In light of the Court decision, EPA re-evaluated the existing technical record for Sheboygan County for data and information that was used for the initial April 2018 designations. Based on EPA's technical re-analysis as described in this TSD, the EPA does intend to modify the initial air quality designation for Sheboygan County. Table 1 shows EPA's 2018 designation and any final modification to that designation. The EPA must designate an area nonattainment if it has an air quality monitor that is violating the standard or if it has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Detailed descriptions of the nonattainment boundary for Sheboygan County are found in the supporting technical analysis below.

The Court granted EPA's request for voluntary remand for the Milwaukee area including Milwaukee, Waukesaha, Ozaukee, Washington, and Racine counties. In light of the Court decision, EPA re-evaluated the existing technical record for the Milwaukee area for data and information that was used for the initial April 2018 designations. Based on EPA's technical re-analysis as described in this TSD, the EPA does intend to modify the initial air quality designation for the Milwaukee area. Table 1 shows EPA's 2018 designation and any final modification to that designation. The EPA must designate an area nonattainment if it has an air quality monitor that is violating the standard or if it has sources of emissions that are contributing to a violation of the NAAQS in a nearby area. Detailed descriptions of the nonattainment boundary for the Milwaukee area are found in the supporting technical analysis below.

Table 1. Recommended Nonattainment Areas and the EPA's Final Nonattainment Areas for the 2015 Ozone NAAQS

Area	**Recommended Nonattainment Counties** **September 2016**	**EPA's Intended Nonattainment Counties** **December 22, 2017**	**EPA's Final Nonattainment Counties** **April 30, 2018**	**EPA's Final Nonattainment Counties - Remand Response** **January 15, 2021**
Door County, WI	None	The portion of Door County north of Sturgeon Bay Canal	Newport State Park	The portion of Door County north of Sturgeon Bay Canal excluding Newport State Park, which was redesignated to attainment on June 10, 2020 (85 FR 35377)

Manitowoc County, WI	None	A portion of Manitowoc county inclusive and east of the following roadways with the boundary starting from north to south: County Road B which turns into South State Street to County Road V which turns into Forest Home Drive to South Packer Drive to West Hillcrest Road to Highway 43 to West Custer Street to Dufek Drive which turns into Highway 42	A portion of Manitowoc county inclusive and east of the following roadways going from the northern county boundary to the southern county boundary: Saxonburg Road, Zander Road, Saxonburg Road, Tapawingo Road, Tannery Road, E County Road V, Tannery Road, E Hillcrest Road, Sunset Drive, County Road VV, Manitou Drive, County Road B, Goodwin Road, N Rapids Road, S Rapids Road, Calumet Avenue, Hecker Road, Silver Creek Road, Gass Lake Road, Clover Road, Center Road, County Road F, Westview Road, County Road X, S Union Road	A portion of Manitowoc county inclusive and east of the following roadways with the boundary starting from north to south: County Road B which turns into South State Street to County Road V which turns into Forest Home Drive to South Packer Drive to West Hillcrest Road to Highway 43 to West Custer Street to Dufek Drive which turns into Highway 42

Sheboygan County, WI	None	A portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW	A portion of Sheboygan County inclusive and east of the following roadways going from the northern county boundary to the southern county boundary: Highway 43, Wilson Lima Road, Minderhaud Road, County Road KK/Town Line Road, N 10th Street, County Road A S/Center Avenue, Gibbons Road, Hoftiezer Road, Highway 32, Palmer Road/Smies Road/Palmer Road, Amsterdam Road/County Road RR, Termaat Road	A portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW

Milwaukee, WI	None	Ozaukee County Milwaukee County Washington County Waukesha County Racine County	The northeastern corner of Milwaukee County bounded by and inclusive of the following roadways going from the northern county border to Lake Michigan: Highway 57/N. Sherman Blvd/N. 43rd Street to W. Mill Road to Highway 57/N. Green Bay Ave to W. Bender Road/Devon Street to N. Santa Monica Blvd to E. Belle Ave to the southern boundary of Klode Park. And, Ozaukee County inclusive and east of the following roadways: County Road KW, Cedar Beach Road, 6 Mile Road, County Road A, Lovers Land Road, Woodland Road, County Road KK, Willow Road, Highway 57, County Road W, N. Riverside Drive, E. Green Bay Avenue, S. Main Street, N. Green Bay Road, 12th Avenue, Wisconsin Avenue, Green Bay Road, S. Main Street, N. Cedarburg Road/Highway 57.	Ozaukee County Milwaukee County Washington County (partial) —inclusive and east of the following roadways going from the northern to southern county boundary: County H to N Main St/ Old US Hwy 45 to WI-60 Trunk E to WI-164 S Waukesha County (partial) — going from the western to southern county boundary: inclusive and north of I-94 and inclusive and east of Highway 67 Racine County (partial) — inclusive and east of the following roadways going from the northern to southern county boundary: Highway 45 to Washington Ave. to South Beaumont Ave.

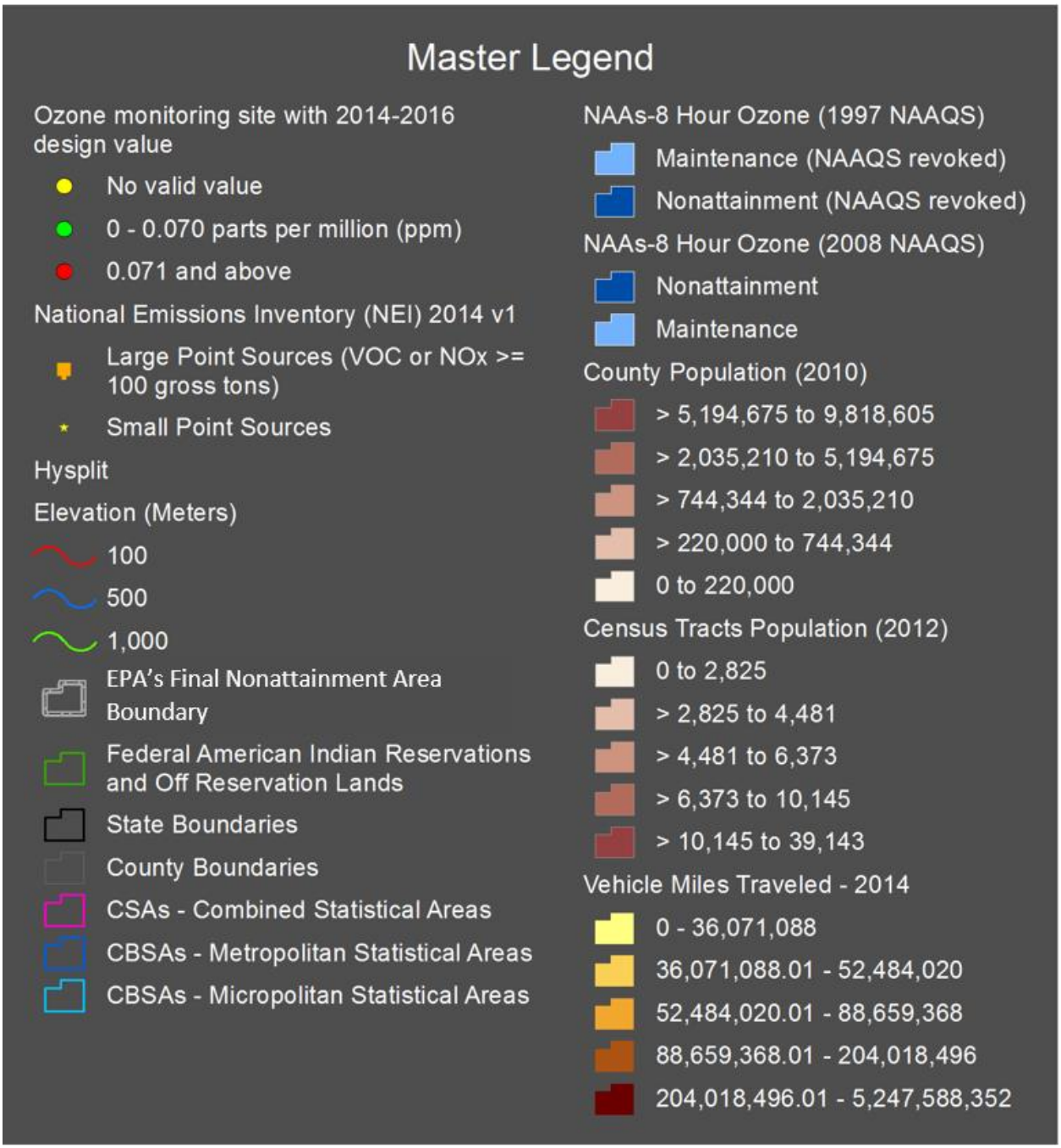
2.0 Nonattainment Area Analyses and Boundary Determination

The EPA re-evaluated the designations for the Milwaukee area, Sheboygan County, Manitowoc County, and Door County considering the specific facts and circumstances of the area using data available at the time of the original designation in April 2018. In accordance with the CAA section 107(d), the EPA is designating as nonattainment the areas with the monitors that are violating the 2015 ozone NAAQS and nearby areas with emissions sources (i.e., stationary, mobile, and/or area sources) that contribute to the violations. As described in the EPA's designations guidance for the 2015 NAAQS (hereafter referred to as the "ozone designations guidance"[1] after identifying each monitor indicating a violation of the ozone NAAQS in an area, the EPA analyzed those nearby areas with emissions potentially contributing to the violating area. In guidance issued in February 2016, the EPA provided that using the Core Based Statistical Area (CBSA) or Combined Statistical Area (CSA)[2] as a starting point for the contribution analysis is a reasonable approach to ensure that the nearby areas most likely to contribute to a violating area are evaluated. The area-specific analyses may support nonattainment boundaries that are smaller or larger than the CBSA or CSA.

As noted above, EPA completed initial area designations in three separate rounds. In accordance with the Court's decision, EPA has re-evaluated the designations for the Milwaukee area, Sheboygan County, Manitowoc County, and Door County consistent with the designations guidance (and EPA's past practice) regarding the scope of the area EPA would analyze in determining nonattainment boundaries for the ozone NAAQS as outlined above. The Technical Analysis section below contains EPA's re-analysis of the existing technical record for the Milwaukee area, Sheboygan County, Manitowoc County, and Door County.

[1] The EPA issued guidance on February 25, 2016 that identified important factors that the EPA intends to evaluate in determining appropriate area designations and nonattainment boundaries for the 2015 ozone NAAQS. Available at *https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs*

[2] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html. The Office of Management and Budget (OMB) adopts standards for defining statistical areas. The statistical areas are delineated based on U.S. Census Bureau data. The lists are periodically updated by the OMB. The EPA used the most recent July 2015 update (OMB Bulletin No. 15-01), which is based on application of the 2010 OMB standards to the 2010 Census, 2006-2010 American Community Survey, as well as 2013 Population Estimates Program data.



Figures in the remainder of this document refer to the master legend above.

3.0 Technical Analyses

The following technical analyses identify any monitors in the Milwaukee area (Milwaukee, Waukesaha, Ozaukee, Washington, and Racine counties), Sheboygan County, Manitowoc County, and Door County that violate the 2015 ozone NAAQS. It also provides EPA's re-evaluation of each county to determine whether it has emissions sources that potentially contribute to ambient ozone concentrations at nearby violating monitors in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In re-analyzing the designations for these counties, the EPA used the technical data and information available at the time of the initial air quality designations.

The five factors recommended in the EPA's guidance are:

1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

3.1 Technical Analysis for the Milwaukee Area

This technical analysis identifies the area with monitors that violate the 2015 ozone NAAQS. It also provides EPA's evaluation of this area and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitors in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA used the 2016 certified data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA Ozone Designations Guidance and Data web page).[3] In addition, the EPA considered the data or information provided to the EPA by states or tribes.

The area of analysis is the Milwaukee-Racine-Waukesha CSA, which includes Dodge, Washington, Ozaukee, Jefferson, Waukesha, Milwaukee, Walworth, and Racine counties in Wisconsin. This area of analysis contains violating monitors. The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area.

The five factors recommended in the EPA's guidance are:

1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);

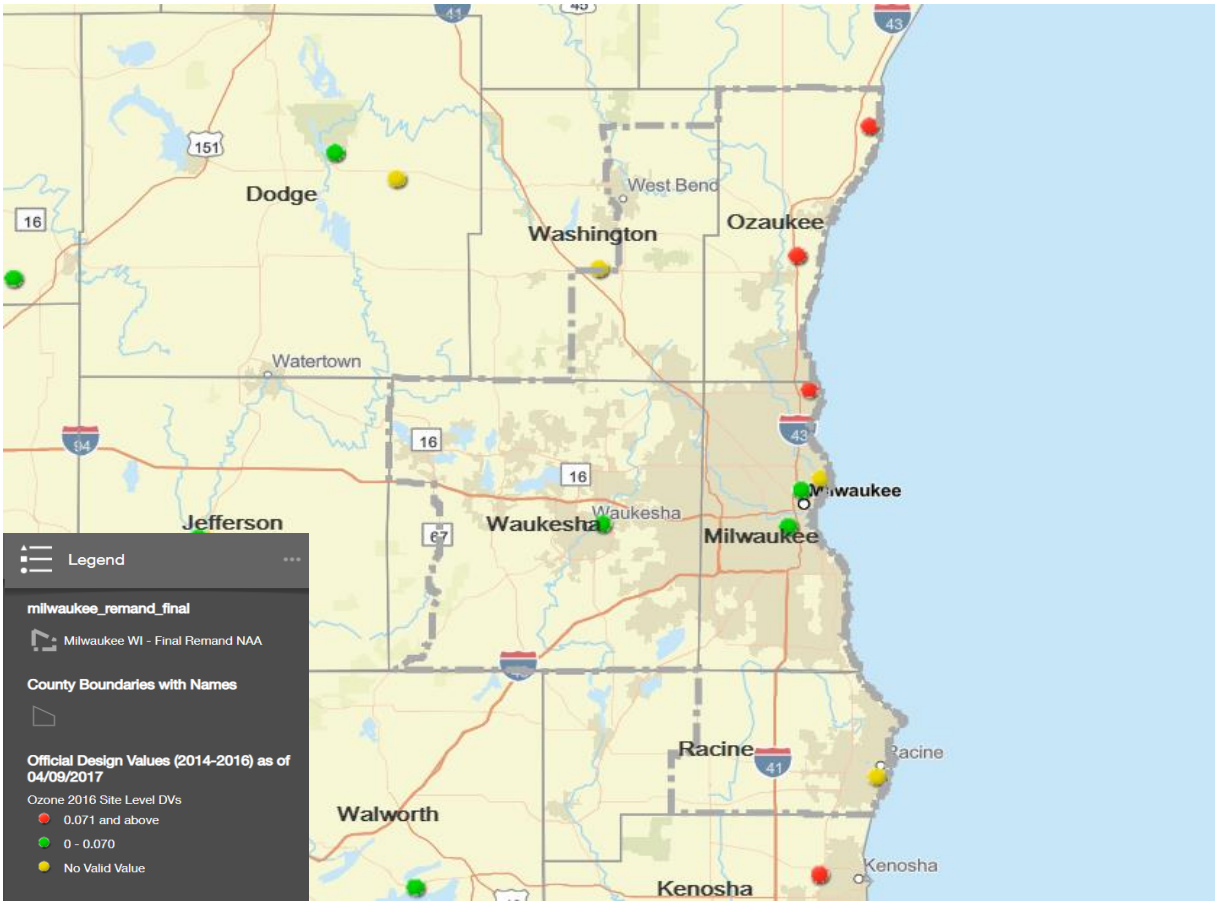
[3] The EPA's Ozone Designations Guidance and Data web page can be found at *https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.*

3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

Figure 1 is a map of the EPA's nonattainment boundary for the Milwaukee area. The map shows the location of the ambient air quality monitors, county boundaries, and other jurisdictional boundaries.

For purposes of the 1997 ozone NAAQS, portions of this area were designated nonattainment. The boundary for the nonattainment area for the 1997 ozone NAAQS included the entire counties of Milwaukee, Ozaukee, Racine, Washington, Waukesha, and Kenosha County. For the purposes of the 2008 ozone NAAQS, the entire counties of Milwaukee, Ozaukee, Racine, Washington, Waukesha, and a portion of Kenosha County were designated as unclassifiable/attainment. The other portion of Kenosha County was designated with the Chicago area as nonattainment for the 2008 ozone NAAQS as explained below. The new boundary is different from the previous boundaries as explained below.

Figure 1. EPA's Nonattainment Boundary for the Milwaukee Area



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Ozaukee and Milwaukee counties have monitors in

violation of the 2015 ozone NAAQS, therefore these counties are included in the nonattainment area. The EPA determined that portions of Washington, Waukesha, and Racine counties contribute to the violating area, therefore these portions are also included. The following sections describe the five-factor analysis. While the factors are presented individually, they are not independent. The five-factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values in ppm for air quality monitors in the Milwaukee area of analysis based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[4] The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.[5] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[6] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the 2016 certified design values violate the NAAQS and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are operated in accordance with 40 CFR part 58, appendices A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible

[4] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.

[5] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.

[6] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*

for comparison to the NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

The 2016 design values for counties in the Milwaukee-Racine-Waukesha CSA are shown in Table 2.

Table 2. Air Quality Data (all values in ppm)

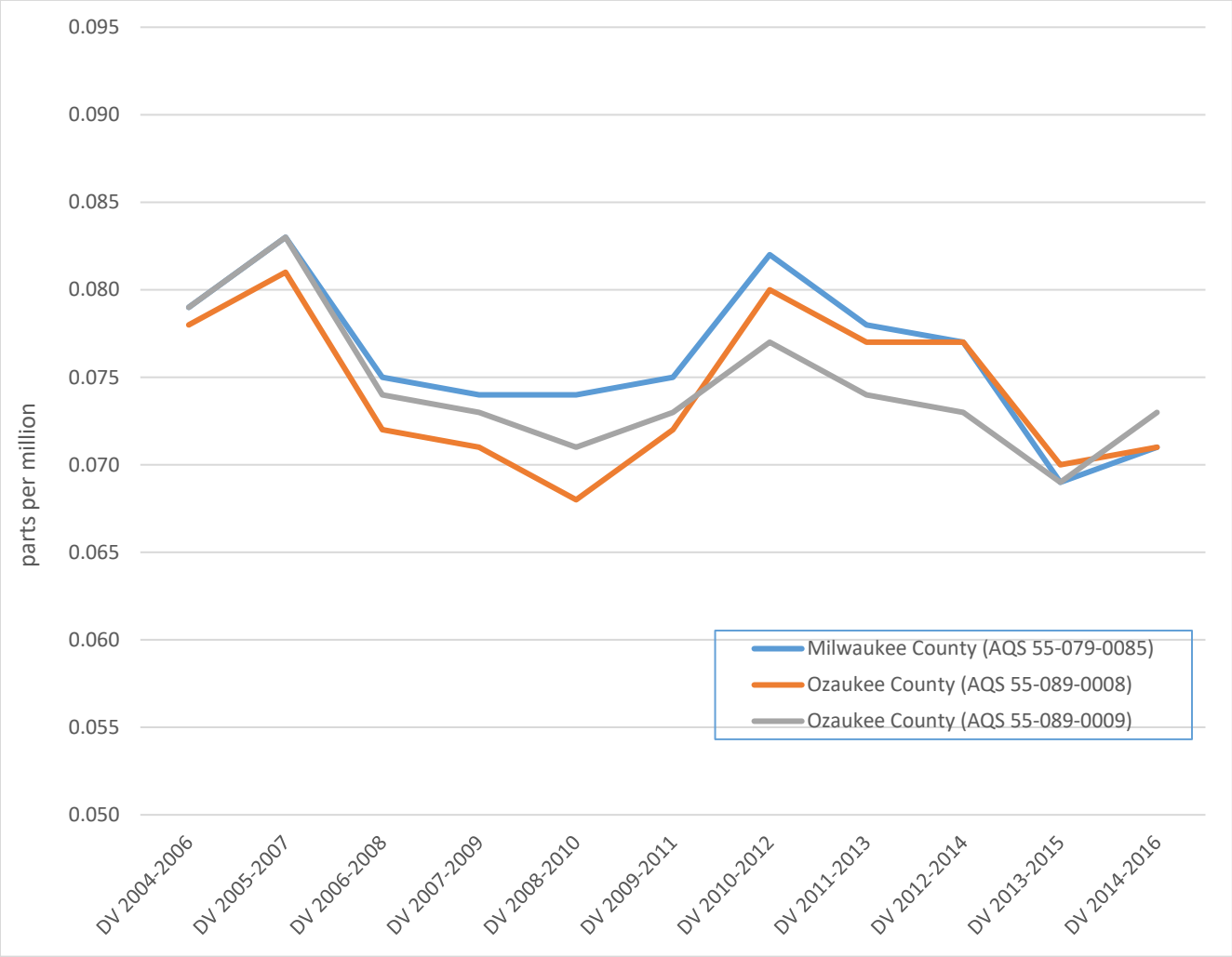
County, State	State Recommended Nonattainment?	AQS Site ID	2014 - 2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Dodge, WI	No	55-027-0001	0.068	0.071	0.066	0.068
Jefferson, WI	No	55-055-0009	0.069	0.071	0.065	0.071
Milwaukee, WI	No	55-079-0026	0.068	0.068	0.066	0.070
		55-079-0085	**0.071***	0.069	0.068	0.077
		55-079-0010	0.064	0.062	0.063	0.068
Ozaukee, WI	No	55-089-0008	**0.071***	0.074	0.070	0.071
		55-089-0009	**0.073***	0.070	0.071	0.079
Racine, WI	No	55-101-0020	N/A	N/A	0.068	0.076
Walworth, WI	No	55-127-0005	0.070	0.073	0.067	0.072
Washington, WI	No	no monitor				
Waukesha, WI	No	55-133-0027	0.066	0.067	0.066	0.067

*Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Milwaukee County to be 2.9 miles from the lakeshore in the northeastern portion of the county and 2.8 miles south of the Bayside monitor before cutting due east to the coastline. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Ozaukee County to be 2.9 miles from the lakeshore. Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation of attainment. EPA finds Wisconsin's methodology for these estimates to be fundamentally unsupported as explained in the Response to Comments associated with this action.

Figure 1, shown previously, identifies the Milwaukee nonattainment area and the violating monitors. Table 2 identifies the 2016 design value for each of the monitors in the area of analysis and Figure 2 shows the historical trend of design values for the violating monitors. As indicated on the map, there were three violating monitors that are located in the Milwaukee-Racine-Waukesha CSA. Two of the violating

monitors are located in Ozaukee County. The third violating monitor is located in Milwaukee County. As shown in Figure 2, the violating monitors have historically high ozone design values, which have been generally decreasing over time; however, there was a small increase in 2016 design values.

Figure 2. Three-Year Design Values for Violating Monitors



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Ozaukee County has two monitors and Milwaukee County has one monitor in violation of the 2015 ozone NAAQS, therefore these counties are included in the nonattainment area based on the air quality data factor.

Factor 2: Emissions and Emissions-Related Data

As mentioned previously, the presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for

determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA evaluated emissions of ozone precursors, which include nitrogen oxides (NO_x) and volatile organic compounds (VOC), and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NO_x or VOC emissions greater than 100 tons per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 3 provides a county-level emissions summary of NO_x and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for inclusion in the Milwaukee nonattainment area.

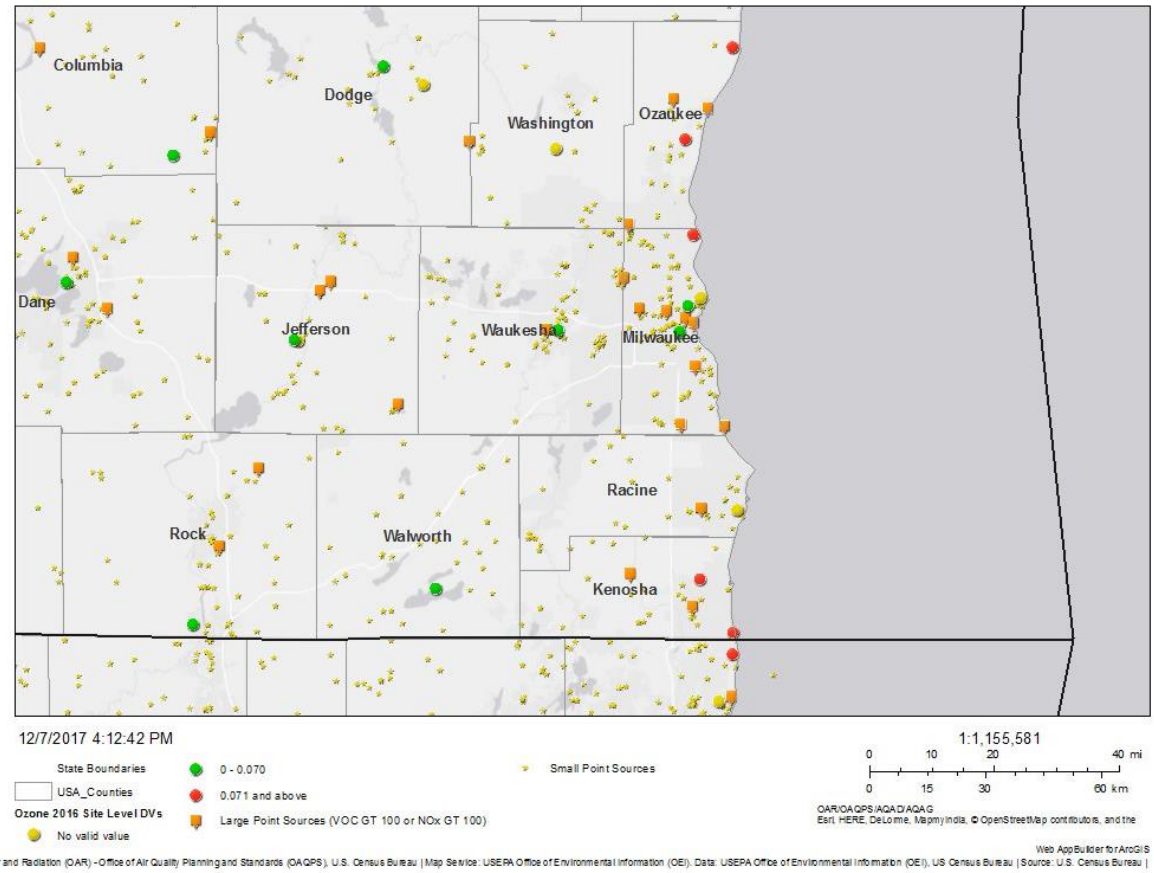
Table 3. Total County-Level NO_x and VOC Emissions

County, State	State Recommended Nonattainment?	Total NO_x (tpy)	Total VOC (tpy)
Dodge, WI	No	3,087	4,450
Jefferson, WI	No	3,306	3,651
Milwaukee, WI	No*	22,012	17,016
Ozaukee, WI	No*	3,107	2,003
Racine, WI	No	4,153	4,296
Walworth, WI	No	2,929	3,563
Washington, WI	No	3,543	3,625
Waukesha, WI	No	9,685	10,526
	Total:	51,822	49,129

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

In addition to reviewing county-wide emissions of NO_x and VOC in the area of analysis, the EPA also reviewed emissions from point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The locations of the point sources are shown in Figure 3 below.

Figure 3. Point Sources in the Area of Analysis



The EPA's analysis of county-level emissions and the geographic locations of the emissions showed the following. In terms of NO_x emissions from the counties without violating monitors in the Milwaukee-Racine-Waukesha CSA, Waukesha County has the greatest NO_x emissions, on the order of 9,000 tpy, followed by Racine County, on the order of 4,000 tpy, followed by Washington, Jefferson, Dodge, and Walworth counties, each on the order of 3,000 tpy. In terms of VOC emissions from the counties without violating monitors in the Milwaukee-Racine-Waukesha CSA, Waukesha County has the greatest VOC emissions, on the order of 10,000 tpy, followed by Dodge and Racine counties, each on the order of 4,000 tpy, followed by Jefferson, Washington, and Walworth counties, each on the order of 3,000 tpy.

Of the counties without violating monitors, Waukesha County accounts for about 19% of the total CSA NO_x emissions followed by Racine, Washington, Jefferson, Dodge, and Walworth, each accounting for about 6-8% of the CSA NO_x emissions. Of the counties without violating monitors, Waukesha County accounts for about 21% of the total CSA VOC emissions followed by Dodge and Racine counties each accounting for about 9%, followed by Jefferson, Walworth, and Washington counties each accounting for about 7% of the total CSA VOC emissions.

Population Density and Degree of Urbanization

In this part of the factor analysis, the EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions.

These include emissions of NO_x and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for each county in the area of analysis. Figure 4 shows the county-level population density map of the area of analysis.

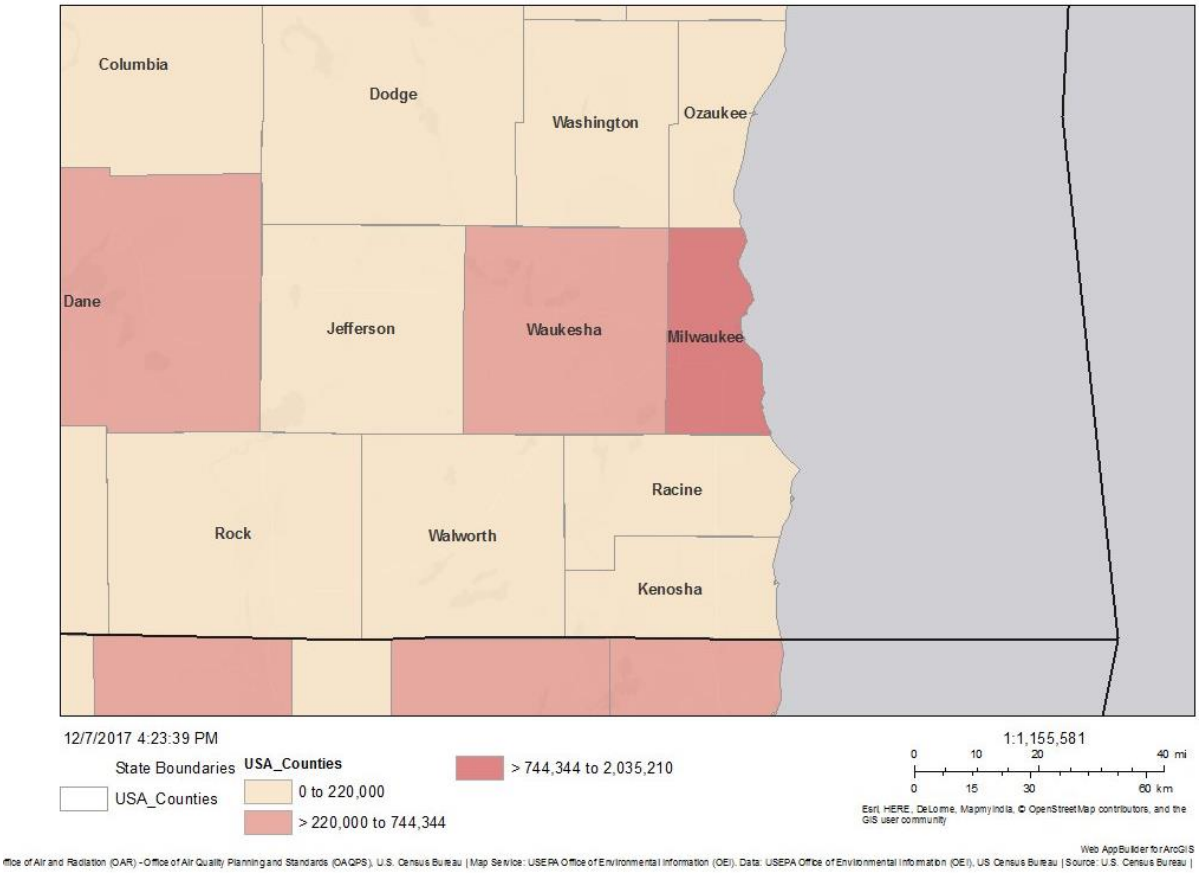
Table 4. Population and Growth.
Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.htm.

County, State	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Dodge, WI	No	88,759	88,502	101	257	-0.3
Jefferson, WI	No	83,686	84,559	152	873	1.0
Milwaukee, WI	No*	947,735	957,735	3967	10,000	1.1
Ozaukee, WI	No*	86,395	87,850	377	1,455	1.7
Racine, WI	No	195,408	195,080	587	328	-0.2
Walworth, WI	No	102,228	102,804	185	576	0.6
Washington, WI	No	131,887	133,674	310	1,787	1.4
Waukesha, WI	No	389,891	396,488	721	6,597	1.7
	Total:	2,222,938	2,242,067	460	19,129	0.9

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

The population did not change more than 2% from 2010 to 2015 in any county in the CSA. Of all the counties in the CSA, the population density is greatest in Milwaukee County (on the order of 4,000 per sq. mi.), which has a violating monitor for the 2014-2016 time period, followed by Waukesha and Racine counties (on the order of 700 and 600, respectively), which do not have violating monitors for the 2014-2016 time period. The remaining counties in the CSA have population densities less than 400 per sq. mi, including Ozaukee County, which is the only other county in the CSA, other than Milwaukee County, with a violating monitor(s).

Figure 4. County-Level Population.



Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for each county in the area of analysis. In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau[7] for the area of analysis. Table 5 shows the traffic and commuting pattern data, including total VMT for each county, number of residents who work in each county, number of residents that work in counties with violating monitor(s), and the percent of residents working in counties with violating monitor(s). The data in Table 5 are 2014 data.

[7] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Table 5. Traffic and Commuting Patterns

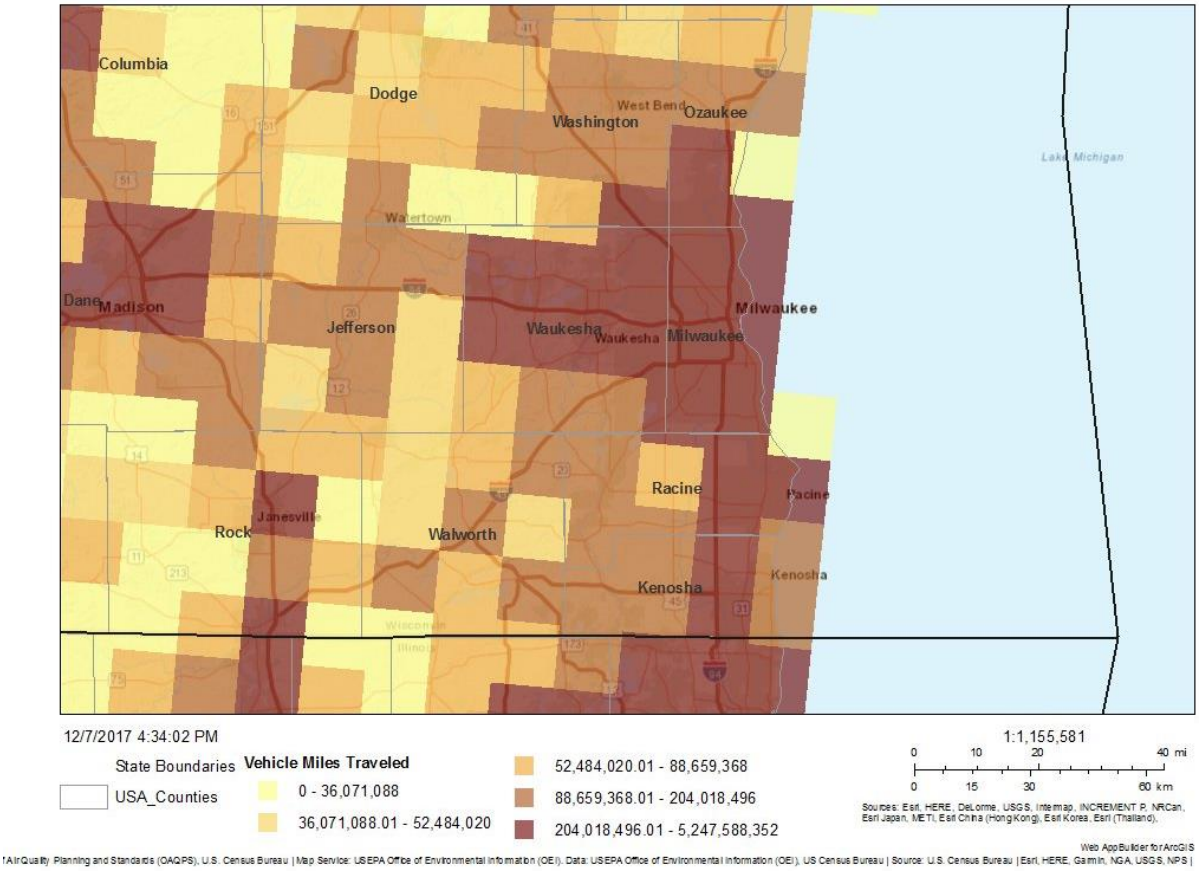
County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Dodge, WI	No	942	43,001	1,769	4%
Jefferson, WI	No	989	42,341	3,405	8%
Milwaukee, WI	**No***	**6,102**	**433,062**	**313,985**	**73%**
Ozaukee, WI	**No***	**903**	**45,289**	**31,852**	**70%**
Racine, WI	No	1,357	97,523	23,445	24%
Walworth, WI	No	979	47,254	4,212	9%
Washington, WI	No	1,330	72,126	22,484	31%
Waukesha, WI	No	3,613	206,449	73,735	36%
	Total:	16,215	987,045	474,887	48%

Counties with a monitor(s) violating the NAAQS are indicated in bold.

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

To show traffic and commuting patterns, Figure 5 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



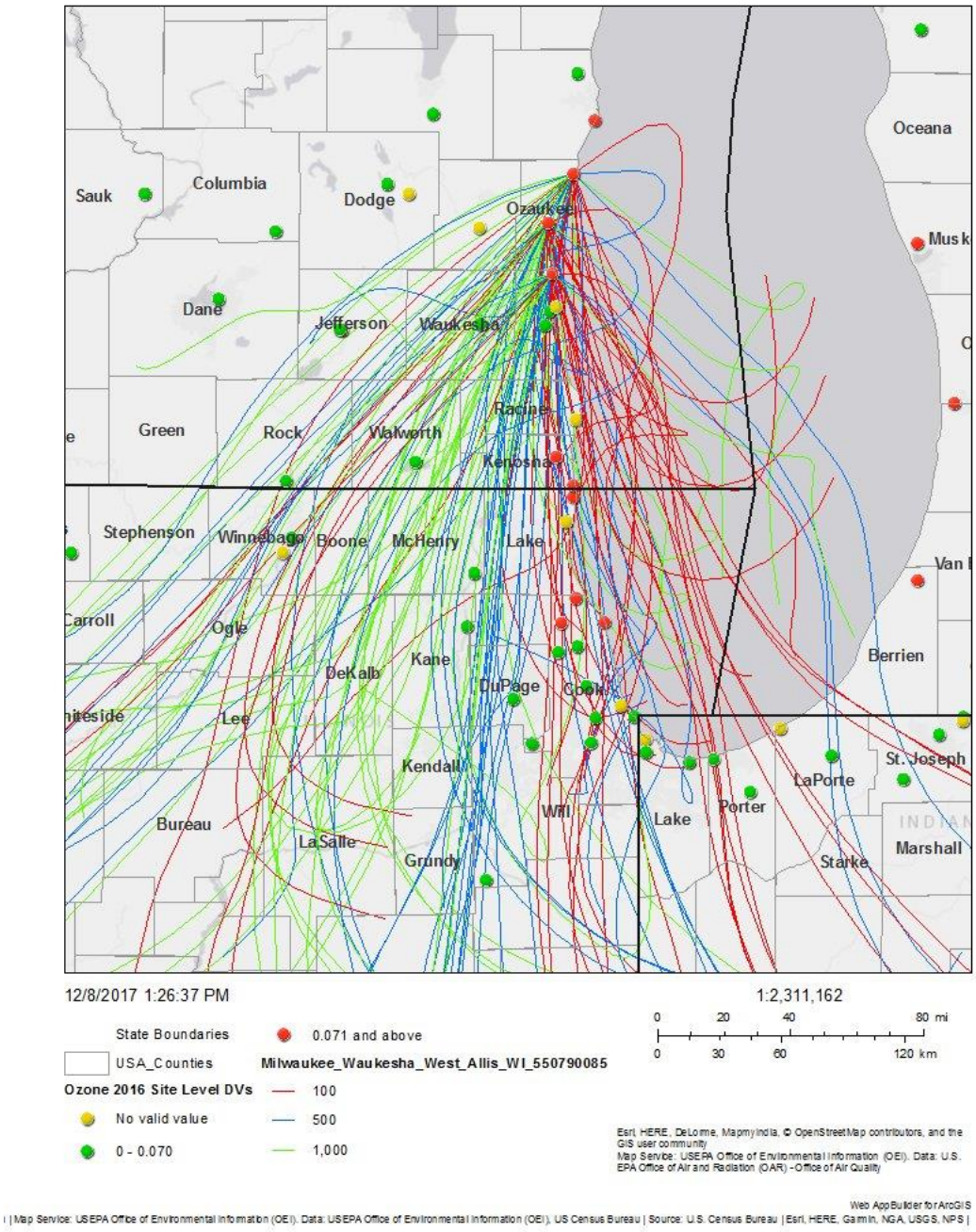
Approximately half of the residents in the CSA commute to or within the counties with violating monitors. Of the counties without violating monitors, Waukesha has the largest number of residents (approximately 74,000) commuting to counties with violating monitors, which is 36% of the Waukesha County residents who work. This is followed by Racine and Washington counties (with approximately 23,000 and 22,000, respectively), which is 24% and 31%, respectively, of the Racine County and Washington County residents who work. The remaining counties each have less than 5,000 residents who commute to counties with violating monitors, which, for each of the remaining counties, represents less than 10% of the county residents who work. Total VMT is highest in Milwaukee County with over 6 billion VMT per year, followed by Waukesha with 3.6 billion and Racine and Washington with 1.4 and 1.3 billion VMT respectively. The remaining counties within the area of analysis each had less than 1 billion VMT.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources

in the area, the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figure 6 shows the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8-hour values that exceed the 2015 ozone NAAQS) for the violating monitors.

Figure 6. HYSPLIT Back Trajectories for Violating Monitors



The HYSPLIT back trajectories show that, on exceedance days, air parcels traveled to the violating monitors from the south, west-southwest, southwest, and southeast. To the southeast of the violating monitors, is Lake Michigan and the Indiana portion of the Chicago area. South of the violating monitors are Ozaukee (which also includes 2 violating monitors), Milwaukee (which also includes 1 violating monitor), Waukesha, Racine and Kenosha counties. Racine County is part of the Milwaukee-Racine-Waukesha CSA. Kenosha County is in a separate CSA and is therefore being evaluated separately as part of the Chicago area. Farther south, is the Chicago urban area. To the west-southwest of the counties with the violating monitors are Washington, Waukesha, Jefferson, and Walworth counties, which are all part of the Milwaukee-Racine-Waukesha CSA. Dodge County, while in the Milwaukee-Racine-Waukesha CSA, is due west of Ozaukee County with Washington County in between. Dodge County contains very few HYSPLIT back trajectories relative to the other counties in the CSA without violating monitors and these HYSPLIT back trajectories only cover the southeastern-most corner of Dodge County.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA uses geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

The Milwaukee area does not have any geographical or topographical features significantly limiting air pollution transport within its airshed. The eastern boundaries of Ozaukee, Milwaukee, and Racine counties follow the shoreline of Lake Michigan. As described under Factor 3: Meteorology, for the Sheboygan County, Manitowoc County, and Door County areas (Sections 3.2, 3.3, and 3.4 respectively), areas geographically located along a land-water interface, in this case the Milwaukee area, which is located along the shoreline of Lake Michigan, can be impacted by lake breeze meteorology, which has the potential to transport photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind areas, and to blow pollution (precursors) offshore and (ozone) back onshore again. The emissions and emissions-related data from the counties in the Milwaukee area described above are a dominating factor influencing ozone formation in the Milwaukee area. The precursor emissions from the Milwaukee area (with or without the added influence of lake breeze meteorology, which can exacerbate ozone formation) are sufficiently high emissions for forming ozone in the Milwaukee area, moreover, combined with the meteorology factor, which includes lake breezes and the influence of shallow stable inversion layers that can form over the lake, this area is particularly susceptible to ozone contribution and impacts including violations of the ozone standard.

Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby areas contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly

defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the Milwaukee nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the designated areas.

The area of analysis was the Milwaukee-Racine-Waukesha CSA, which includes Dodge, Washington, Ozaukee, Jefferson, Waukesha, Milwaukee, Walworth, and Racine counties in Wisconsin. The Milwaukee area has a previously established nonattainment boundary associated with the 1997 ozone NAAQS consisting of Washington, Ozaukee, Waukesha, Milwaukee, Racine, and Kenosha counties in Wisconsin. For the purposes of the 2008 ozone NAAQS, the entire counties of Milwaukee, Ozaukee, Racine, Washington, Waukesha, and a portion of Kenosha County were designated as unclassifiable/attainment (the other portion of Kenosha County was designated with the Chicago area as nonattainment for the 2008 ozone NAAQS).

Based on the five-factor analysis, EPA's boundary for the Milwaukee nonattainment area for the 2015 ozone NAAQS consists of Ozaukee, Milwaukee, Washington (partial), Waukesha (partial), and Racine (partial) counties in Wisconsin. This differs from the 1997 ozone NAAQS Milwaukee nonattainment area in that Washington, Waukesha, and Racine are partial counties as opposed to full counties, and Kenosha is not included in the Milwaukee area, since, as explained previously, Kenosha is included in the area of analysis for the Chicago nonattainment area.

Additional Information

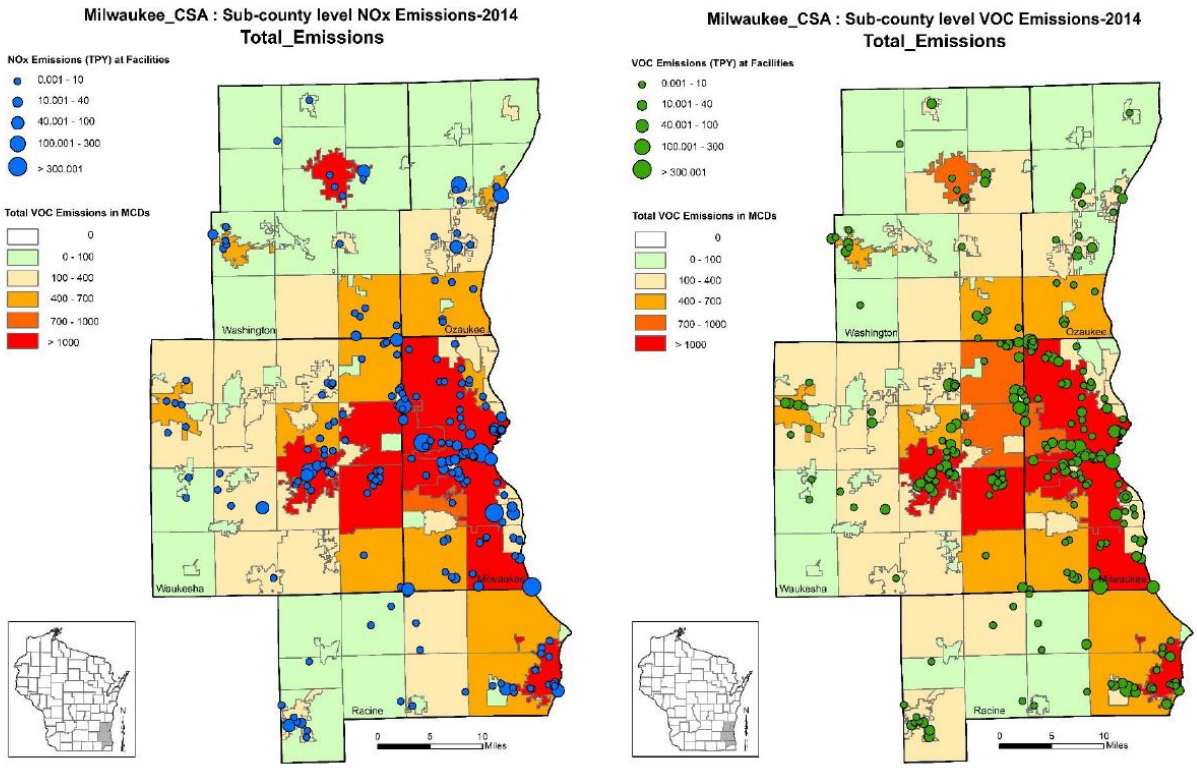
The Wisconsin Department of Natural Resources (WDNR) provided the maps depicted in Figure 7 below showing EPA's 2014 NEI data spatially allocated over the 5-county area. WDNR's methodology and emissions data used to create these maps are in the docket to this rulemaking. The subcounty areas, sometimes appearing as squares, on the map denote Minor Civil Divisions (MCDs), which consist of subcounty governmental units including towns and unincorporated areas.[8] Based on the factor analysis described above and in conjunction with the spatial allocation of NOx and VOC emissions shown on WDNR's maps below, the following partial counties (as opposed to full counties) could be included in the nonattainment area. The portions excluded from the full 5-county area are not likely to substantially contribute to the area violations, since emissions and emissions-related data are low in these portions, and with respect to the northwest corner of Washington County the HYSPLIT trajectories do not fully travel over this portion of the area. Approximately 90+% of the emissions from the full 5-county area are captured in the final partial county nonattainment area described below. The 90+% calculation was achieved by summing the subcounty emissions (in spreadsheets provided by WDNR for each emissions sector and included in the docket to this action) associated with each MCD or partial MCD captured

[8] https://www.sco.wisc.edu/2016/08/04/what-the-acronym-qmcdq-really-means/

within the boundaries described below as a percentage of the total NOx and VOC emissions from the full five counties. Roughly 90% of the NOx emissions and 90% of the VOC emissions are contained within the nonattainment area boundaries described below.

- Milwaukee County (full)
- Ozaukee County (full)
- Washington County (partial) —inclusive and east of the following roadways going from the northern to southern county boundary: County H to N Main St/ Old US Hwy 45 to WI-60 Trunk E to WI-164 S
- Waukesha County (partial) — going from the western to southern county boundary: inclusive and north of I-94 and inclusive and east of Highway 67
- Racine County (partial) — inclusive and east of the following roadways going from the northern to southern county boundary: Highway 45 to Washington Ave. to South Beaumont Ave.

Figure 7. WDNR's Spatially Allocated NOx and VOC Emissions in the Milwaukee Area (based on 2014 NEI data)



The resulting nonattainment area is Ozaukee County, Milwaukee County, Washington County (partial), Waukesha (partial), and Racine (partial), with the partial county boundaries described above.

Conclusion for Milwaukee Area

Based on the assessment of factors described above, the EPA has concluded that the following counties meet the CAA criteria for inclusion in the Milwaukee nonattainment area: Ozaukee County, Milwaukee County, Washington County (partial), Waukesha County (partial), and Racine County (partial). This differs from the 1997 ozone NAAQS Milwaukee nonattainment area in that Washington, Waukesha, and Racine are partial counties as opposed to full counties, and Kenosha is not included in the Milwaukee area, since, as explained previously, Kenosha is included in the area of analysis for the Chicago nonattainment area. The air quality monitors in Ozaukee County and Milwaukee County indicate violations of the 2015 ozone NAAQS based on the 2016 design values, therefore these counties are included in the nonattainment area.

Washington County, Waukesha County, and Racine County are nearby counties that either do not have monitors (Washington County), or, in the case of Waukesha County, does not have a violating monitor. Racine County has a monitor that does not have a valid design value for 2016; however, the 4th high maximum daily 8-hour average ozone concentration in 2016 for the Racine County monitor was 0.076 ppm. The EPA has concluded that these nearby areas contribute to the ozone concentrations in violation of the 2015 ozone NAAQS through emissions from point and non-point sources into the counties with violating monitors. Waukesha County has, by far, the highest NO_x and VOC emissions in the CSA of the counties without violating monitors, followed by Racine and Washington counties, which have the next greatest NO_x emissions. Waukesha and Racine counties have the greatest population densities of counties in the CSA without violating monitors. Waukesha (36%), Washington (31%), and Racine (24%) counties have the greatest percentage of county workers commuting to counties with violating monitors, whereas the remaining three counties in the CSA without violating monitors (Dodge, Jefferson, and Walworth counties) each have fewer than 10% of workers commuting to the counties with the violating monitors (Ozaukee and Milwaukee counties).

The HYSPLIT back trajectories from the northern violating monitor in Ozaukee County (AQS 55-089-0009) show the paths traveled by air parcels to this violating monitor on exceedance days at this violating monitor. These trajectories show air parcels traveling over, among other counties, Washington, Waukesha, Milwaukee, and Racine counties. The HYSPLIT back trajectories from the southern violating monitor in Ozaukee County (AQS 55-089-0008) show the paths traveled by air parcels to this violating monitor on exceedance days at this violating monitor. These trajectories show air parcels traveling over, among other counties, Waukesha, Milwaukee, and Racine counties. The HYSPLIT back trajectories from the violating monitor in Milwaukee County (AQS 55-079-0085) show the paths traveled by air parcels to this violating monitor on exceedance days at this violating monitor. These trajectories show air parcels traveling over, among other counties, Waukesha and Racine counties.

These factors, when considered together provide the key evidence for the EPA's determination of the 2015 ozone NAAQS nonattainment area boundary for the Milwaukee area, which is different from the Milwaukee nonattainment area for the 1997 ozone NAAQS in that it does not include Kenosha County, which, as explained previously, is being evaluated as part of the Chicago area, and it excludes portions of Washington County, Waukesha County, and Racine County as described above.

3.2 Technical Analysis for the Sheboygan County Area

This technical analysis identifies the area with a monitor that violates the 2015 ozone NAAQS. It also provides EPA's evaluation of this area and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitor in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA used the 2016 certified data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA Ozone Designations Guidance and Data web page).[9] In addition, the EPA considered the data or information provided to the EPA by states or tribes.

The initial area of analysis was Sheboygan County, which is not part of a CSA and which is its own CBSA.

The five factors recommended in the EPA's guidance are:

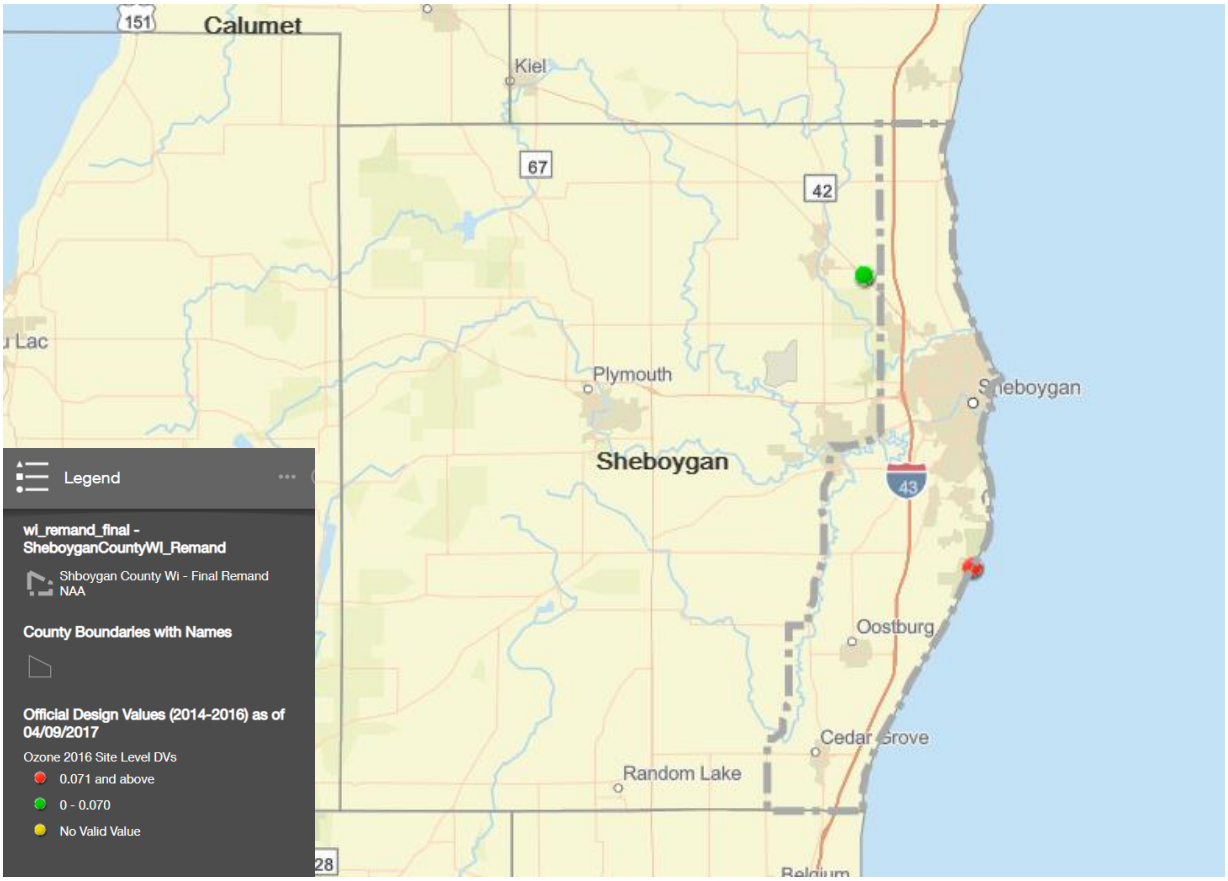
1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

Figure 1 is a map of the EPA's nonattainment boundary for the Sheboygan County area. The map shows the location of the ambient air quality monitors, county, and other jurisdictional boundaries.

For purposes of both the 1997 ozone NAAQS and the 2008 ozone NAAQS, the entirety of Sheboygan County was designated nonattainment. Due to new information from a second ozone monitor in Sheboygan County accompanied by an analysis submitted by Wisconsin, both of which are discussed in more detail below in the context of the five-factor weight-of-evidence analysis, the EPA's nonattainment boundary for the Sheboygan County area for the 2015 ozone NAAQS is a portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW. This boundary is different from the boundary for the both the 1997 ozone NAAQS and the 2008 ozone NAAQS, which consisted of the entirety of Sheboygan County.

[9] The EPA's Ozone Designations Guidance and Data web page can be found at *https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.*

Figure 1. EPA's Nonattainment Boundary for the Sheboygan County Area



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Sheboygan County has a monitor in violation of the 2015 ozone NAAQS, therefore a portion of this county containing the violating monitor is included in the nonattainment area. The following sections describe the five-factor analysis. While the factors are presented individually, they are not independent. The five-factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered the 8-hour ozone design value in ppm for the air quality monitors in Sheboygan County based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[10] The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM)

[10] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.

monitors are used for NAAQS compliance determinations.[11] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[12] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the 2016 design values violate the NAAQS and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are operated in accordance with 40 CFR part 58, appendices A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

There are two monitors located in Sheboygan County. The Sheboygan Kohler Andrae monitor (AQS Site ID 55-117-0006) is located within several hundred feet of the Lake Michigan shoreline, and the Sheboygan Haven monitor (AQS Site ID 55-117-0009) is located approximately 3.2 miles from the Lake Michigan shoreline and approximately 10.9 miles north northwest of the Kohler Andrae monitor. The 2016 design value for each of these monitors is shown in Table 2.

[11] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.

[12] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*

Table 2. Air Quality Data (all values in ppm)

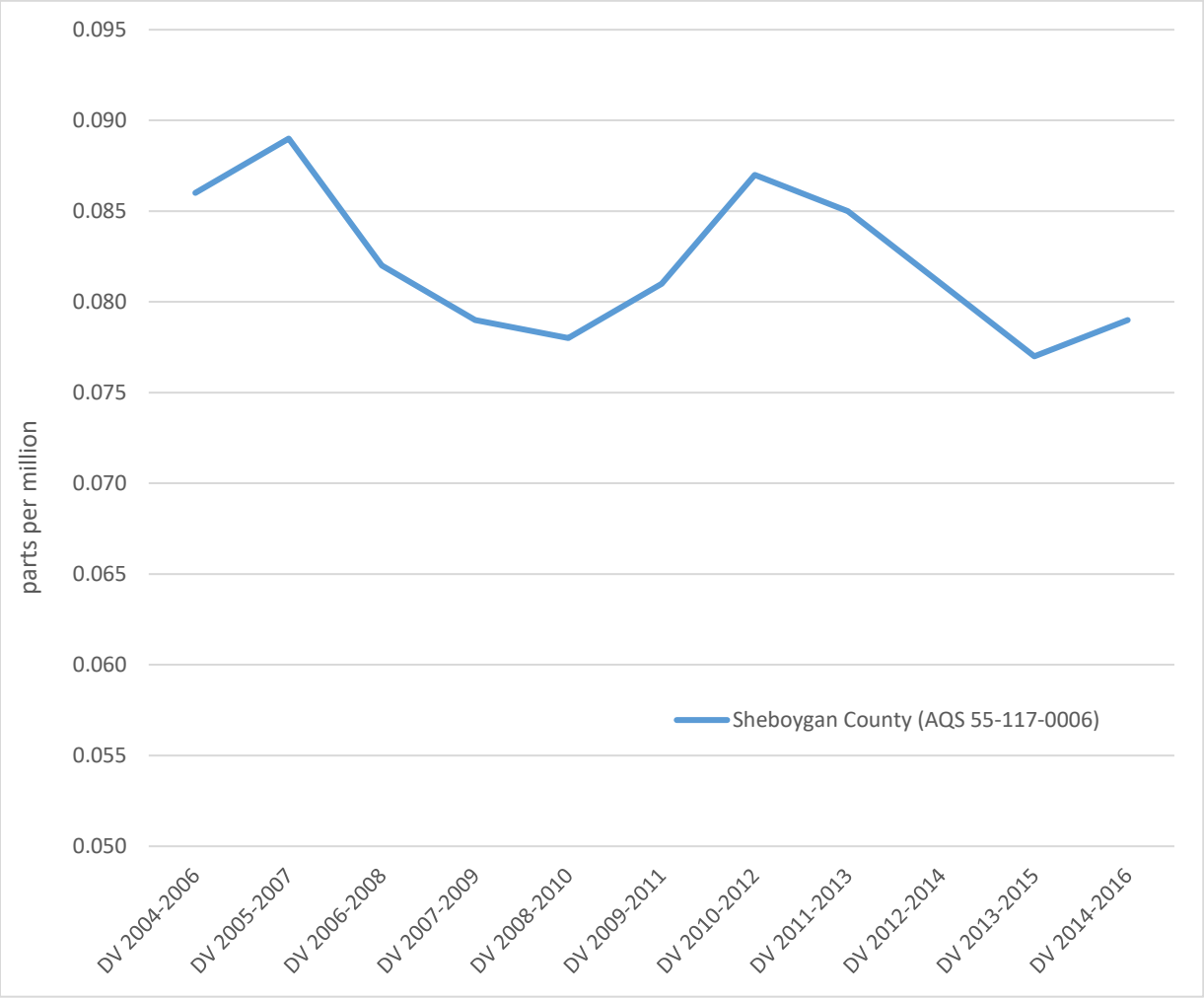
County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Sheboygan, WI	No	55-117-0006	**0.079***	0.072	0.081	0.085
		55-117-0009	0.069	0.068	0.067	0.074

* Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Sheboygan County to be 2.9 miles from the lakeshore. Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation of attainment. EPA finds Wisconsin's methodology for this estimate to be fundamentally unsupported as explained in the Response to Comments associated with this action.

The easternmost monitor in Sheboygan County shows a violation of the 2015 ozone NAAQS, therefore a portion of the county containing the easternmost monitor is included in the nonattainment area.

Figure 1, shown previously, identifies the Sheboygan County nonattainment area and the violating monitor. Table 2 identifies the 2016 design value for each of the two monitors in the area of analysis and Figure 2 shows the historical trend of design values for the violating monitor. As indicated on the map, there is one violating monitor that is located in Sheboygan County, the Sheboygan Kohler Andrae monitor (AQS Site ID 55-117-0006), which is located within several hundred feet of the Lake Michigan shoreline. In 2014, Wisconsin installed a second monitor in Sheboygan County, the Sheboygan Haven monitor (AQS Site ID 55-117-0009), which is located approximately 3.2 miles inland from the shoreline of Lake Michigan and approximately 10.9 miles north northwest of the Kohler Andrae monitor. The Sheboygan Haven monitor has a valid 2016 design value of 0.069 ppm which indicates that this monitor is not violating the 2015 ozone NAAQS of 0.070 ppm. There are several monitors to the west and southwest of the Sheboygan County CBSA, including one in Fond du Lac County and one in Dodge County that are not violating for the 2014-2016 time period. There are three monitors to the south of the Sheboygan County CBSA, including two in Ozaukee County, and one in Milwaukee County that are violating for the 2014-2016 time period, but this area will be addressed separately, since it is part of a separate CSA. As shown in Figure 2, the Sheboygan County violating monitor has historically high ozone design values, which have been generally decreasing over time; however, there was a small increase in the 2016 design value.

Figure 2. Three-Year Design Values for Violating Monitors



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Sheboygan County has a monitor in violation of the 2015 ozone NAAQS, therefore a portion of Sheboygan County that contains the violating monitor is included in the nonattainment area based on the air quality data factor.

Factor 2: Emissions and Emissions-Related Data

As mentioned previously, the presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA evaluated emissions of ozone precursors, which include nitrogen oxides (NO_x) and volatile organic compounds (VOC), and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NO_x or VOC emissions greater than 100 tons per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 3 provides a county-level emissions summary of NO_x and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for Sheboygan County.

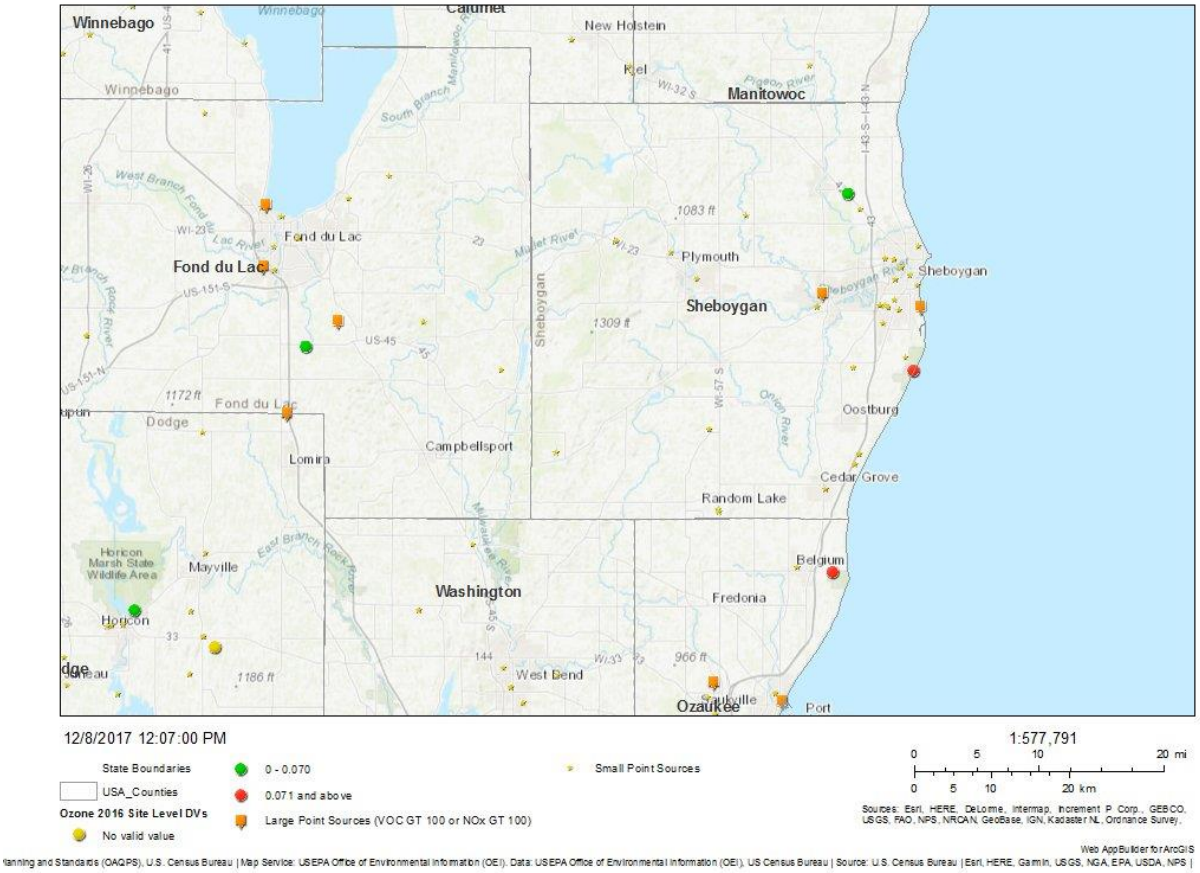
Table 3. Total County-Level NO_x and VOC Emissions

County, State	State Recommended Nonattainment?	Total NO_x (tpy)	Total VOC (tpy)
Sheboygan, WI	No*	4,585	3,421

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

In addition to reviewing county-wide emissions of NO_x and VOC in the area of analysis, the EPA also reviewed emissions from point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The locations of the point sources are shown in Figure 3 below.

Figure 3. Point Sources in the Area of Analysis



The EPA's analysis of county-level emissions shows two large point sources in Sheboygan County, which are the Wisconsin Power and Light (WPL)-Edgewater Generating Station and the Bemis Manufacturing Company-Plant B. WPL-Edgewater reported 1,639.74 tons of NO_x and 37.47 tons of VOC emitted in 2014. Bemis-Plant B reported 5.04 tons of NO_x and 183.89 tons of VOC emitted in 2014. The EPA's analysis shows approximately 23 small point sources in Sheboygan County, 18 of which reported NO_x emissions, and all of which reported VOC emissions to the 2014 NEI. These 23 small point sources collectively emitted a reported 166.72 tons of NO_x and 329.64 tons of VOC in 2014. The largest NO_x emitter of these sources, Nemak Gateway Plant, emitted a reported 45.39 tons of NO_x and the largest VOC emitter of these sources, Plymouth Foam Inc., emitted a reported 56.67 tons of VOC in 2014. While the point source precursor emissions in Sheboygan County are not trivial, the NO_x and VOC emissions from the point sources in Sheboygan County, with the exception of WPL-Edgewater, are relatively low, and are concentrated in the central and eastern portion of the county east of I-43 and mostly in the city of Sheboygan.

Population Density and Degree of Urbanization

In this part of the factor analysis, the EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NO_x and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial

development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for the county in the area of analysis. Figure 4 shows the county-level population density map of the area of analysis.

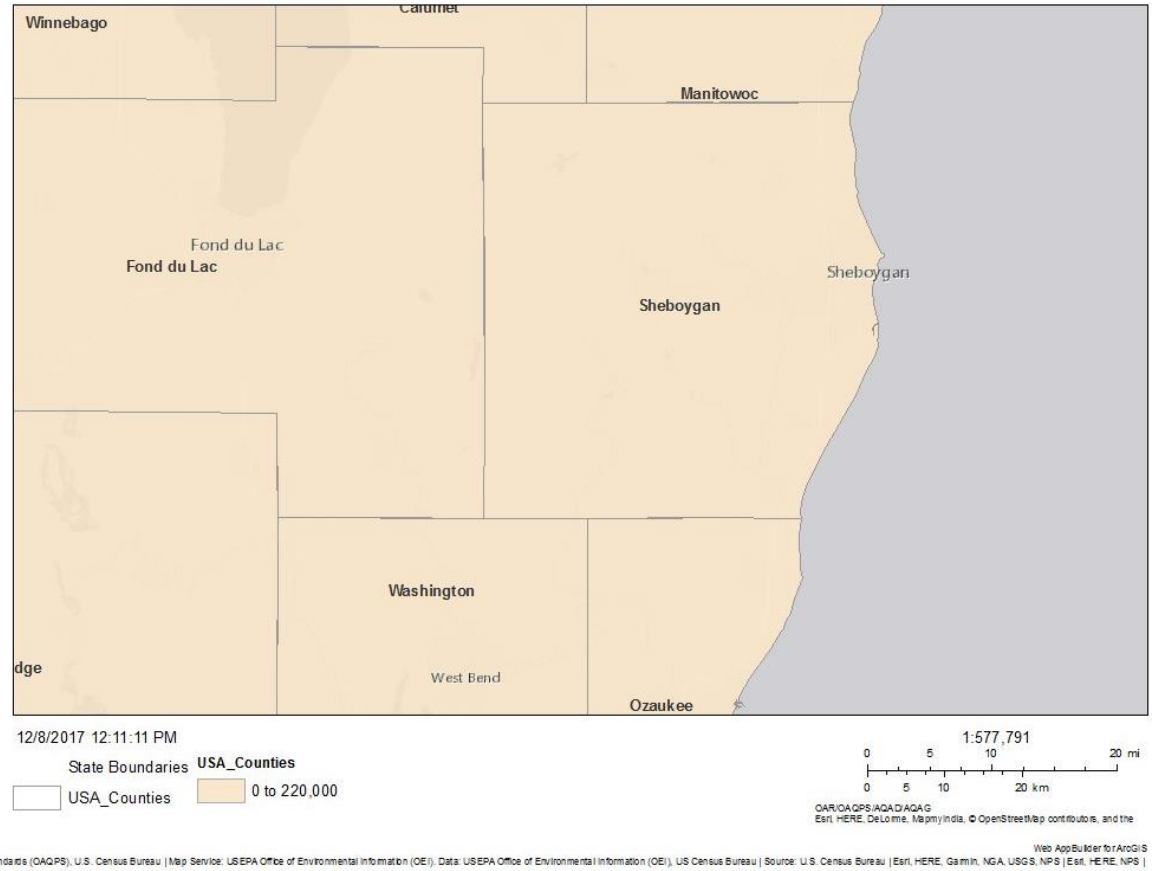
Table 4. Population and Growth

Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.html.

County, State	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Sheboygan, WI	No*	115,507	115,569	226	62	0.1

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

Figure 4. County-Level Population



The population and population density in Sheboygan County are both relatively low. The non-point (area) source emissions reported to the 2014 NEI were 681 tons of NO_x and 1,405 tons of VOC. The on-road emissions reported to the 2014 NEI were 1,384 tons of NO_x and 676 tons of VOC. The non-road emissions reported to the 2014 NEI were 708 tons of NO_x and 775 tons of VOC. These quantities of precursor emissions are not trivial; however, the reported NO_x and VOC emissions from the non-point (area), on-road, and non-road source sectors, which are the source sectors that are often correlated with population and population density, are relatively low in Sheboygan County.

Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for the county in the area of analysis. In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau[13] for the area of analysis. Table 5 shows the traffic and commuting pattern data, including total VMT for the county, number of county residents who work, number of county residents commuting within the county, and the percentage of county residents commuting within the county. The data in Table 5 are 2014 data.

Table 5. Traffic and Commuting Patterns

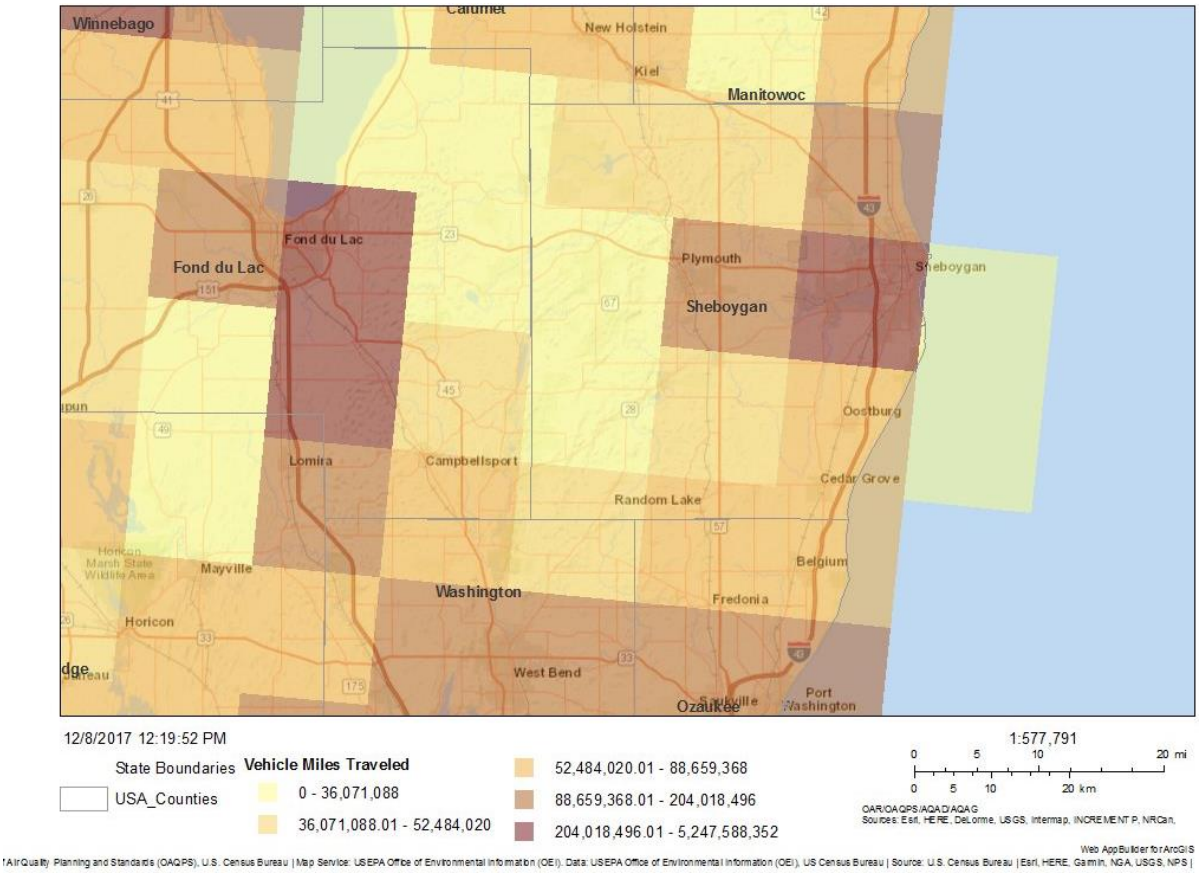
County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number of County Residents Commuting Within the County	Percentage of County Residents Commuting Within the County
Sheboygan, WI	No*	928	58,178	39,848	68%

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

To show traffic and commuting patterns, Figure 5 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

[13] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



Sheboygan County has a relatively low population density and degree of urbanization. The reported vehicle miles traveled (VMT) for 2014 were 928 million miles, and the on-road emissions reported to the 2014 NEI were 1,384 tons of NO_x and 676 tons of VOC. The majority of the VMT are concentrated along the I-43 corridor and in the area around the cities of Sheboygan, Sheboygan Falls, and the village of Kohler, as seen in Figure 5.

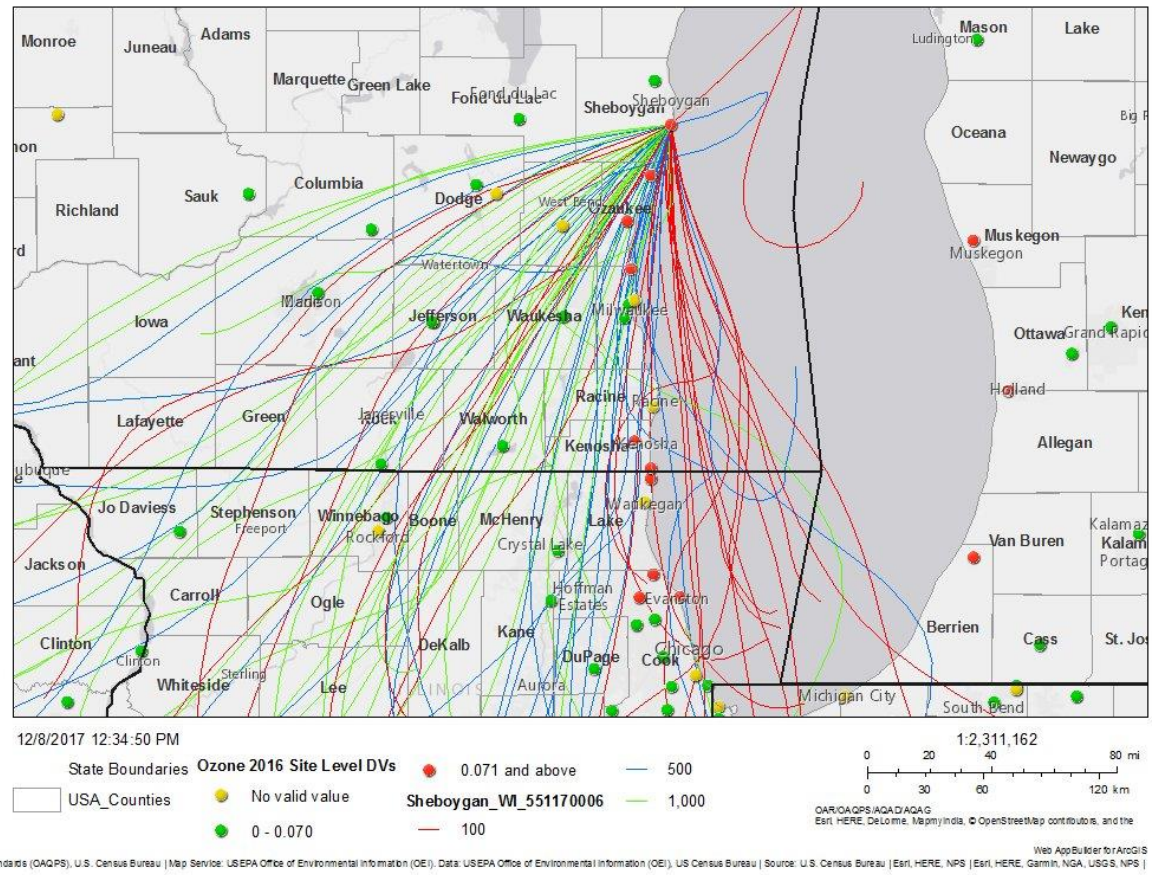
The Sheboygan County emissions and emissions-related data are not trivial. Emission sources, emissions, and population are concentrated near the I-43 corridor and the cities of Sheboygan, Sheboygan Falls, and the village of Kohler. The NO_x and VOC emissions from the various source sectors, including point (with the exception of WPL-Edgewater), non-point (area), on-road mobile, and off-road mobile, in Sheboygan County are relatively low, such that the emissions and emissions-related data factor of the analysis can be ranked relatively low (with the exception of WPL-Edgewater) in terms of potential contribution to ozone formation.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to

determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area, the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figure 6 shows the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8-hour values that exceed the 2015 ozone NAAQS) for the violating monitor.

Figure 6. HYSPLIT Back Trajectories for Violating Monitor.



The eastern boundary of Sheboygan County follows the shoreline of Lake Michigan. Due to its proximity to the lake, Sheboygan County has the potential to be impacted by lake breeze meteorology. The land breeze and lake breeze occur when wind blows from the land and lake, respectively, due to air pressure differences caused by the different heating capacities of the land and the water. Land absorbs and loses solar radiation much faster than water. The land breeze typically occurs in the early morning after air above the relatively warm nighttime water of Lake Michigan heats and rises, setting up an area of low pressure which is filled by the cooler air from over the land. The lake breeze typically occurs in the afternoon when the area of low pressure is created by rising air over the heated land, creating winds off the cooler lake. The land/lake breeze is typically more localized than the prevailing (synoptic) winds. Studies indicate the land/lake breeze can trap, stratify, and recirculate polluted air, sometimes in a helical pattern. Daytime inversions can create shallow, stable layers of precursor plumes, which, on warm sunny days, are conducive to ozone formation. The afternoon lake breeze can carry photochemically aged,

ozone-rich air from nearby and upwind plumes, to nearby and downwind areas like Sheboygan County where violations of the ozone standard can be measured particularly along the shoreline. Additionally, large scale, summertime, stagnant high-pressure systems centered to the south and southeast of Lake Michigan have been implicated in high ozone episodes for areas near the shoreline of Lake Michigan. The relative role of each (the land/lake breeze and synoptic flow) is episode-specific and not fully understood.[14, 15, 16, 17, 18]

The HYSPLIT trajectories (Figure 6) indicate that exceedance day air masses generally traveled from the south and southwest prior to being detected at the violating monitor. Many of the lower level trajectories represented by the red lines at 100 meters AGL and the blue lines at 500 m AGL traveled over the eight counties in the Milwaukee CSA as well as over the greater Chicago area, northwest Indiana, and Lake Michigan. The higher-level trajectories represented by the green lines at 1,000 m AGL mainly traveled overland, over the areas mentioned previously. Sheboygan County is downwind of two large CSAs including the Milwaukee-Racine-Waukesha CSA (total 2014 reported CSA NO_x = 51,822 tons, VOC= 49,129 tons) and the Chicago CSA (total 2014 reported CSA NO_x = 274,440 tons, VOC= 206,171 tons) which includes counties in northeast Illinois and northwest Indiana. The HYSPLIT trajectories indicate the exceedance day air masses traveled over these areas to reach the violating monitor in Sheboygan County. Any precursor emissions that flow out from these areas over the lake with the morning land breeze have the potential to photochemically react to form ozone, which has the potential to be transported by the afternoon lake breeze to the violating monitor in Sheboygan County as corroborated by the studies cited above and by the HYSPLIT trajectories shown in Figure 6. The Milwaukee area and the Chicago area are evaluated as separate nonattainment areas since they are part of their own CSAs whereas Sheboygan is not part of a CSA but is its own CBSA.

The HYSPLIT trajectories are just one piece of evidence corroborating the body of scientific literature on the potential for lake breeze meteorology, and lake breeze meteorology combined with synoptic meteorology, to transport photochemically aged, ozone-rich air masses from nearby and upwind areas to nearby and downwind areas near the shoreline of Lake Michigan, such as Sheboygan County, Wisconsin. Evidence of the potential for land/lake breeze and synoptic meteorology to transport ozone to areas along the shoreline of Lake Michigan is documented in the peer-reviewed scientific literature from study data

[14] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[15] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[16] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[17] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[18] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

specific to Lake Michigan collected mostly in the early 1990's.[19, 20, 21, 22, 23] More recent data has also been collected during the 2017 Lake Michigan Ozone Study[24] with similar and more refined results for more recent ozone episodes.[25] It is important to reiterate that the relative role of the land/lake breeze and synoptic flow on ozone transport in the Lake Michigan area is episode-specific and not fully parsed out. Specific details on the factors and mechanisms influencing Lake Michigan ozone are the subject of ongoing study (e.g. changes in precursor mixes, changes in radical concentrations, relative importance of multi-day ozone formation versus same day formation, lake breeze inland penetration distances and vertical mixing, the extent to which shallow inversions above the cool lake water prevent vertical mixing, etc.).[26]

While there are gaps in the peer-reviewed scientific literature regarding lake breeze impacts on ozone production and transport in the Lake Michigan area, Wisconsin has recently been able to conduct an analysis of lake breeze ozone inland penetration distances specific to Sheboygan County. Wisconsin used wind direction data, satellite data, and the ozone data from the two monitors in Sheboygan County to investigate and analyze the local lake breeze ozone inland penetration distances for Sheboygan County. The Sheboygan Kohler Andrae monitor (AQS Site ID 55-117-0006) is located within several hundred feet of the Lake Michigan shoreline, whereas the Sheboygan Haven monitor (AQS Site ID 55-117-0009) is located approximately 3.2 miles from the Lake Michigan shoreline and approximately 10.9 miles north northwest of the Kohler Andrae monitor. Given the relative proximity from the lakeshore, we will sometimes refer to the Sheboygan Kohler Andrae monitor as the "lakeshore monitor" and the Sheboygan Haven monitor as the "inland monitor." The inland monitor began operating in 2014. Therefore, the 2014-2016 design value is the first design value for this monitor, making the data from this monitor a new component of the ozone analysis for Sheboygan County under the 2015 ozone NAAQS relative to previous designations under the previous ozone standards such as the 1997 ozone NAAQS and the 2008 ozone NAAQS.

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[19] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[20] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[21] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[22] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[23] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

[24] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

[25] Abdi-Oskouei, M., G. Carmichael, M. Christiansen, G. Ferrada, B. Roozitalab, N. Sobhani, K. Wade, A. Czarnetzki, R. B. Pierce, T. Wagner, and C. Stanier. Sensitivity of Meteorological Skill to Selection of WRF-Chem Physical Parameterizations and Impact on Ozone Prediction During the Lake Michigan Ozone Study (LMOS), JGR Atmospheres, J. Geophys. Res. Atmos., 125 (2020), Article e2019JD031971, 10.1029/2019jd031971.

[26] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

Wisconsin used these new data to classify days with peak 1-hour ozone concentrations above the 2015 ozone NAAQS of 0.070 ppm (70 ppb) into one of three event types: 1) "Deep" lake breeze, meaning a day on which the lake breeze affected both the lakeshore and inland monitors; 2) "Shallow" lake breeze, meaning a day on which the lake breeze affected the lakeshore but not the inland monitor; and 3) No lake breeze, meaning a day with no apparent lake breeze. Wisconsin was not able to classify some days according to the event types above because of complex patterns. Wisconsin's classification of high ozone days into these categories yielded the distribution of event types shown in Table 6 below.

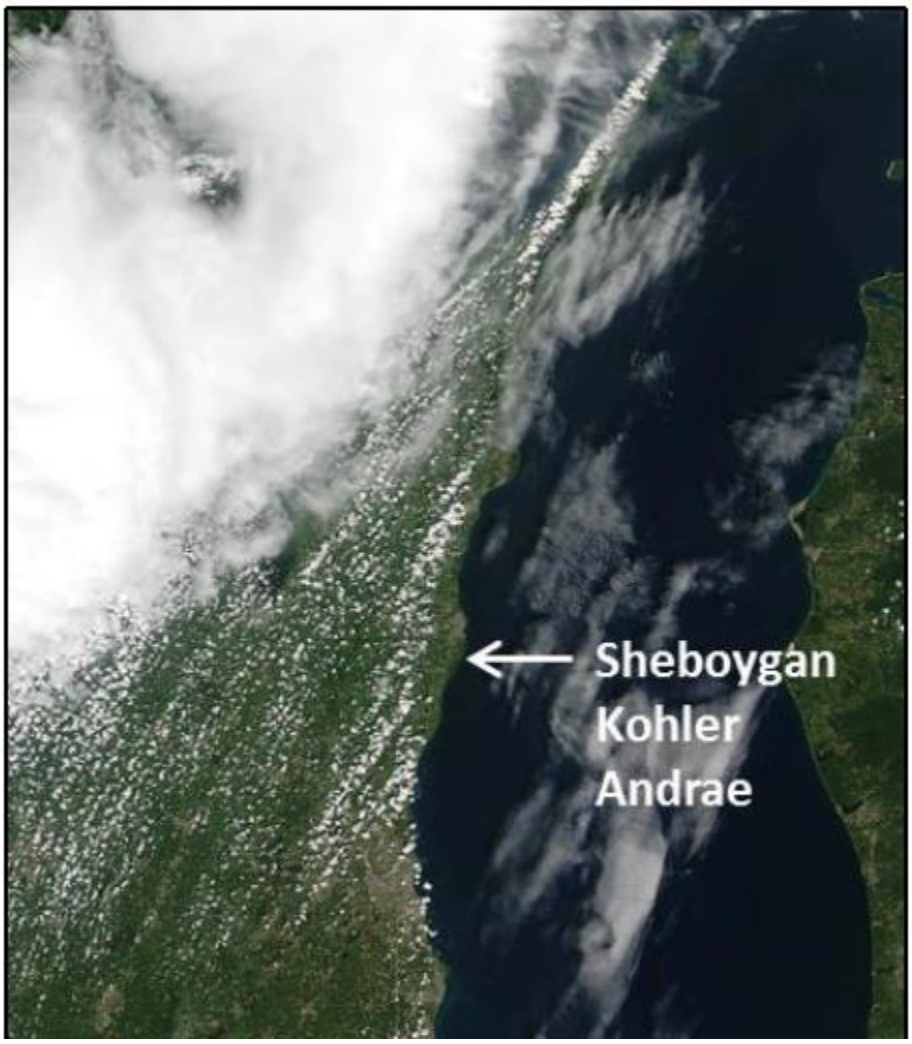
Table 6. Distribution of the Occurrence of Different Types of Lake Breeze Events at the Sheboygan County Monitors*

	Deep lake breeze	Shallow lake breeze	No lake breeze	Unclear	Total days
Sheboygan	33 (67%)	5 (10%)	11 (22%)	8	57 (2014-16)

*The percentage of the classifiable events (which excludes "unclear" events) in each category is shown in parentheses.

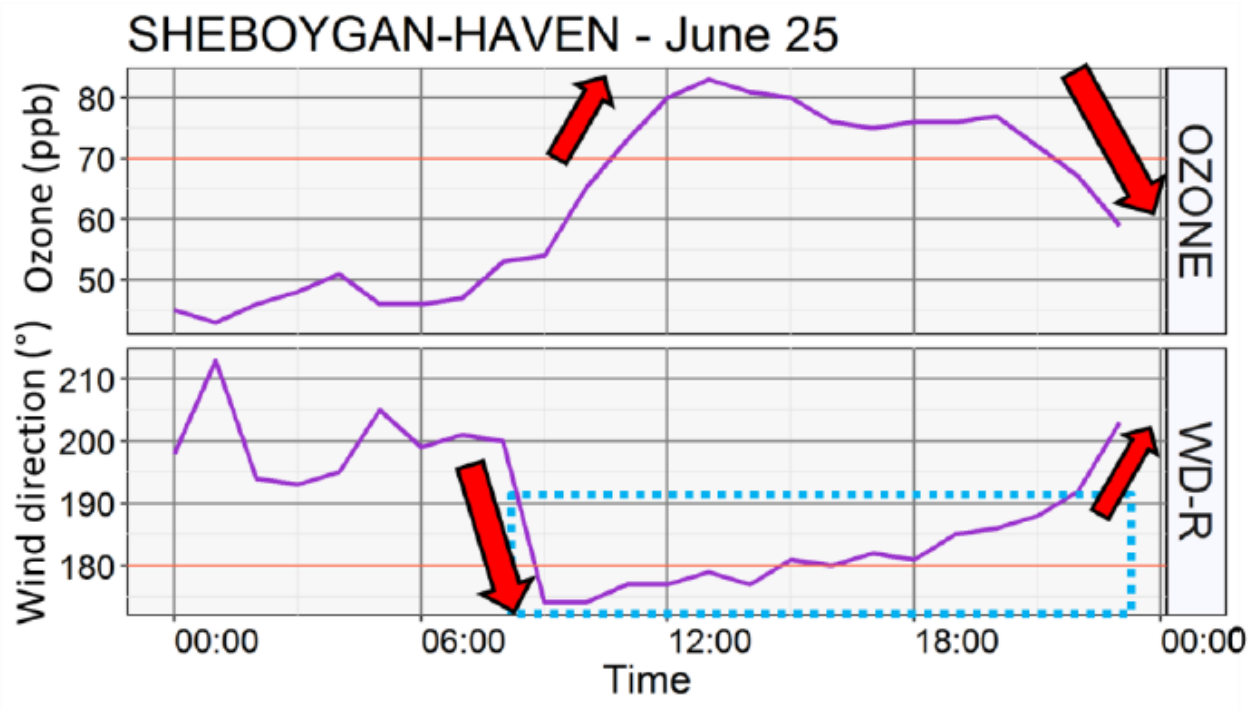
Wisconsin used Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images to confirm lake breeze event types derived from the wind direction data. The MODIS satellite passes over the Lake Michigan region around 2:30 pm daily and collects visual images of the landscape. On days with a lake breeze and light cloud cover, lake breeze "fronts" can be seen as the interface between areas of clear skies towards the lake and light cloud cover to the west. The clear area is the area experiencing a lake breeze. On days with heavy cloud cover or no cloud cover, MODIS images cannot identify the presence or absence of a lake breeze front. The MODIS image in Figure 7 provided by Wisconsin shows a lake breeze impacting Sheboygan County. Wisconsin found that days with a shallow lake breeze did not show any obvious lake breeze in the MODIS images. If the lake breeze classification was not conclusive from the wind and MODIS data or if wind data was missing, Wisconsin looked for additional confirmation by examining the synoptic meteorology of that day or wind patterns at nearby airports or air quality monitors.

Figure 7. MODIS Satellite Image for the Afternoon of August 4, 2016, Showing a Lake Breeze at Sheboygan.



Wisconsin found that days with a lake breeze typically begin with winds from the southwest during the early morning hours. Wisconsin observed that these wind directions typically shift abruptly to come from a more southerly or southeasterly direction with this shift typically occurring in the morning at the lakeshore monitor and later in the day at the inland monitor. Wisconsin observed that the lake breeze may occur for anywhere from a few minutes to 15 or more hours. For its classification scheme, Wisconsin only counted as "lake breeze" a wind pattern that held for at least 2-3 hours. Wisconsin observed that at the conclusion of a lake breeze event, winds usually revert to their original southwesterly direction unless the lake breeze event is ended by a synoptic wind shift such as a frontal passage. Figure 8, provided by Wisconsin, shows an example of a lake breeze wind pattern with co-located ozone data from the Sheboygan Haven inland monitor.

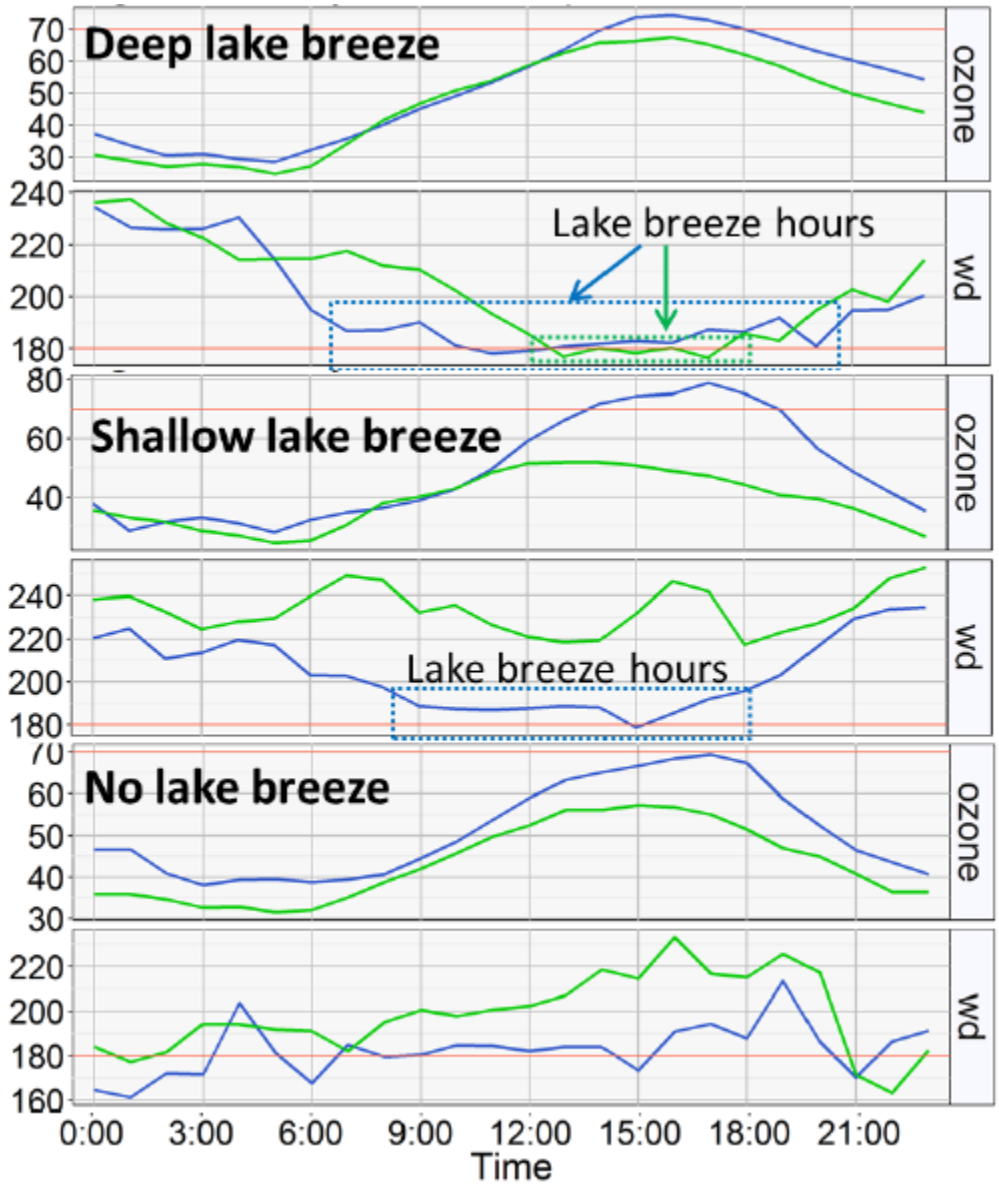
Figure 8. Hourly ozone concentrations (top) and wind directions (bottom) for an example day (June 25, 2016) at the Sheboygan Haven monitor. The red arrows show the onset and cessation of the lake breeze and when ozone concentrations rose and declined. The blue box encloses the hours with a lake breeze.



Wisconsin found that during "deep" lake breeze events, wind shifts occurred at both the inland and lakeshore monitor, whereas on "shallow" lake breeze days, they only occurred at the lakeshore monitor. Such shifts were absent on days without a lake breeze. Figure 9 shows the average (mean) ozone concentration and wind direction profile for each event type. The average ozone concentration profiles were similar for all three classes of events at the lakeshore monitor and inland monitor and follow the typical diurnal pattern associated with ozone formation. The highest mean peak lakeshore ozone concentrations were observed during lake breeze events and the lowest during events without a lake breeze. The greatest ozone concentrations at the inland monitor were observed during the deep lake breeze events. Shallow lake breeze events resulted in relatively low average peak mean inland ozone concentrations when the peak lakeshore concentrations were relatively high. Wisconsin reasoned that during deep lake breeze events, the lower ozone concentrations at the inland monitor likely resulted from dilution of ozone-rich air via mixing with less ozone-rich overlying air as the air moved inland from the lakeshore. This reasoning is consistent with the conceptual model of Lake Michigan ozone formation and transport developed by Dye et al. as a result of the aircraft and ground-based monitoring data collected during several high ozone episodes which occurred over the course of the Lake Michigan ozone study during the summer of 1991. Dye et al. indicate that when ozone-rich air from over the lake flowed downwind to onshore locations, air with the highest ozone concentrations mixed down to the surface first, causing the highest ozone observations along the shoreline. Eventually air from higher altitudes mixed down to the surface farther inland, diluting the overall ozone mixing ratios.[27]

[27] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

Figure 9. Plots of mean hourly ozone concentrations (in ppb) and wind direction ("wd", in degrees) for Sheboygan County monitors for high ozone episodes with a deep lake breeze (top), a shallow lake breeze (middle), and no lake breeze (bottom). Values for the lakeshore monitor are shown in blue and those for the inland monitor in green.



Details of the various factors regarding how emissions and local lake breezes (alone or combined with synoptic-scale meteorology) influence ozone production and transport around Lake Michigan are episode-specific. There are gaps in the peer-reviewed scientific literature on this topic. However, the basic concepts of lake breeze meteorology and its potential to influence ozone production and transport are understood well enough to weight the meteorology factor relatively high given the above analysis. The peer-reviewed results from the Lake Michigan-specific ozone studies, the HYSPLIT trajectories presented here, and Wisconsin's lake breeze ozone inland penetration distance analysis, which relies on the ozone data from the new inland monitor, without which this analysis would not have been possible, provide

evidence that meteorology plays a role in ozone production and transport to this area. Therefore, this factor can be weighted relatively high in terms of potential contribution to ozone formation with respect to this area.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA uses geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

Sheboygan County does not have any geographical or topographical features significantly limiting air pollution transport within its airshed. The eastern boundary of Sheboygan County follows the shoreline of Lake Michigan. As described under Factor 3: Meteorology, areas geographically located along land-water interfaces, such as Sheboygan County on Lake Michigan, can be impacted by lake breeze meteorology which has the potential to transport photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind areas.

Factor 5: Jurisdictional Boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the Sheboygan County nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the designated areas.

The respective locations of the violating lakeshore monitor and the attaining inland monitor in Sheboygan County and Wisconsin's lake breeze ozone inland penetration distance analysis, which relies on the ozone data from the new inland monitor, are described in the factor analysis above and provide information suggesting that the spatial extent of the violating area is east of the attaining monitor in Sheboygan County. While more monitors would be needed to verify if this is true for the entire north-to-south length of Sheboygan County, the EPA has determined that the above analysis is sufficient for estimating the nonattainment boundary described as follows. The EPA delineated the nonattainment area boundary using roadways and excluded the attaining monitor (which is approximately 3.2 miles inland from the

lakeshore) but included the land area at least as far inland as 3.2 miles from the shoreline (in some cases more than 3.2 miles inland given the location of existing roadways) over the length of the county in an effort to conservatively encompass the geographic extent of the nonattainment area. The EPA's nonattainment boundary for the Sheboygan County area for the 2015 ozone NAAQS is a portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW.

Additional Information

Wisconsin provided a summary of a zero-out photochemical modeling scenario in which Sheboygan County emissions were removed or "zeroed out" relative to a modeling scenario in which the emissions were not zeroed-out. Wisconsin indicated resulting design values were not significantly different between the two modeling scenarios, which suggests that, Sheboygan County does not substantially contribute to its local ozone violations for the particular time-period and associated meteorological conditions simulated at that model resolution (12km). This piece of information further supports that the prior determination mentioned above that emissions and emissions-related for this area of analysis, while not trivial, can be weighted relatively low, particularly in light of the meteorology factor, which can be weighted relatively high, particularly including the lake breeze inland penetration distance analysis relative to the two monitors in the area of analysis.

Conclusion for Sheboygan County Area

The EPA must designate as nonattainment any area that violates the NAAQS. Since Sheboygan County has a monitor in violation of the 2015 ozone NAAQS, a portion of this county is included in the nonattainment area based on the air quality data factor. The remaining factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor. The emissions data and emissions-related data factor analysis including information about population density, degree of urbanization, traffic, and vehicle miles traveled for Sheboygan County indicates that overall ozone precursor emissions from sources in Sheboygan County (total 2014 reported NO_x = 4,585 tons, VOC= 3,421 tons) are relatively low albeit non-trivial and are mainly concentrated in a portion of the county east of I-43 including the cities of Sheboygan, Sheboygan Falls, and the village of Kohler. This portion of the county is also the portion of the county in which the violating monitor is located. This portion of the county is also the portion of the county in which the largest NO_x emitting point source, WPL-Edgewater, is located.

The peer-reviewed scientific literature, the HYSPLIT trajectories, and Wisconsin's lake breeze ozone inland penetration distance analysis indicate that lake breeze meteorology can influence ozone transport to Sheboygan County. The HYSPLIT trajectories indicate that the exceedance day air masses traveled over the Milwaukee and Chicago areas and Lake Michigan to reach the violating monitor in Sheboygan County. The peer-reviewed scientific literature indicates that precursor emissions have the potential to flow out over the lake with the morning land breeze, photochemically react to form high concentrations of ozone in a shallow, stable, inversion layer over the lake, and be transported back toward land by the

afternoon lake breeze toward nearby and downwind areas such as the location of the violating monitor in Sheboygan County.

The EPA must designate as nonattainment any nearby areas that contribute to the violation in the violating area. Sheboygan County is immediately downwind of the Milwaukee-Racine-Waukesha CSA (total 2014 reported CSA NO_x = 51,822 tons, VOC= 49,129 tons) and is also downwind of the Chicago CSA (total 2014 reported CSA NO_x = 274,440 tons, VOC= 206,171 tons) which includes counties in northeast Illinois and northwest Indiana. While the Milwaukee area is immediately upwind and adjacent to Sheboygan County, it is being evaluated as a separate nonattainment area since, like Chicago, it is part of a separate CSA, whereas Sheboygan County is not part of a CSA but is its own CBSA. As mentioned previously, Wisconsin provided zero-out modeling results indicating for the time period modeled, Sheboygan County is not likely to substantially contribute to its own ozone violations. However, to the extent any contribution comes from within Sheboygan itself, that contribution would be largely captured by the nonattainment area boundary. The boundary captures 95% of the 2014 reported Sheboygan County point source NO_x emissions. These point source NO_x emissions (which do not include area, on-road, and off-road mobile sources of emissions) are 38% of the total county NO_x emissions. This analysis shows that only 41% of the 2014 reported Sheboygan County point source VOC emissions are captured within the nonattainment area boundary. These point source VOC emissions (which do not include area, on-road, and off-road mobile sources of emissions) are only 7% of the total county VOC emissions. EPA study results suggest that NO_x may be the more important ozone precursor relative to VOC in this region of the United States.[28] Therefore, given the factor analysis which weighted the emissions and emissions-related data relatively low and the meteorology relatively high, particularly including Wisconsin's lake breeze inland penetration distance analysis with respect to the violating monitor and the attaining monitor in Sheboygan County, the EPA has determined that it is reasonable to exclude the portion of the county west of the final nonattainment area.

Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Sheboygan County to be 2.9 miles from the lakeshore. Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area

[28] Supplemental Information for Ozone Advance Areas Based On Pre-Existing National Modeling Analyses EPA Office of Air Quality Planning and Standards, Air Quality Modeling Group May 2017. https://www.epa.gov/sites/production/files/2017-05/documents/national_modeling.advance.may_2017.pdf Figures 1 and 3 in this document show maps of July 2011 modeled monthly maximum daily 8-hour ozone average (MDA8) changes with 50% VOC and 50% NOx across-the-board cuts, nationally. These results show that VOC reductions have some impact on ozone levels for the portion of the country in which Sheboygan County, Wisconsin, is located but that NOx reductions are expected to have larger impacts. This modeling is limited in that it only looks at one month and is thus not directly comparable to the design value calculated over 3 years. However, it is indicative that NOx reductions are likely to be more effective than VOC reductions for the portion of the country in which Sheboygan County, Wisconsin, is located but that VOC reductions may still have some impact.

designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation of attainment. EPA finds Wisconsin's methodology for estimating this to be fundamentally unsupported as explained in the Response to Comments associated with this action.

Historically, the EPA has designated the entirety of Sheboygan County as nonattainment under previous ozone standards including the 1997 ozone NAAQS and the 2008 ozone NAAQS due to the violating lakeshore monitor. However, in 2014 Wisconsin began operating the Sheboygan Haven (3.2 miles inland) monitor, which is currently showing attainment. The 2014-2016 design value is the first design value for this monitor, making the data from this monitor a new component of the ozone analysis for Sheboygan County with respect to the 2015 ozone NAAQS designations as opposed to designations under the previous ozone standards for which ozone data from this new inland monitor was not available. The EPA does not consider eliminating geographic areas with attaining monitors from CSA's or CBSA's with violating monitors for nonattainment designations purposes on the basis of the monitoring data alone. The EPA must consider the monitoring data in conjunction with other relevant factors, including the emissions and meteorological data as a basis for excluding a portion of a CSA or CBSA, or, in this case, a portion of the county from a nonattainment area. The HYSPLIT trajectories indicate that exceedance day air masses traveled over the Milwaukee and Chicago areas and Lake Michigan. The peer-reviewed scientific literature indicates that areas along the shoreline of Lake Michigan, such as Sheboygan County, can be impacted by land/lake breeze-related ozone production and transport. Wisconsin's lake breeze ozone inland penetration distance analysis, which would not have been possible without the new inland monitor, indicates that ozone measurements in Sheboygan County have a relationship with the lake breeze observations in Sheboygan County. These factors taken altogether enable the EPA to consider Wisconsin's request for a smaller geographic extent for this nonattainment area rather than reiterate the historical nonattainment area boundary which included the entirety of Sheboygan county.

The factor analysis above suggests that Sheboygan County is impacted by ozone transport from nearby areas, like the Milwaukee area, which is immediately upwind and adjacent to Sheboygan County, and from areas farther upwind like the Chicago area, and that ozone production from precursor pollutants from these areas and subsequent downwind transport can be exacerbated by the lake breeze meteorology. The meteorology factor in conjunction with the information from the inland monitor, which is attaining the 2015 ozone NAAQS, indicate that the spatial extent of the violating area is not likely to extend beyond the location of the attaining monitor which is 3.2 miles inland from the lakeshore, however as stated above, more monitors would be needed to verify if this is true for the entire north-to-south length of Sheboygan County. Therefore, in light of Wisconsin's April 2017 and February 2018 recommendation that if EPA designates the area as nonattainment due to the violating monitor that EPA minimize the extent of the area included in the nonattainment area boundary, the EPA has delineated a boundary using jurisdictional roadways which is approximately 3.2 miles inland from the lakeshore. The EPA delineated the nonattainment area boundary using roadways and excluded the attaining monitor (which is approximately 3.2 miles inland from the lakeshore) but included the land area at least as far inland as 3.2 miles from the shoreline (in some cases slightly more than 3.2 miles inland given the location of existing roadways) over the length of the county. The EPA's nonattainment boundary for the Sheboygan County area for the 2015 ozone NAAQS is a portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y

which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW.

Based on the assessment of factors described above, the EPA has concluded that this portion of Sheboygan County meets the CAA criteria for inclusion in the Sheboygan County nonattainment area. This boundary is different from the boundary for both the 1997 ozone NAAQS and the 2008 ozone NAAQS. For purposes of both the 1997 ozone NAAQS and the 2008 ozone NAAQS, the entirety of Sheboygan County was designated nonattainment. However, due to new information from a second ozone monitor in Sheboygan County coupled with a review of existing information on lake breeze meteorology including a recent ozone inland penetration distance analysis submitted by Wisconsin (all of which are discussed in detail above) and taken together in the context of the other factors in the five-factor weight-of-evidence analysis, the EPA's nonattainment boundary for the Sheboygan County area for the 2015 ozone NAAQS is a portion of Sheboygan County inclusive and east of the following roadways with the boundary starting from north to south: Union Road which turns into County Road Y which turns into Highland Drive, to Lower Road which turns into Monroe Street, to Broadway/Main Street to Highway 32 which turns into Giddings Avenue to County Road W to County Road KW.

3.3 Technical Analysis for the Manitowoc County Area

This technical analysis identifies the area with a monitor that violates the 2015 ozone NAAQS. It also provides EPA's evaluation of this area and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitor in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA used the 2016 certified data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA Ozone Designations Guidance and Data web page).[29] In addition, the EPA considered the data or information provided to the EPA by states or tribes.

The area of analysis was Manitowoc County, which is not part of a CSA and which is its own CBSA.

The five factors recommended in the EPA's guidance are:

1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

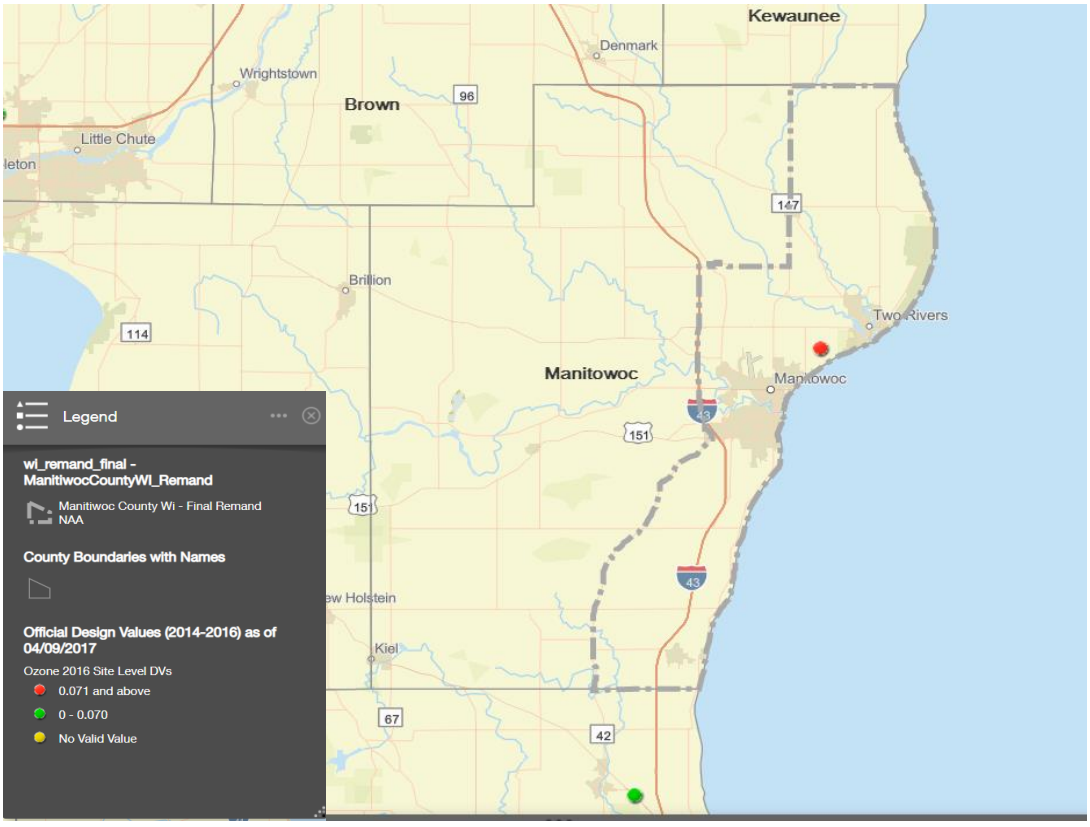
[29] The EPA's Ozone Designations Guidance and Data web page can be found at *https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.*

Figure 1 is a map of the EPA's nonattainment boundary for the Manitowoc County area. The map shows the location of the ambient air quality monitors, county, and other jurisdictional boundaries.

For purposes of the 1997 ozone NAAQS, the entirety of Manitowoc County was designated nonattainment, since the Manitowoc County monitor was violating the 1997 standard at the time of designation. For the purposes of the 2008 ozone NAAQS, Manitowoc County was designated as unclassifiable/attainment, since the Manitowoc County monitor was attaining the 2008 standard at the time of designation.

The EPA's nonattainment boundary for the Manitowoc County area for the 2015 ozone NAAQS is the portion of the county inclusive and east of the following roadways with the boundary starting from north to south: County Road B which turns into South State Street to County Road V which turns into Forest Home Drive to South Packer Drive to West Hillcrest Road to Highway 43 to West Custer Street to Dufek Drive which turns into Highway 42. This boundary is different from the boundary for the 1997 ozone NAAQS, which consisted of the entirety of Manitowoc County. This is primarily due to new information from a second ozone monitor located farther inland in a neighboring county and an accompanying lake breeze ozone inland penetration distance analysis submitted by Wisconsin, both of which are discussed in more detail below in the context of the five-factor weight-of-evidence analysis.

Figure 1. EPA's Nonattainment Boundary for the Manitowoc County Area



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Manitowoc County has a monitor in violation of the 2015 ozone NAAQS, therefore a portion of this county containing the violating monitor is included in the nonattainment area. The following sections describe the five-factor analysis. While the factors are presented individually, they are not independent. The five-factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values in ppm for the air quality monitor in the Manitowoc County area based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[30] The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.[31] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[32] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the 2016 design values violate the NAAQS and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are operated in accordance with 40 CFR part 58, appendices A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the

[30] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.

[31] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.

[32] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*

NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

There is one monitor located in Manitowoc County. The 2016 design value for the monitor is shown in Table 2.

Table 2. Air Quality Data (all values in ppm).

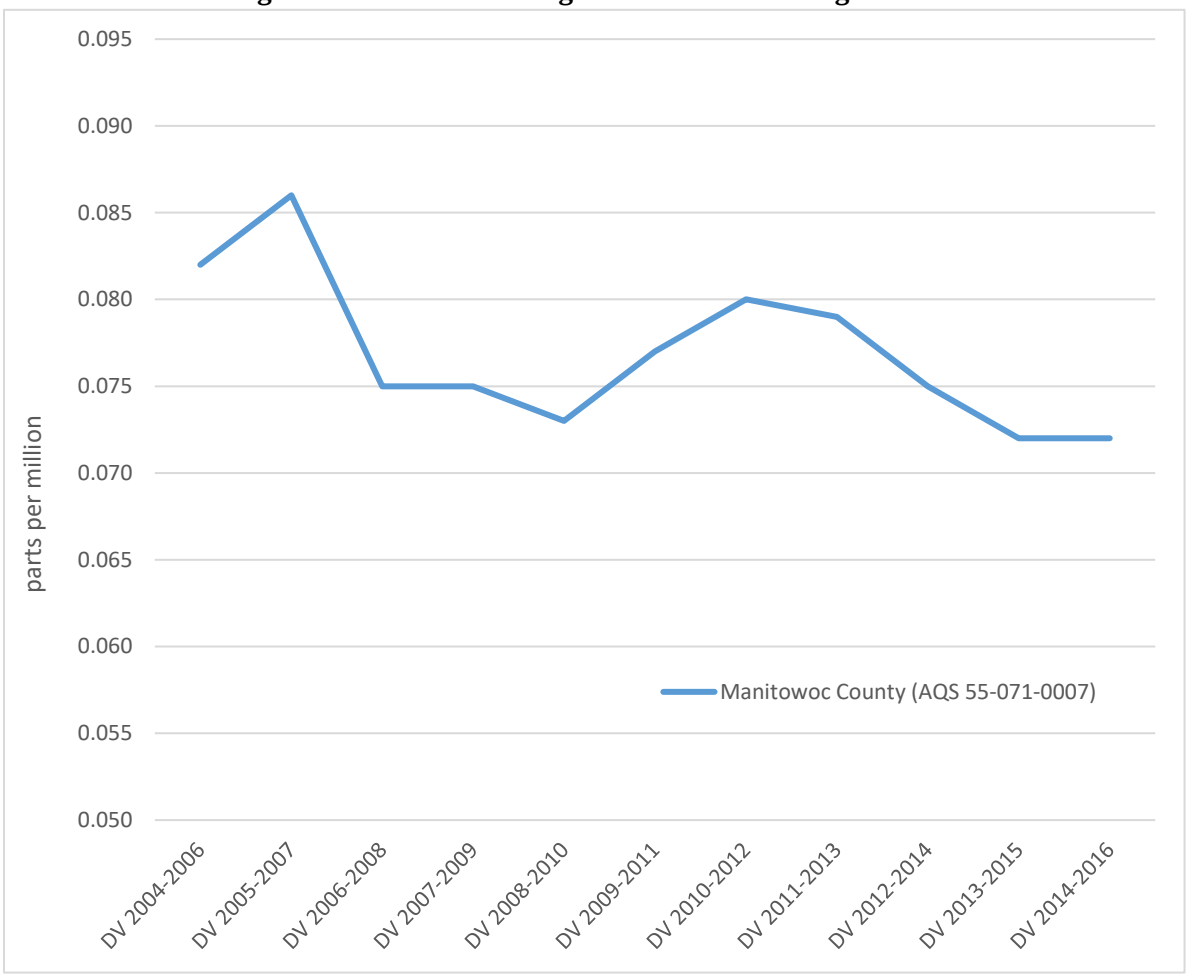
County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Manitowoc, WI	No	55-071-0007	**0.072***	0.066	0.077	0.074

* Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Manitowoc County to be 2.9 miles from the lakeshore Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation of attainment. EPA finds Wisconsin's methodology for this estimate to be fundamentally unsupported as explained in the Response to Comments associated with this action.

Manitowoc County shows a violation of the 2015 ozone NAAQS, therefore a portion of this county containing the violating monitor is included in EPA's nonattainment area.

Figure 1, shown previously, identifies the Manitowoc County nonattainment area and the violating monitor. Table 2 identifies the 2016 design value for the monitor in the area of analysis and Figure 2 shows the historical trend of design values for the violating monitor. As indicated on the map, there is one violating monitor that is located in the northeastern portion of Manitowoc County approximately 0.8 miles from the shoreline of Lake Michigan. There are three monitors to the north and northwest of the Manitowoc County CBSA, including one in Kewaunee County near the shoreline of Lake Michigan, one in Brown County, Wisconsin, and one in Outagamie County, Wisconsin, that are not violating for the 2014-2016 time period. There are two monitors to the southwest of the Manitowoc County CBSA, including one in Fond du Lac County and one in Dodge County, Wisconsin, that are not violating for the 2014-2016 time period. There are two monitors to the south of the Manitowoc County CBSA in Sheboygan County, one that is not violating for the 2014-2016 time period and one that is violating for the 2014-2016 time period, but this area will be addressed separately, since Sheboygan County is its own CBSA-Metropolitan Statistical Area. As shown in Figure 2, the Manitowoc County monitor has historically high ozone design values, which have been generally decreasing over time.

Figure 2. Three-Year Design Values for Violating Monitor



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Manitowoc County has a monitor in violation of the 2015 ozone NAAQS, therefore a portion of this county containing the violating monitor is included in EPA's nonattainment area based on the air quality data factor.

Factor 2: Emissions and Emissions-Related Data

As mentioned previously, the presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA evaluated ozone precursor emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOC) and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For each county in the area of analysis, the EPA examined the magnitude of large sources (NO_x or VOC emissions greater than 100 tons per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 3 provides a county-level emissions summary of NO_x and VOC (given in tons per year (tpy)) for Manitowoc County.

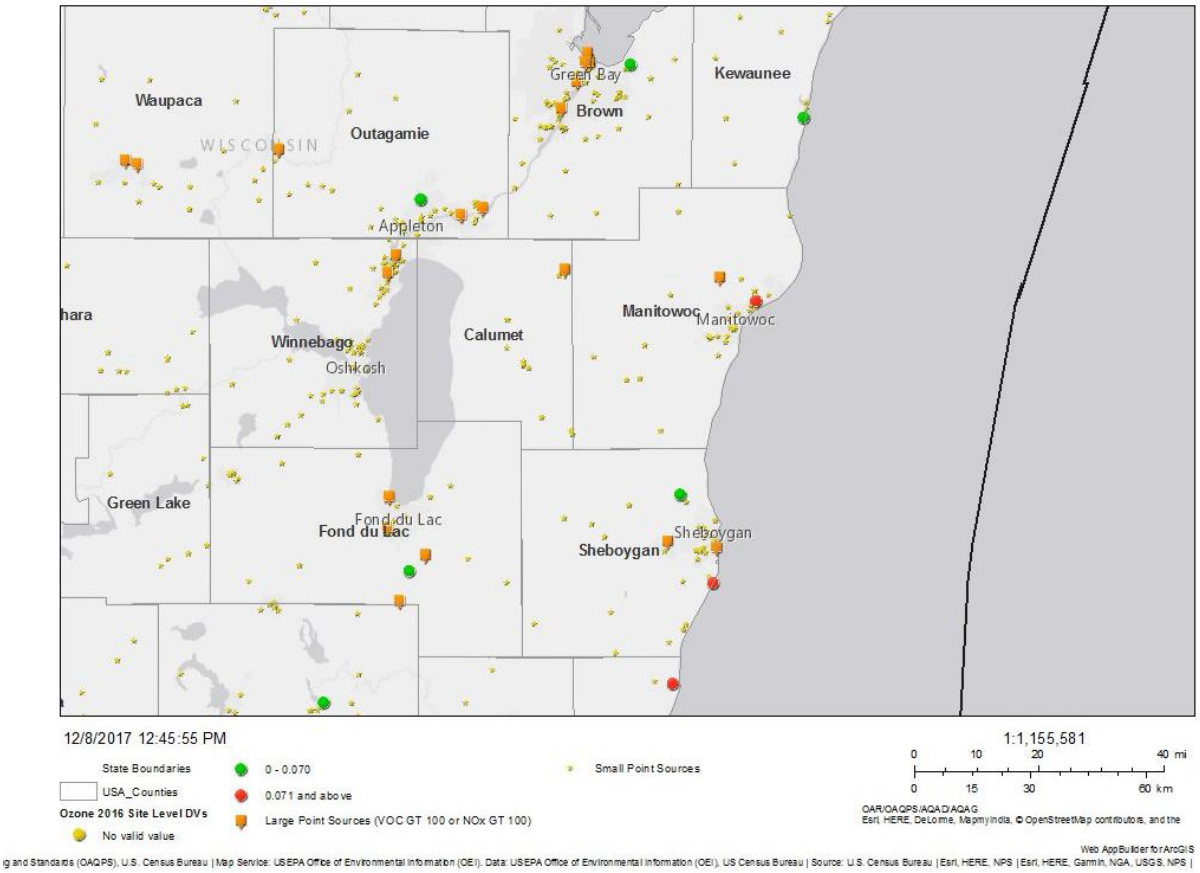
Table 3. Total County-Level NO_x and VOC Emissions

County, State	State Recommended Nonattainment?	Total NO_x (tpy)	Total VOC (tpy)
Manitowoc, WI	No*	3,253	2,812

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

In addition to reviewing county-wide emissions of NO_x and VOC, the EPA also reviewed emissions from point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The locations of the point sources are shown in Figure 3 below.

Figure 3. Point Sources in the Area of Analysis



The EPA's analysis of county-level emissions shows one large point source in Manitowoc County, which is the Carmeuse Lime and Stone-Rockwell Operation. This facility is within the partial county nonattainment area boundary and reported 423.42 tons of NO_x (13% of the total NOx emission within the County) and 0.10 tons of VOC in 2014. The EPA's analysis showed approximately 27 small point sources in Manitowoc County, 23 of which reported NO_x emissions and all of which reported VOC emissions to the 2014 NEI. These 27 small point sources collectively emitted a reported 409.49 tons of NO_x and 467.17 tons of VOC in 2014. The largest NO_x emitter of these sources, Manitowoc Public Utilities, emitted a reported 74.71 tons of NO_x and the largest VOC emitter of these sources, Broadwind Towers, emitted a reported 76.57 tons of VOC in 2014. While the point source precursor emissions in Manitowoc County are not trivial, the NO_x and VOC emissions from the point sources in Manitowoc County, with the exception of the Carmeuse Lime and Stone-Rockwell Operation, are relatively low, and are concentrated in the east central portion of the county in and around the city of Manitowoc.

Population density and degree of urbanization

In this part of the factor analysis, the EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NO_x and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may

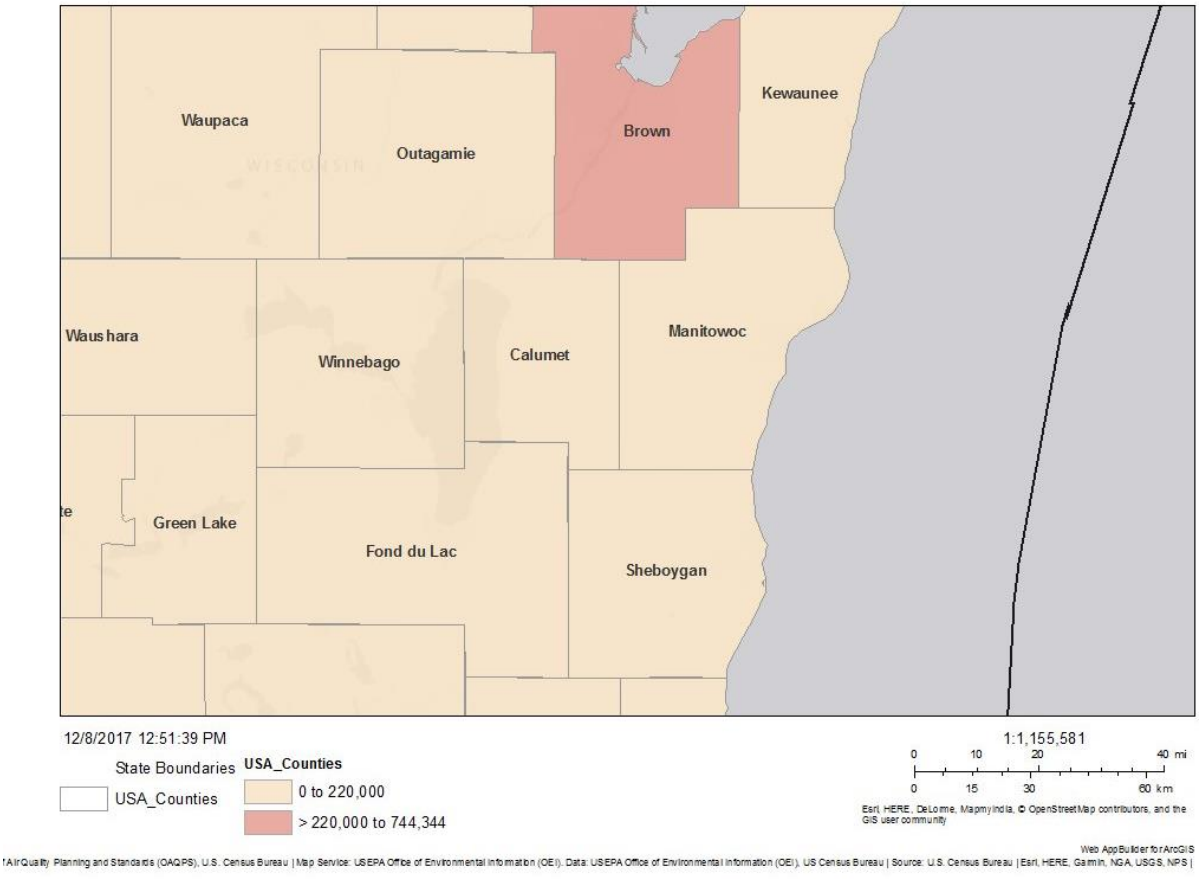
contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for Manitowoc County. Figure 4 shows the county-level population density map of the area of analysis.

Table 4. Population and Growth.
Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.html.

County, State	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Manitowoc, WI	No*	81,442	79,806	135	1,636	-2.0

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

Figure 4. County-Level Population



The population and population density in Manitowoc County are both relatively low. The non-point (area) source emissions reported to the 2014 NEI were 508 tons of NO_x and 1,091 tons of VOC. The on-road emissions reported to the 2014 NEI were 1,372 tons of NO_x and 699 tons of VOC. The non-road emissions reported to the 2014 NEI were 539 tons of NO_x and 554 tons of VOC. These quantities of

precursor emissions are not trivial; however, the reported NO_x and VOC emissions from the non-point (area), on-road, and non-road source sectors, which are the source sectors that are often correlated with population and population density, are relatively low in Manitowoc County.

Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for the area of analysis. In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau[33] for the area of analysis. Table 5 shows the traffic and commuting pattern data, including total VMT for the county, number of county residents who work, number of county residents commuting within the county, and the percentage of county residents commuting within the county. The data in Table 5 are 2014 data.

Table 5. Traffic and Commuting Patterns

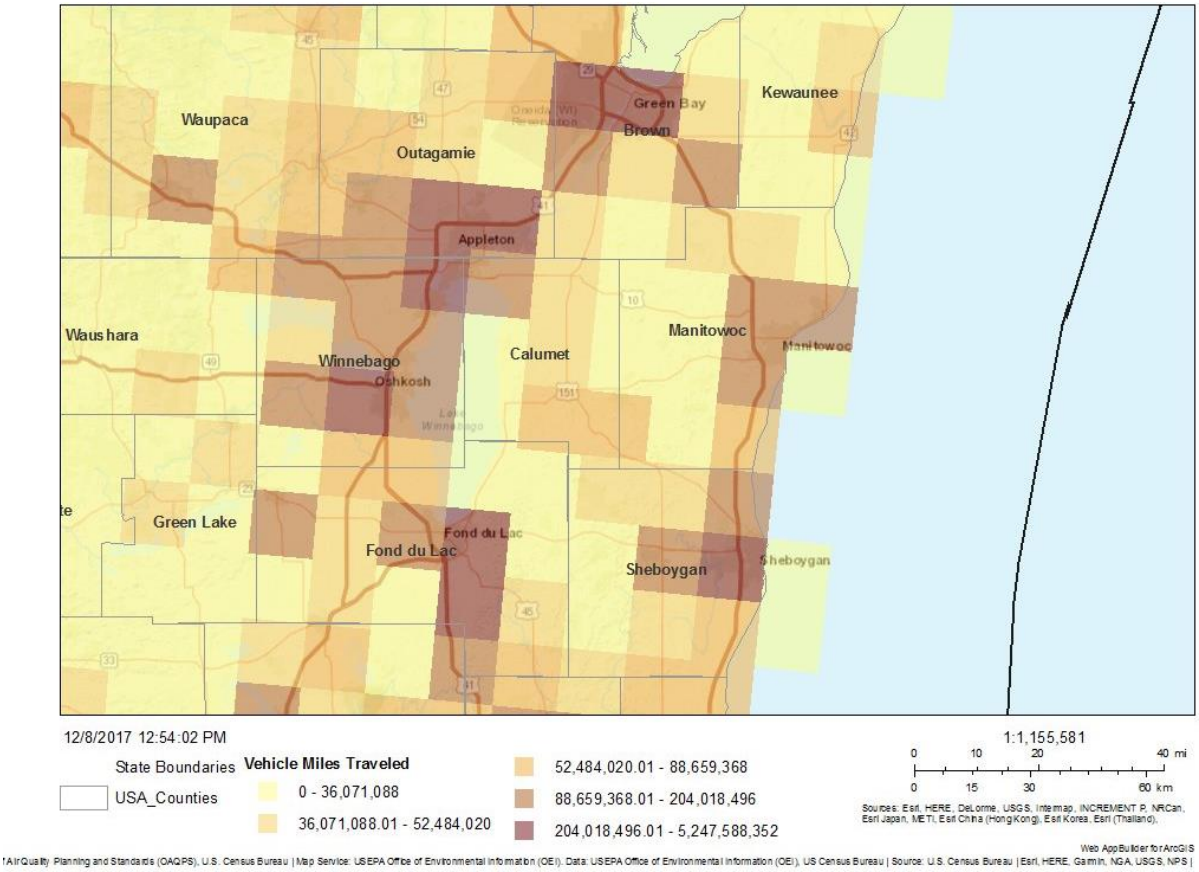
County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number of County Residents Commuting Within the County	Percentage of County Residents Commuting Within the County
Manitowoc, WI	No*	762	41,356	23,181	56%

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

To show traffic and commuting patterns, Figure 5 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

[33] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



Manitowoc County has a relatively low population density and degree of urbanization. The reported vehicle miles traveled (VMT) for 2014 were 762 million miles, and the on-road emissions reported to the 2014 NEI were 1,372 tons of NO_x and 699 tons of VOC. The majority of the VMT are concentrated in the central and eastern portions of the county, particularly around the I-43 corridor and the city of Manitowoc as seen in Figure 5.

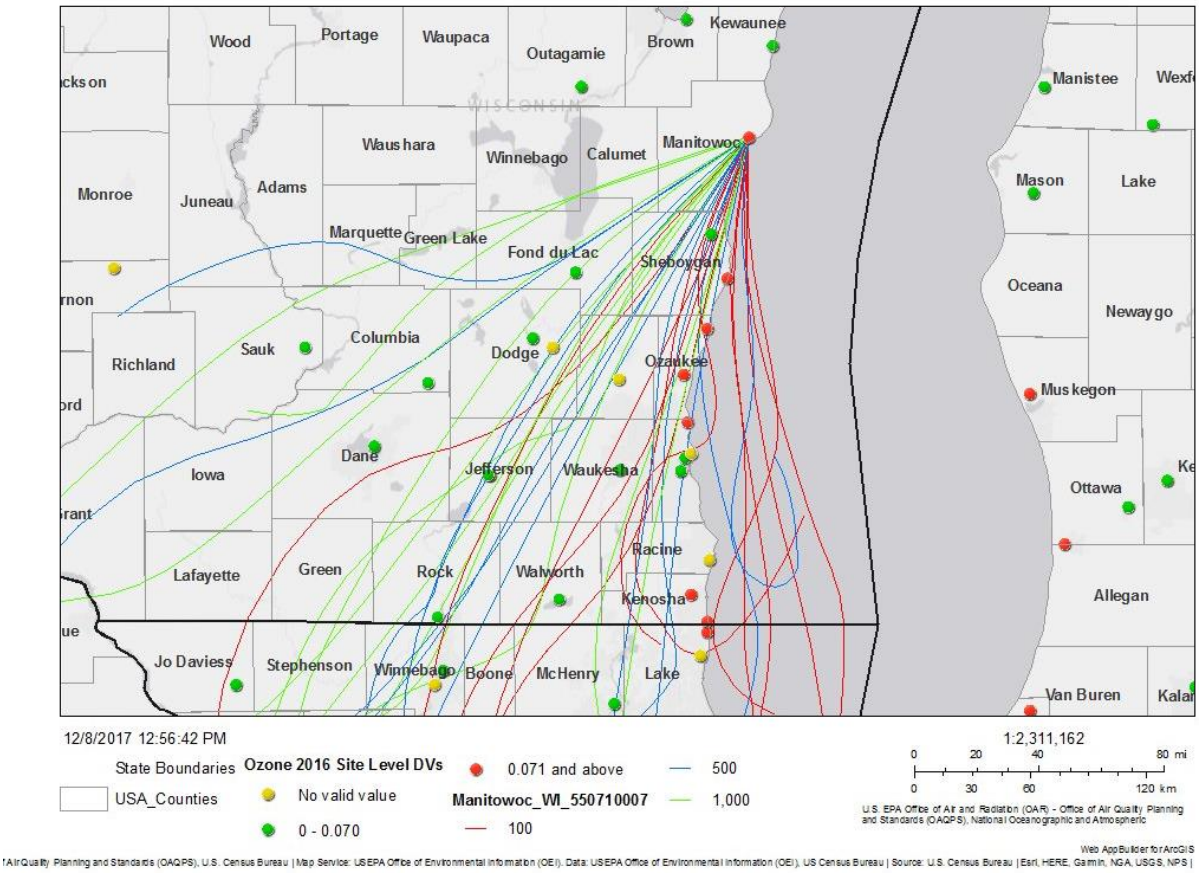
The Manitowoc County emissions and emissions-related data are not trivial. The NO_x and VOC emissions from the various source sectors, including point (with the exception of the Carmeuse Lime and Stone-Rockwell Operation), non-point (area), on-road, and off-road, in Manitowoc County are relatively low, such that the emissions and emissions-related data factor of the analysis can be ranked relatively low in terms of contribution to ozone formation. Emissions sources, emissions, and population are largely concentrated in the eastern portion of the county near the I-43 corridor and the city of Manitowoc.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources

in the area, the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figure 6 shows the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8-hour values that exceed the 2015 ozone NAAQS) for the violating monitor.

Figure 6. HYSPLIT Back Trajectories for Violating Monitor



The eastern boundary of Manitowoc County follows the shoreline of Lake Michigan. Due to its proximity to the lake, Manitowoc County has the potential to be impacted by lake breeze meteorology. The land breeze and lake breeze occur when wind blows from the land and lake, respectively, due to air pressure differences caused by the different heating capacities of the land and the water. Land absorbs and loses solar radiation much faster than water. The land breeze typically occurs in the early morning after air above the relatively warm nighttime water of Lake Michigan heats and rises, setting up an area of low pressure which is filled by the cooler air from over the land. The lake breeze typically occurs in the afternoon when the area of low pressure is created by rising air over the heated land, creating winds off the cooler lake. The land/lake breeze is typically more localized than the prevailing (synoptic) winds. Studies indicate the land/lake breeze can trap, stratify, and recirculate polluted air, sometimes in a helical pattern. Daytime inversions can create shallow, stable layers of precursor plumes, which, on warm sunny days, are conducive to ozone formation. The afternoon lake breeze can carry photochemically aged, ozone-rich air from nearby and upwind plumes, to nearby and downwind areas like Manitowoc County

where violations of the ozone standard can be measured particularly along the shoreline. Additionally, large scale, summertime, stagnant high-pressure systems centered to the south and southeast of Lake Michigan have been implicated in high ozone episodes for areas near the shoreline of Lake Michigan. The relative role of each (the land/lake breeze and synoptic flow) is episode-specific and not fully understood.[34, 35, 36, 37, 38]

The HYSPLIT trajectories (Figure 6) indicate that exceedance day air masses generally traveled from the south and southwest prior to being detected at the violating monitor. Many of the lower level trajectories represented by the red lines at 100 meters AGL traveled over Sheboygan, Ozaukee, Milwaukee, and Waukesha, among other counties, including counties farther south, and over the lake near the shoreline, as did some of mid-level trajectories represented by the blue lines at 500 m AGL. The higher-level trajectories represented by the green lines at 1,000 m AGL traveled over wide swaths of counties to the south and southwest of the violating monitor. Manitowoc County is downwind of Sheboygan County (2014 reported NO_x = 4,585 tons, VOC= 3,421 tons) and two large CSAs including the Milwaukee-Racine-Waukesha CSA (total 2014 reported CSA NO_x = 51,822 tons, VOC= 49,129 tons) and the Chicago CSA (total 2014 reported CSA NO_x = 274,440 tons, VOC= 206,171 tons) which includes counties in northeast Illinois and northwest Indiana. The HYSPLIT trajectories indicate the exceedance day air masses traveled over these areas to reach the violating monitor in Manitowoc County. Any precursor emissions that flow out from these areas over the lake with the morning land breeze have the potential to photochemically react to form ozone, which has the potential to be transported by the afternoon lake breeze to the violating monitor in Manitowoc County as corroborated by the studies cited above and by the HYSPLIT trajectories shown in Figure 6. Sheboygan County, the Milwaukee area, and the Chicago area are each evaluated as separate nonattainment areas since Sheboygan County is not part of a CSA and is its own CBSA and Milwaukee and Chicago are each part of separate CSAs. Manitowoc County is, likewise to Sheboygan County, not part of a CSA and is its own CBSA.

The HYSPLIT trajectories are just one piece of evidence corroborating the body of scientific literature on the potential for lake breeze meteorology, and lake breeze meteorology combined with synoptic meteorology, to transport photochemically aged, ozone-rich air masses from nearby and upwind areas to nearby and downwind areas near the shoreline of Lake Michigan, such as Manitowoc County, Wisconsin. Evidence of the potential for land/lake breeze and synoptic meteorology to transport ozone to areas along the shoreline of Lake Michigan is documented in the peer-reviewed scientific literature from study data

[34] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[35] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[36] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[37] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[38] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

specific to Lake Michigan collected mostly in the early 1990's.[39, 40, 41, 42, 43] More recent data has also been collected during the 2017 Lake Michigan Ozone Study[44] with similar and more refined results for more recent ozone episodes.[45] It is important to reiterate that the relative role of the land/lake breeze and synoptic flow on ozone transport in the Lake Michigan area is episode-specific and not fully parsed out. Specific details on the factors and mechanisms influencing Lake Michigan ozone are the subject of ongoing study (e.g. changes in precursor mixes, changes in radical concentrations, relative importance of multi-day ozone formation versus same day formation, lake breeze inland penetration distances and vertical mixing, the extent to which shallow inversions above the cool lake water prevent vertical mixing, etc.).[46]

While there are gaps in the peer-reviewed scientific literature regarding lake breeze impacts on ozone production and transport in the Lake Michigan area, Wisconsin has recently been able to conduct an analysis of lake breeze ozone inland penetration distances specific to Sheboygan County, which is just south of Manitowoc County. Wisconsin's analysis is explained in detail in Section 3.2 Technical Analysis for the Sheboygan County Area and summarized here. Wisconsin's analysis showed information about the ozone observations at the monitors in Sheboygan County on days with peak 1-hour ozone concentrations above the 2015 ozone NAAQS of 0.070 ppm during three types of events including deep lake breeze, shallow lake breeze, and days with no apparent lake breeze. The average ozone profiles at the Sheboygan County "lakeshore" monitor, which is located within several hundred feet of the Lake Michigan shoreline, and the Sheboygan County "inland" monitor, which is located approximately 3.2 miles from the Lake Michigan shoreline, were similar for each event type and follow the typical diurnal pattern associated with ozone formation. The average ozone profiles were consistently lower for the inland monitor than the lakeshore monitor for all event types for the time of day during which ozone peaked. The average ozone profiles for both monitors were slightly higher for the deep and shallow lake breeze events relative to the days with no apparent lake breeze. The average ozone profiles for both

[39] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[40] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[41] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[42] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[43] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

[44] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

[45] Abdi-Oskouei, M., G. Carmichael, M. Christiansen, G. Ferrada, B. Roozitalab, N. Sobhani, K. Wade, A. Czarnetzki, R. B. Pierce, T. Wagner, and C. Stanier. Sensitivity of Meteorological Skill to Selection of WRF-Chem Physical Parameterizations and Impact on Ozone Prediction During the Lake Michigan Ozone Study (LMOS), JGR Atmospheres, J. Geophys. Res. Atmos., 125 (2020), Article e2019JD031971, 10.1029/2019jd031971.

[46] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

monitors were slightly higher for the days with shallow lake breeze events than the days with deep lake breeze events (Figure 9 in Section 3.2 Technical Analysis for the Sheboygan County Area). Overall, this analysis showed that ozone measurements in Sheboygan County have a relationship with the lake breeze observations in Sheboygan County.

Wisconsin reasoned that during deep lake breeze events, the lower ozone concentrations at the inland monitor likely resulted from dilution of ozone-rich air via mixing with less ozone-rich overlying air as the air moved inland from the lakeshore. This reasoning is consistent with the conceptual model of Lake Michigan ozone formation and transport developed by Dye et al. as a result of the aircraft and ground-based monitoring data collected during several high ozone episodes which occurred over the course of the Lake Michigan ozone study during the summer of 1991. Dye et al. indicate that when ozone-rich air from over the lake flowed downwind to onshore locations, air with the highest ozone concentrations mixed down to the surface first, causing the highest ozone observations along the shoreline. Eventually air from higher altitudes mixed down to the surface farther inland, diluting the overall ozone mixing ratios.[47]

The Sheboygan County inland monitor began operating in 2014. Therefore, the 2014-2016 design value is the first design value for this monitor, making the data from this monitor a new component of the ozone analysis for Sheboygan County under the 2015 ozone NAAQS relative to previous designations under the 1997 ozone NAAQS and the 2008 ozone NAAQS. Wisconsin's analysis provides recent, county-specific evidence that lake breeze meteorology plays a role in ozone production and transport to the Sheboygan County area. Wisconsin's analysis would not have been possible without the new inland ozone monitor in Sheboygan County. Manitowoc County does not have an "inland" ozone monitor. Manitowoc County only has one ozone monitor, which is located approximately 0.9 miles from the Lake Michigan shoreline, and which is approximately 24 miles northeast of the Sheboygan County inland monitor and approximately 33 miles north northeast of the Sheboygan County lakeshore monitor.

Since the Sheboygan County inland monitor has a fully-certified 2016 design value that is attaining the 2015 ozone NAAQS, the EPA was able to use the information from the five-factor analysis to delineate a nonattainment area boundary for Sheboygan County which excludes the attaining inland monitor but includes the violating lakeshore monitor. Although Manitowoc County does not have an "inland" ozone monitor like Sheboygan County, since Manitowoc County is relatively close to Sheboygan County, the analysis of the lake breeze ozone inland penetration distance to the Sheboygan County monitors may be somewhat relevant to Manitowoc County. However, it is important to emphasize that lake breeze ozone events are episode and location specific. For instance, during an air quality study over southwestern Ontario, Canada, Brook et al. observed lake breeze ozone events associated with Lake Erie, Lake Huron, and Lake St. Clair. Median lake breeze inland penetration distances ranged from 45-75 km (approximately 28-47 miles) with a maximum observed distance of 215 km (approximately 134 miles) inland from the Lake Huron shoreline.[48] The Sheboygan County inland monitor located 3.2 miles from the Lake Michigan shoreline has a 2014-2016 design value of 0.069 ppm (just below the 2015 ozone

[47] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.
[48] Brook, J. R., Makar, P.A., Sills D. M. L., Hayden, K. L. and McLaren, R. Exploring the nature of air quality over southwestern Ontario: main findings from the Border Air Quality and Meteorology Study, Atmos. Chem. Phys., 13, 10461–10482, 2013.

NAAQS of 0.070 ppm). This does not necessarily indicate that a hypothetical inland monitor placed 3.2 miles from the Lake Michigan shoreline in Manitowoc County would also have a 2016 design value below the 2015 ozone NAAQS. As mentioned previously, Manitowoc County only has one ozone monitor, which is located approximately 0.9 miles from the Lake Michigan shoreline, and which is approximately 24 miles northeast of the Sheboygan County inland monitor and approximately 33 miles north northeast of the Sheboygan County lakeshore monitor.

Details of the various factors regarding how emissions and local lake breezes (alone or combined with synoptic-scale meteorology) influence ozone production and transport around Lake Michigan are episode-specific. There are gaps in the peer-reviewed scientific literature on this topic. However, the basic concepts of lake breeze meteorology and its potential to influence ozone production and transport are understood well enough to weight the meteorology factor relatively high. The peer-reviewed results from the Lake Michigan-specific ozone studies, the HYSPLIT trajectories presented here, and Wisconsin's Sheboygan County lake breeze ozone inland penetration distance analysis provide evidence that meteorology plays a role in ozone production and transport to the Manitowoc County area and nearby areas such as the Sheboygan County area. Therefore, this factor can be weighted relatively high.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA uses geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

The Manitowoc County area does not have any geographical or topographical features significantly limiting air pollution transport within its airshed. The eastern boundary of Manitowoc County follows the shoreline of Lake Michigan. As described under Factor 3: Meteorology, areas geographically located along land-water interfaces, such as Manitowoc County on Lake Michigan, can be impacted by lake breeze meteorology which has the potential to transport photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind areas.

Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the Manitowoc County nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where

existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the designated areas.

Wisconsin's Sheboygan County lake breeze inland penetration distance analysis described briefly above and in more detail in Section 3.2 Technical Analysis for Sheboygan County suggests that the spatial extent of the violating area for Sheboygan is east of the inland monitor in Sheboygan County, which is located 3.2 miles inland from the lakeshore and which is attaining the 2015 ozone NAAQS. While more monitors would be needed to verify if this is true for the entire north-to-south length of Sheboygan County, the EPA has determined that the available information and data analysis is sufficient for estimating the nonattainment boundary for Sheboygan County. Since Manitowoc County is just north of Sheboygan County, the EPA has determined that the above analysis is also informative for estimating the nonattainment boundary for Manitowoc County. Given the results of the Sheboygan County analysis and including the HYSPLIT trajectory analysis for Manitowoc, it is unlikely that the spatial extent of the violating area in Manitowoc County extends all the way to the western boundary of the county which is approximately 18 miles at its narrowest from the shoreline of Lake Michigan. There is no "inland" monitor in Manitowoc County; thus, there is no information from a second ozone monitor in Manitowoc County to indicate the exact spatial extent of the violating area. However, given the information from the nearby Sheboygan County inland monitor, the EPA delineated the Manitowoc County nonattainment area boundary using roadways but included the land area at least as far inland as 3.2 miles from the shoreline, which is the inland distance at which the attaining monitor in nearby Sheboygan County is located. The EPA delineated the nonattainment area boundary using roadways but included the land area at least as far inland as 3.2 miles from the shoreline (and in most cases more than 3.2 miles inland) over the length of the county in an effort to encompass the geographic extent of the nonattainment area. The EPA's nonattainment boundary for the Manitowoc County area for the 2015 ozone NAAQS is a portion of Manitowoc County inclusive and east of the following roadways with the boundary starting from north to south: County Road B which turns into South State Street to County Road V which turns into Forest Home Drive to South Packer Drive to West Hillcrest Road to Highway 43 to West Custer Street to Dufek Drive which turns into Highway 42.

Conclusion for Manitowoc County Area

The EPA must designate as nonattainment any area that violates the NAAQS. Since Manitowoc County has a monitor in violation of the 2015 ozone NAAQS, a portion of this county is included in the nonattainment area based on the air quality data factor. The remaining factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor. The emissions data and emissions-related data factor analysis including information about population density, degree of urbanization, traffic, and vehicle miles traveled for Manitowoc County indicates that overall ozone precursor emissions (NO_x and VOC) from sources in Manitowoc County (total 2014 reported CSA NO_x = 3,253 tons, VOC= 2,812 tons) are relatively low albeit non-trivial and are mainly concentrated in the east central portion of the county particularly around the I-43 corridor and in and around the city of Manitowoc. This portion of the county is also the portion of the county in which the violating monitor is located. This is also the portion of the county in which the largest

point source, the Carmeuse Lime and Stone-Rockwell Operation (2014 reported NO_x = 423 tons VOC = 0.1 tons), is located.

The peer-reviewed scientific literature, the HYSPLIT trajectories, and Wisconsin's Sheboygan County lake breeze ozone inland penetration distance analysis indicate that lake breeze meteorology can influence ozone transport to Manitowoc County and nearby areas such as the Sheboygan County area. The HYSPLIT trajectories indicate that the exceedance day air masses traveled over Sheboygan County, the Milwaukee and Chicago areas, and Lake Michigan to reach the violating monitor in Manitowoc County. The peer-reviewed scientific literature indicates that precursor emissions have the potential to flow out over the lake with the morning land breeze, photochemically react to form high concentrations of ozone in a shallow, stable, inversion layer over the lake, and be transported back toward land by the afternoon lake breeze toward nearby and downwind areas like the location of the violating monitor in Manitowoc County.

The EPA must designate as nonattainment any nearby areas that contribute to the violation in the violating area. Manitowoc County (total 2014 reported CSA NO_x = 3,253 tons, VOC= 2,812 tons) is immediately downwind of Sheboygan County (total 2014 reported CSA NO_x = 4,585 tons, VOC= 3,421 tons) which is immediately downwind of the Milwaukee-Racine-Waukesha CSA (total 2014 reported CSA NO_x = 51,822 tons, VOC= 49,129 tons) which is immediately downwind of the Chicago CSA (total 2014 reported CSA NO_x = 274,440 tons, VOC= 206,171 tons) which includes counties in northeast Illinois and northwest Indiana. While Sheboygan County and the Milwaukee area are immediately upwind of Manitowoc County, they are each being evaluated as separate nonattainment areas, since Sheboygan County is its own CBSA and the Milwaukee area, like the Chicago area, is part of a separate CSA, whereas Manitowoc County is not part of a CSA but is its own CBSA. To the extent any contribution comes from within Manitowoc County itself, that contribution would be largely captured by the nonattainment area boundary. The boundary captures 86% of the 2014 reported Manitowoc County point source NO_x emissions. These point source NO_x emissions (which do not include area, on-road, and off-road mobile sources of emissions) are 22% of the total county NO_x emissions. This analysis shows that 83% of the 2014 reported Manitowoc County point source VOC emissions are captured within the nonattainment area boundary. These point source VOC emissions (which do not include area, on-road, and off-road mobile sources of emissions) are 14% of the total county VOC emissions. EPA study results suggest that NO_x may be the more important ozone precursor relative to VOC in this region of the United States.[49] Therefore, given the factor analysis which weighted the emissions and emissions-related data relatively low and the meteorology relatively high, particularly including Wisconsin's lake breeze inland

[49] Supplemental Information for Ozone Advance Areas Based On Pre-Existing National Modeling Analyses EPA Office of Air Quality Planning and Standards, Air Quality Modeling Group May 2017. https://www.epa.gov/sites/production/files/2017-05/documents/national_modeling.advance.may_2017.pdf Figures 1 and 3 in this document show maps of July 2011 modeled monthly maximum daily 8-hour ozone average (MDA8) changes with 50% VOC and 50% NOx across-the-board cuts, nationally. These results show that VOC reductions have some impact on ozone levels for the portion of the country in which Sheboygan County, Wisconsin, is located but that NOx reductions are expected to have larger impacts. This modeling is limited in that it only looks at one month and is thus not directly comparable to the design value calculated over 3 years. However, it is indicative that NOx reductions are likely to be more effective than VOC reductions for the portion of the country in which Sheboygan County, Wisconsin, is located but that VOC reductions may still have some impact.

penetration distance analysis with respect to the violating monitor and the attaining monitor in Sheboygan County, which is just south of Manitowoc County, the EPA has determined that it is not unreasonable to exclude the portion of Manitowoc county west of the nonattainment area.

Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Manitowoc County to be 2.9 miles from the lakeshore. Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation. EPA finds Wisconsin's methodology for this estimate to be fundamentally unsupported as explained in the Response to Comments associated with this action.

Historically, the EPA has designated the entirety of Manitowoc County as nonattainment under previous ozone standards such as the 1997 ozone NAAQS due to the violating monitor near the lakeshore. Wisconsin's Sheboygan County lake breeze inland penetration distance analysis described briefly above and in more detail in Section 3.2 Technical Analysis for Sheboygan County suggests that the spatial extent of the violating area for Sheboygan is east of the inland monitor in Sheboygan County, which is located 3.2 miles inland from the lakeshore and which is attaining the 2015 ozone NAAQS. While more monitors would be needed to verify if this is true for the entire north-to-south length of Sheboygan County, the EPA has determined that the available information and data analysis is sufficient for estimating the nonattainment boundary for Sheboygan County. Manitowoc County extends approximately 18 miles at its narrowest width from the shoreline of Lake Michigan to the western boundary of the county. However, since there is no "inland" monitor in Manitowoc County, and thus, there is no information from a second ozone monitor in Manitowoc County to indicate the exact spatial extent of the violating area. However, since Manitowoc County is just north of Sheboygan County, the EPA has determined that the above analysis is also informative for estimating the nonattainment boundary for Manitowoc County. The EPA delineated the Manitowoc County nonattainment area boundary using roadways but included the land area at least as far inland as 3.2 miles from the shoreline, which is the inland distance at which the attaining monitor in nearby Sheboygan County is located.
This portion of Manitowoc County is also the portion of the county in which the violating monitor is located and the portion of the county included in the nonattainment area.

The factor analysis above suggests that Manitowoc County is impacted by ozone transport from nearby areas, like the Milwaukee area, which is upwind and adjacent to Sheboygan County, and from areas farther upwind like the Chicago area, and that ozone production from precursor pollutants from these areas and subsequent downwind transport can be exacerbated by the lake breeze meteorology. The meteorology factor in conjunction with the information associated with the nearby Sheboygan County inland monitor, which is attaining the 2015 ozone NAAQS, indicate that the spatial extent of the violating area is not likely to extend all the way to the western boundary of Manitowoc County which is approximately 18 miles at its narrowest from the shoreline of Lake Michigan. In light of the State's April

2017 recommendation that if EPA designates the area as nonattainment due to the violating monitor that EPA minimize the extent of the area included in the nonattainment area boundary, the EPA delineated the nonattainment area boundary using roadways but included the land area at least as far inland as 3.2 miles from the shoreline, which is the inland distance at which the attaining monitor in nearby Sheboygan County is located, (and in most cases more than 3.2 miles inland) over the length of Manitowoc County. The precursor emissions in Manitowoc County while not trivial are relatively low and the analysis above shows that the dominating factor contributing to ozone formation in Manitowoc County is upwind impacts potentially from higher precursor emitting areas.

Based on the assessment of factors described above, the EPA has concluded that the portion of Manitowoc County described above meets the CAA criteria for inclusion in the Manitowoc County nonattainment area. This boundary is different from the nonattainment boundary for the 1997 ozone NAAQS, which was the entire county. However, due to new information from a second ozone monitor in neighboring Sheboygan County and an accompanying lake breeze ozone inland penetration distance analysis submitted by Wisconsin, both of which are discussed in detail above in the context of the five-factor weight-of-evidence analysis, the EPA's nonattainment boundary for the Manitowoc County area for the 2015 ozone NAAQS is a portion of Manitowoc County inclusive and east of the following roadways with the boundary starting from north to south: County Road B which turns into South State Street to County Road V which turns into Forest Home Drive to South Packer Drive to West Hillcrest Road to Highway 43 to West Custer Street to Dufek Drive which turns into Highway 42.

3.4 Technical Analysis for Door County

This technical analysis identifies the area with a monitor that violates the 2015 ozone NAAQS. It also provides EPA's evaluation of this area and any nearby areas to determine whether those nearby areas have emissions sources that potentially contribute to ambient ozone concentrations at the violating monitor in the area, based on the weight-of-evidence of the five factors recommended in the EPA's ozone designations guidance and any other relevant information. In developing this technical analysis, the EPA used the 2016 certified data and information available to the EPA (and to the states and tribes through the Ozone Designations Mapping Tool and the EPA Ozone Designations Guidance and Data web page).[50] In addition, the EPA considered the data or information provided to the EPA by states or tribes.

The area of analysis is Door County, which is not part of a CSA or a CBSA. As per EPA's designations guidance to start with the CSA or CBSA, since Door County is not part of a CSA or CBSA, Door County was analyzed (as per past EPA practice) as a single county area. Door County is unique in the combination of its susceptibility to be impacted by lake breeze meteorology, its precursor emissions are relatively low, and it is located downwind of several large urban areas, making it a recipient of ozone transport from upwind urban areas with high precursor emissions.

The five factors recommended in the EPA's guidance are:

6. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;

[50] The EPA's Ozone Designations Guidance and Data web page can be found at *https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data.*

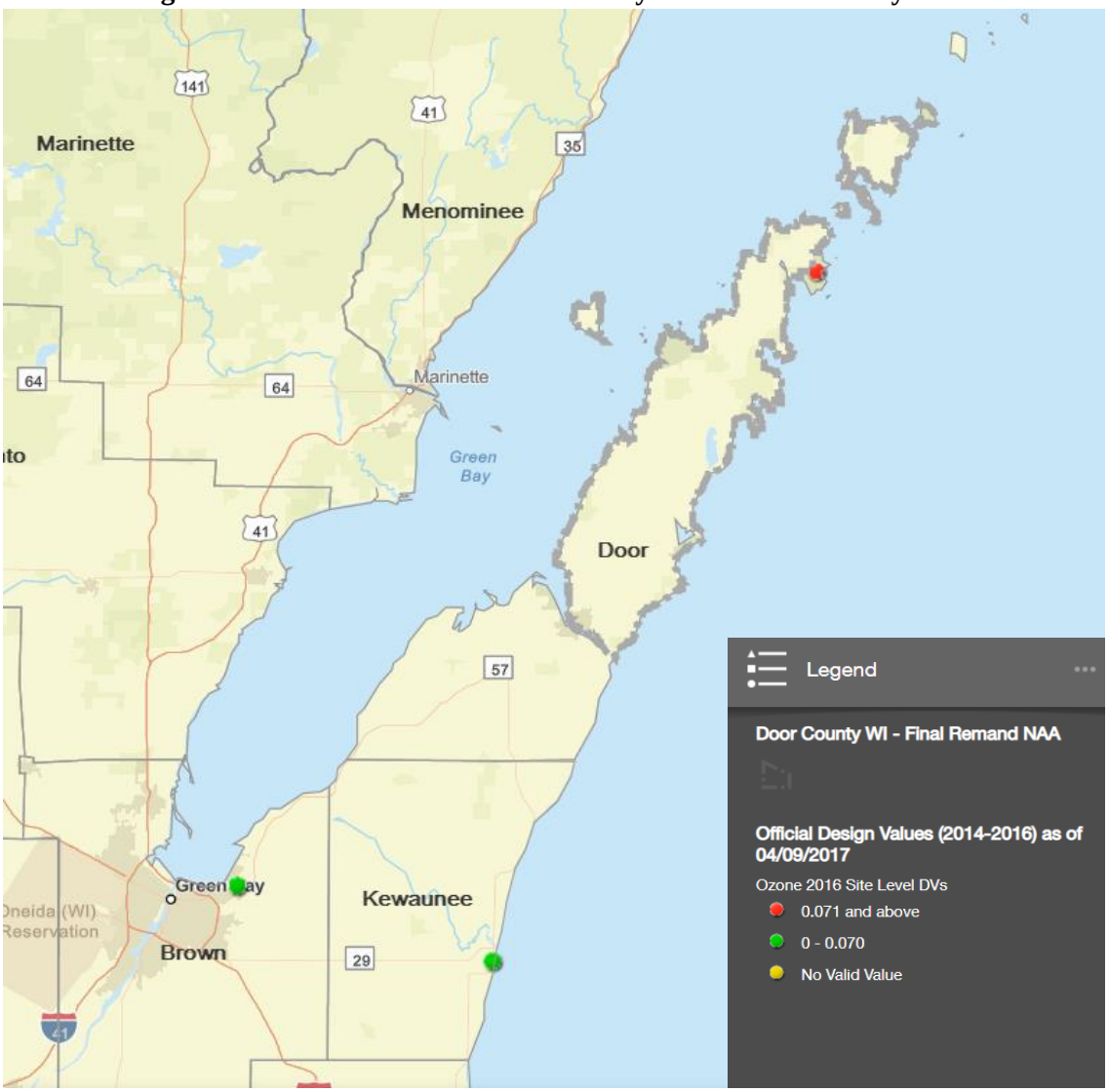
7. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
8. Meteorology (weather/transport patterns);
9. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
10. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

Figure 1 is a map of the EPA's nonattainment boundary for the Door County area. The map shows the location of the ambient air quality monitor, county, and other jurisdictional boundaries.

For purposes of the 1997 ozone NAAQS, the entirety of Door County was designated nonattainment, since the Door County monitor was violating the 1997 standard at the time of designation. For purposes of the 2008 ozone NAAQS, the entirety of Door County was designated unclassifiable/attainment, since the Door County monitor was attaining the 2008 standard at the time of designation.

The EPA's nonattainment boundary for the Door County area for the 2015 ozone NAAQS is the northern portion of the county cut off by the Sturgeon Bay canal. This boundary is different from the boundary for the 1997 ozone NAAQS, which consisted of the entirety of Door County.

Figure 1. EPA's Nonattainment Boundary for the Door County Area



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. The northern portion of Door County had a monitor in violation of the 2015 ozone NAAQS, therefore this portion of the county (but only the Newport State Park portion) was included in a nonattainment area which was designated as nonattainment on April 30, 2018, and redesignated to attainment and maintenance based on clean data on June 10, 2020 (85 FR 35377) . The following sections describe the five-factor analysis. While the factors are presented individually, they are not independent. The five-factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

Factor 1: Air Quality Data

The EPA considered the 8-hour ozone design value in ppm for the air quality monitor in Door County based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour average ozone concentration.[51] The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations.[52] The EPA uses FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule[53] are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified monitors where the 2016 design values violate the NAAQS and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are operated in accordance with 40 CFR part 58, appendices A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

There is one monitor located in Door County. The 2016 design value for the monitor is shown in Table 2.

[51] The specific methodology for calculating the ozone design values, including computational formulas and data completeness requirements, is described in 40 CFR part 50, appendix U.

[52] The QA requirements for ozone monitoring data are specified in 40 CFR part 58, appendix A. The performance test requirements for candidate FEMs are provided in 40 CFR part 53, subpart B.

[53] The EPA finalized the rule on the Treatment of Data Influenced by Exceptional Events (81 FR 68513) and the guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events in September of 2016. For more information, see *https://www.epa.gov/air-quality-analysis/exceptional-events-rule-and-guidance.*

Table 2. Air Quality Data (all values in ppm).

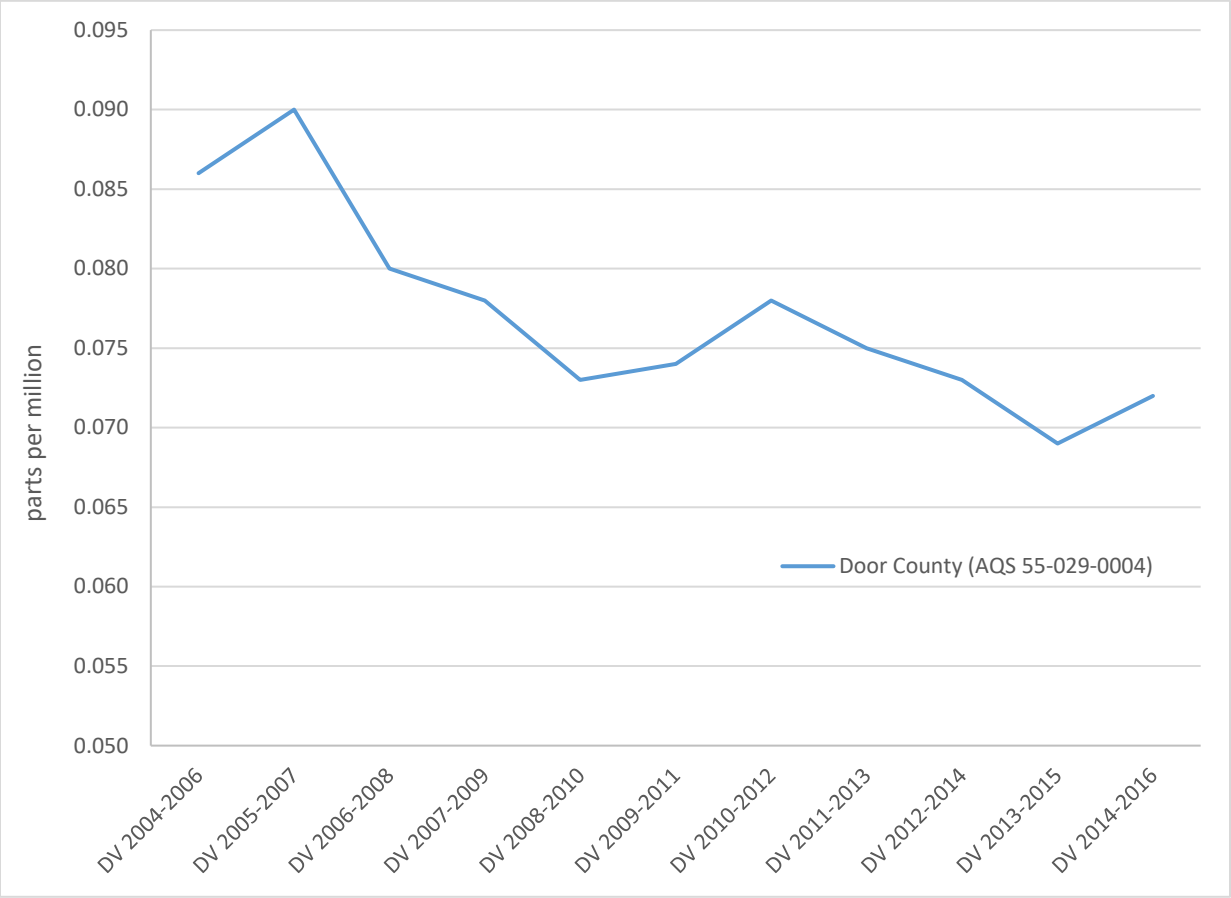
County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Door County, WI	No	55-029-0004	**0.072***	0.065	0.074	0.077

* Despite violating monitors, in a September 21, 2016 letter from its governor, Wisconsin recommended attainment for the entire state. Later in April 20, 2017 and February 28, 2018 submittals, which Wisconsin explains contain technical information for supporting the governor's recommendation, Wisconsin estimated the geographic extent of the areas in Wisconsin with design values above 0.070 ppm. Wisconsin requested that if EPA designates nonattainment areas in Wisconsin, that the geographic scope of these areas be as small as possible. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Door County does not extend beyond the Newport State Park boundary. Wisconsin emphasized that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS, which would conflict with the Governor's recommendation of attainment. EPA finds Wisconsin's methodology for this estimate to be fundamentally unsupported as explained in the Response to Comments associated with this action.

The monitor, which is in the northern portion of Door County, shows a violation of the 2015 ozone NAAQS, therefore this portion of the county is included in EPA's nonattainment area.

Figure 1, shown previously, identifies the portion of Door County in the nonattainment area and the violating monitor. Table 2 identifies the 2016 design value for the monitor in the area of analysis and Figure 2 shows the historical trend of design values for the violating monitor. As indicated on the map, there is one violating monitor that is located on the northeast portion of the Door County peninsula near the shoreline of Lake Michigan. There are three monitors to the south and southwest of Door County, including one in Kewaunee County, which is immediately south of Door County near the shoreline of Lake Michigan, one in Brown County, and one in Outagamie County, that are not violating for the 2014-2016 time-period. There is one monitor to the south of both Door and Kewaunee counties in Manitowoc County, which is near the shoreline of Lake Michigan, that is violating for the 2014-2016 time-period, but this area will be addressed separately, since Manitowoc County is its own CBSA-Micropolitan Statistical Area. As shown in Figure 2, the Door County monitor has historically high ozone design values, which have been generally decreasing over time; however, there was a small increase in the 2016 design value.

Figure 2. Three-Year Design Values for Violating Monitor



The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. The northern portion of Door County has a monitor in violation of the 2015 ozone NAAQS; therefore, this portion of the county is included in the nonattainment area based on the air quality data factor.

Factor 2: Emissions and Emissions-Related Data

As mentioned previously, the presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA evaluated emissions of ozone precursors, which include nitrogen oxides (NO_x) and volatile organic compounds (VOC), and other emissions-related data that provide information on areas contributing to violating monitors.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). For the Door County area of analysis, the EPA examined the magnitude of large sources (NO_x or VOC emissions greater than 100 tons

per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires. Emissions levels from sources in a nearby area indicate the potential for the area to contribute to monitored violations.

Table 3 provides a county-level emissions summary of NO_x and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for inclusion in the Door County nonattainment area.

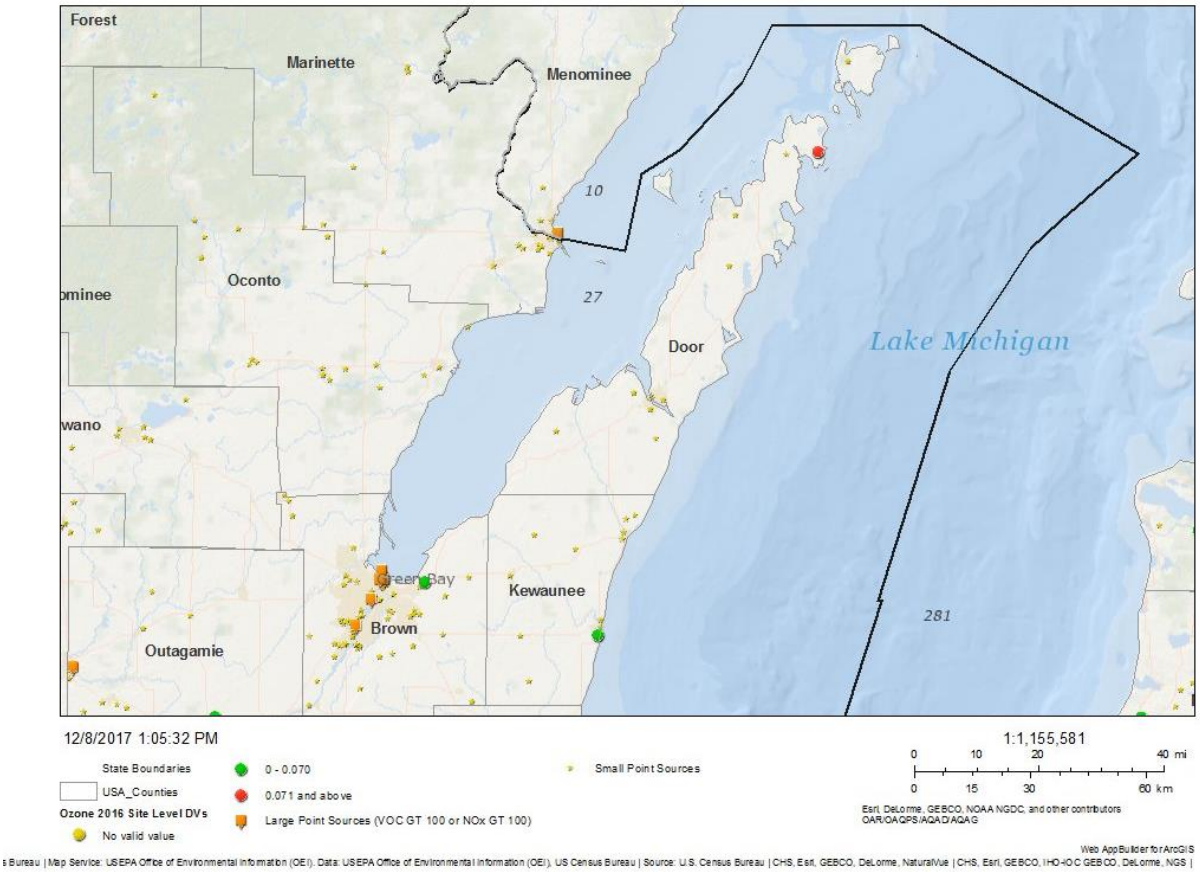
Table 3. Total County-Level NO_x and VOC Emissions.

County, State	State Recommended Nonattainment?	Total NO_x (tpy)	Total VOC (tpy)
Door County, WI	No*	3,066	2,439

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

In addition to reviewing county-wide emissions of NO_x and VOC in the area of analysis, the EPA also reviewed emissions from point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. The locations of the point sources are shown in Figure 3 below.

Figure 3. Point Sources in the Area of Analysis



The EPA's analysis of county-level emissions showed no large point sources in Door County and four out of approximately ten small point sources that reported NO_x and/or VOC emissions of greater than 1 ton to the 2014 NEI. These four sources, including Bay Shipbuilding Co., Marine Travel Lift, Door County Cherryland Airport, and Palmer Johnson Yachts, LLC, combined, emitted a reported 9 tons of NO_x and 80 tons of VOC in 2014. The largest of these sources, Bay Shipbuilding Co., emitted a reported 51.26 tons of VOC and 2.58 tons of NO_x in 2014. The NO_x and VOC emissions from the point sources in Door County are relatively low.

Population density and degree of urbanization

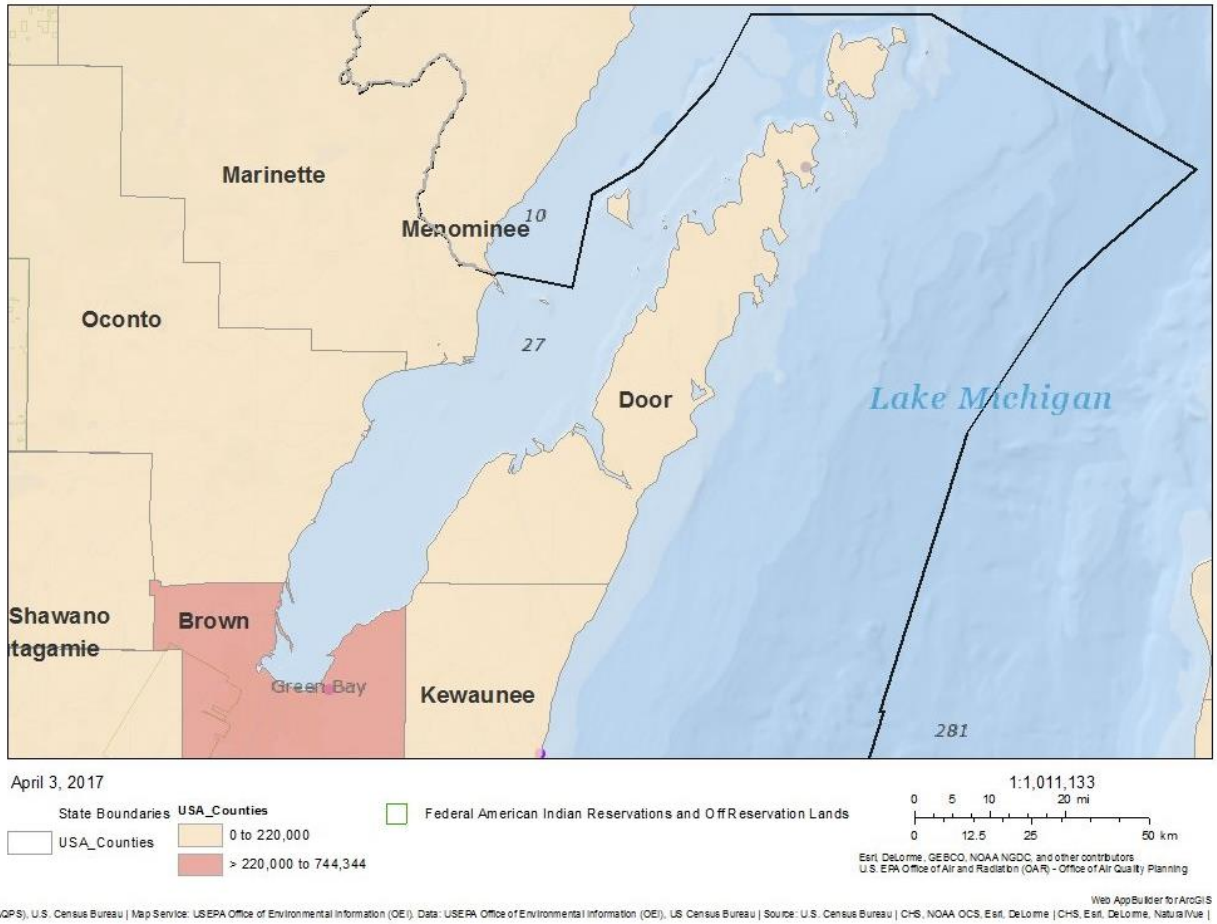
In this part of the factor analysis, the EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NO_x and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for Door County. Figure 4 shows the county-level population density map of the area of analysis.

Table 4. Population and Growth.
Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.html.

County, State	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Door County, WI	No*	27,785	27,554	57	231	-0.8

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

Figure 4. County-Level Population



The population and population density in Door County are both relatively low. The non-point (area) source emissions reported to the 2014 NEI were 1,752 tons of NO_x and 491 tons of VOC. The on-road emissions reported to the 2014 NEI were 600 tons of NO_x and 356 tons of VOC. The non-road emissions reported to the 2014 NEI were 706 tons of NO_x and 1,512 tons of VOC. These quantities of precursor emissions are not trivial; however, the reported NO_x and VOC emissions from the non-point (area), on-road, and non-road source sectors, which are the source sectors that are often correlated with population and population density, are relatively low in Door County.

Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for the area of analysis. In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area, and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census

Bureau[54] for Door County. Table 5 shows the traffic and commuting pattern data, including total VMT for the county, number of county residents who work, number of county residents commuting within the county, and the percentage of county residents commuting within the county. The data in Table 5 are 2014 data.

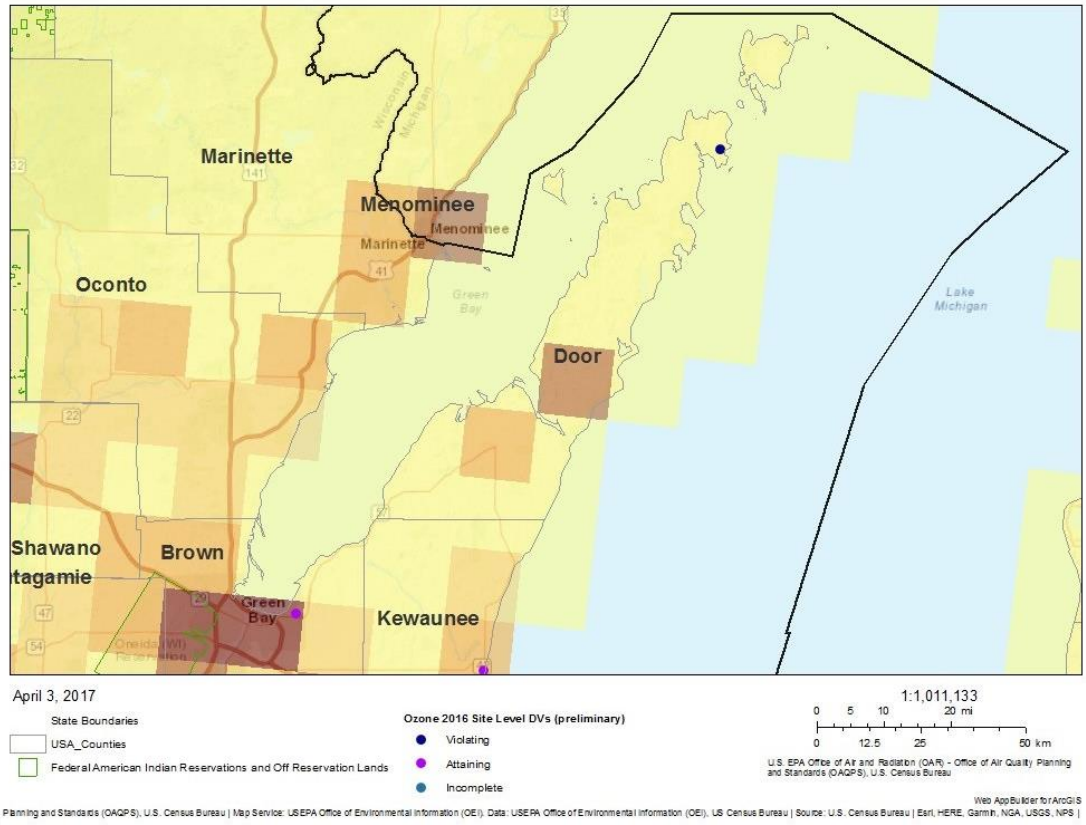
Table 5. Traffic and Commuting Patterns.

County, State	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number of County Residents Commuting Within the County	Percentage of County Residents Commuting Within the County
Door County, WI	No*	399	13,612	8,697	64%

*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

To show traffic and commuting patterns, Figure 5 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



[54] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Door County has a relatively low population density and degree of urbanization. The reported vehicle miles traveled (VMT) for 2014 were 399 million miles, and the on-road emissions reported to the 2014 NEI were 600 tons of NO_x and 356 tons of VOC. The majority of the VMT are concentrated in the central portion of the county just north of the Sturgeon Bay canal as seen in Figure 5.

The Door County emissions and emissions-related data are not trivial. However, the NO_x and VOC emissions from the various source sectors, including point, non-point (area), on-road, and off-road, in Door County are relatively low, such that the county emissions and emissions-related data factor of the analysis can be ranked relatively low in terms of contribution to ozone formation in the county. The majority of the county point source emissions and the majority of the county VMT are concentrated north of the Sturgeon Bay canal.

Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area, the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1,000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figure 6 shows the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8-hour values that exceed the 2015 ozone NAAQS) for the violating monitor. Figure 7 shows the same trajectories as Figure 6 with a zoomed-out perspective.

Figure 6. HYSPLIT Back Trajectories for Violating Monitor

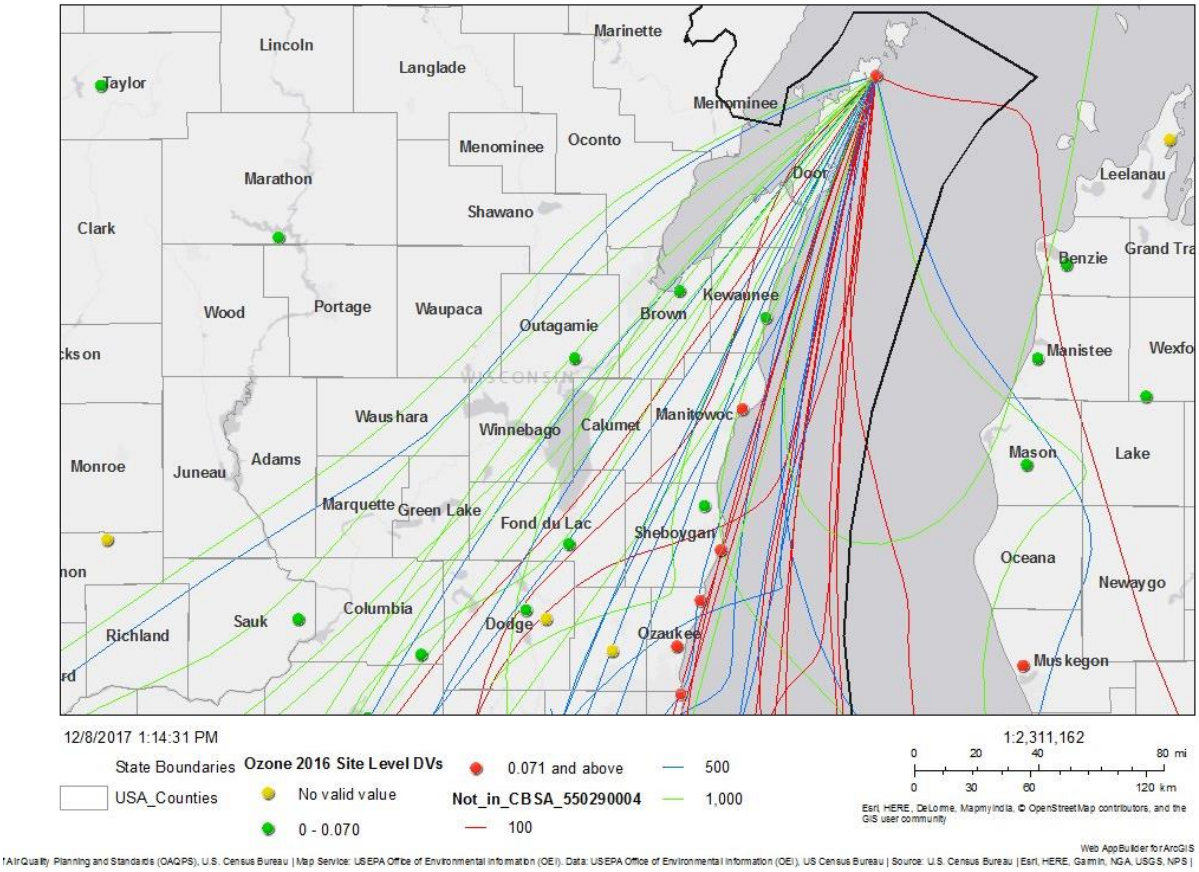
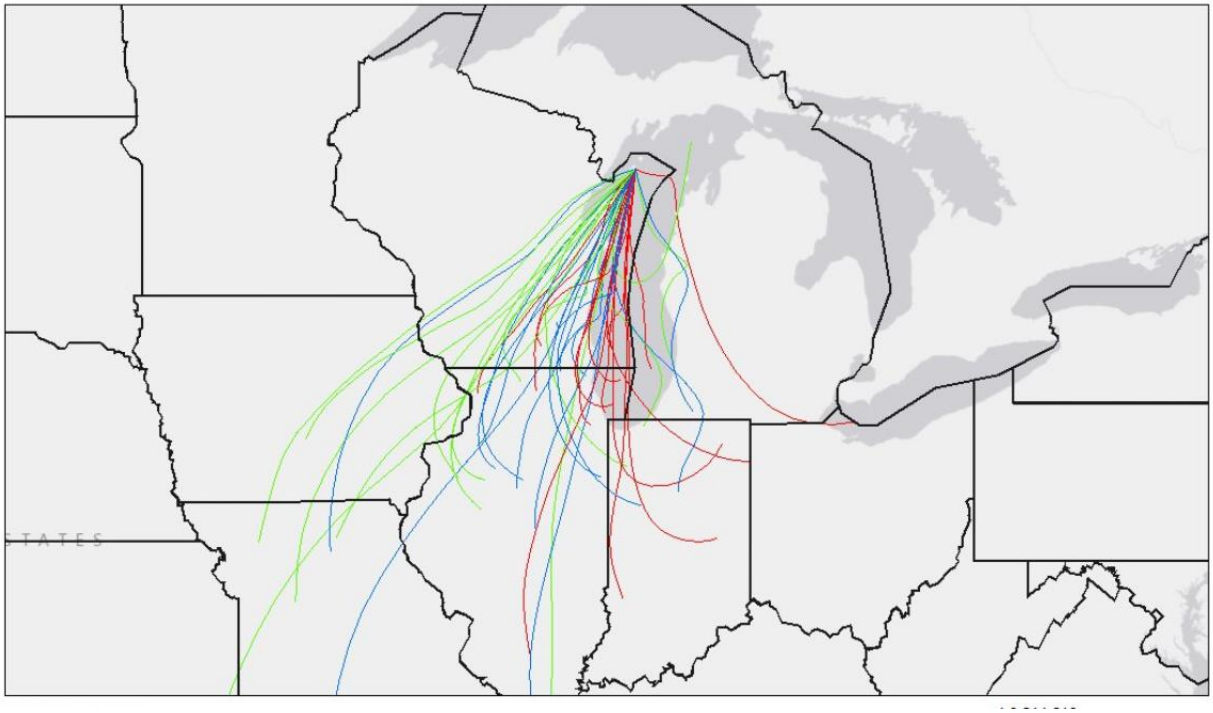


Figure 7. HYSPLIT Back Trajectories for Violating Monitor. Red lines depict trajectories ending 100 m above the monitor, blue lines depict trajectories ending 500 m above the monitor and green lines depict trajectories ending 1,000 m above the monitor.



Door County is a peninsula that juts out into Lake Michigan. Due to its proximity to the lake, Door County has the potential to be impacted by lake breeze meteorology. The land breeze and lake breeze occur when wind blows from the land and lake, respectively, due to air pressure differences caused by the different heating capacities of the land and the water. Land absorbs and loses solar radiation much faster than water. The land breeze typically occurs in the early morning after air above the relatively warm nighttime water of Lake Michigan heats and rises, setting up an area of low pressure which is filled by the cooler air from over the land. The lake breeze typically occurs in the afternoon when the area of low pressure is created by rising air over the heated land, creating winds off the cooler lake. The land/lake breeze is typically more localized than the prevailing (synoptic) winds. Studies indicate the land/lake breeze can trap, stratify, and recirculate polluted air, sometimes in a helical pattern. Daytime inversions can create shallow, stable layers of precursor plumes, which, on warm sunny days, are conducive to ozone formation. The afternoon lake breeze can carry photochemically aged, ozone-rich air from nearby and upwind plumes, to nearby and downwind areas like Door County where violations of the ozone standard can be measured particularly along the shoreline. Additionally, large scale, summertime, stagnant high-pressure systems centered to the south and southeast of Lake Michigan have been implicated in high

ozone episodes for areas near the shoreline of Lake Michigan. The relative role of each (the land/lake breeze and synoptic flow) is episode-specific and not fully understood.[55, 56, 57, 58, 59]

The HYSPLIT trajectories indicate that exceedance day air masses generally traveled from the south and southwest prior to being detected at the violating monitor. Many of the lower level trajectories represented by the red lines at 100 meters AGL and the blue lines at 500 m AGL traveled over upwind portions of Wisconsin, including the Green Bay and Milwaukee areas, and over the greater Chicago area, northwest Indiana, and Lake Michigan. The higher-level trajectories represented by the green lines at 1,000 m AGL mainly traveled overland with a few over the lake. Door County is downwind of the Green Bay-Shawano CSA, which includes Kewaunee, Brown, Oconto, Menominee, and Shawano counties. Of these counties, the majority of the HYSPLIT trajectories travel over Brown County and Kewaunee County on the path to the violating monitor in Door County. Kewaunee County emissions are relatively low, but Brown County emissions are among the highest in the state. The HYSPLIT trajectories also indicate that exceedance day air masses also traveled as far as the Milwaukee and Chicago CSAs to the violating monitor in Door County. The Milwaukee and Chicago CSAs are on the order of 100-200 miles away from the violating monitor in Door County, whereas Brown County is approximately 65 miles away from the Door County violating monitor. While Brown County is upwind of Door County (see HYSPLIT trajectories in Figure 6) and accounts for some of the highest precursor emissions in the state, Brown County (along with Kewaunee County which is immediately south of and adjacent to Door County) is part of a separate CSA (Brown County and Kewaunee County are both part of the Green Bay-Shawano CSA) and is therefore not included in the area of analysis for the Door County nonattainment area.

The HYSPLIT trajectories are just one piece of evidence corroborating the body of scientific literature on the potential for lake breeze meteorology, and lake breeze meteorology combined with synoptic meteorology, to transport photochemically aged, ozone-rich air masses from nearby and upwind areas to nearby and downwind areas near the shoreline of Lake Michigan, such as Door County, Wisconsin. Other evidence of the potential for land/lake breeze and synoptic meteorology to transport ozone to areas along the shoreline of Lake Michigan are documented in the scientific literature from study data collected

[55] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S., Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.
[56] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.
[57] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.
[58] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.
[59] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

mostly in the early 1990's.[60, 61, 62, 63, 64] More recent data has also been collected during the 2017 Lake Michigan Ozone Study[65] with similar and more refined results for more recent ozone episodes.[66] It is important to reiterate that the relative role of the land/lake breeze and synoptic flow on ozone transport in the Lake Michigan area is episode-specific and not fully parsed out. Specific details on the factors and mechanisms influencing Lake Michigan ozone are the subject of ongoing study (e.g. changes in precursor mixes, changes in radical concentrations, relative importance of multi-day ozone formation versus same day formation, lake breeze inland penetration distances and vertical mixing, the extent to which shallow inversions above the cool lake water prevent vertical mixing, etc.).[67]

Details of the various factors regarding how emissions and local lake breezes (alone or combined with synoptic-scale meteorology) influence ozone production and transport around Lake Michigan are episode-specific. There are gaps in the peer-reviewed scientific literature on this topic. However, the basic concepts of lake breeze meteorology and its potential to influence ozone production and transport are understood well enough to weight the meteorology factor relatively high given the above analysis. The peer-reviewed results from the Lake Michigan-specific ozone studies and the HYSPLIT trajectories presented here provide evidence that meteorology plays a role in ozone production and transport to this area. Therefore, this factor can be weighted relatively high.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

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[60] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[61] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[62] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[63] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[64] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

[65] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

[66] Abdi-Oskouei, M., G. Carmichael, M. Christiansen, G. Ferrada, B. Roozitalab, N. Sobhani, K. Wade, A. Czarnetzki, R. B. Pierce, T. Wagner, and C. Stanier. Sensitivity of Meteorological Skill to Selection of WRF-Chem Physical Parameterizations and Impact on Ozone Prediction During the Lake Michigan Ozone Study (LMOS), JGR Atmospheres, J. Geophys. Res. Atmos., 125 (2020), Article e2019JD031971, 10.1029/2019jd031971.

[67] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

The EPA uses geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

Door County does not have any geographical or topographical features significantly limiting air pollution transport within its airshed. Door County is a peninsula in the northeast portion of Wisconsin that juts out into Lake Michigan. As described under Factor 3: Meteorology, areas geographically located along land-water interfaces, such as Door County on Lake Michigan, can be impacted by lake breeze meteorology which has the potential to transport photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind areas.

Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the Door County nonattainment area, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the designated areas.

Since Door County is not part of a CSA or CBSA, for this area, EPA looked at the county boundary as the initial area of analysis. The Door County area has a previously established nonattainment boundary associated with the 1997 ozone NAAQS. For the 1997 ozone NAAQS the entirety of Door County was designated as nonattainment, and the county immediately to the south of Door County, Kewaunee County, which also had a violating monitor at the time of the 1997 ozone NAAQS designations, was designated as a separate nonattainment area. Neither Door County nor Kewaunee County were violating the 2008 ozone NAAQS at the time of the 2008 ozone NAAQS designations. Kewaunee County does not contain a violating monitor for the 2015 ozone NAAQS. Given the lake breeze inland penetration distance analysis described in the Sheboygan County section (Section 3.2) and given that the Kewaunee County monitor, which is located near the Lake Michigan shoreline, is not violating the 2015 ozone NAAQS, it is reasonable to assume the spatial extent of the violating area in Door County may not extend to the southern portion of Door County (south of the Sturgeon Bay canal).

Conclusion for Door County Area

As discussed in the factor analysis above, Door County emission and emissions-related data are relatively low. There are no large point sources in Door County and four out of approximately ten small point sources that reported NO_x and/or VOC emissions of greater than 1 ton to the 2014 NEI. These four sources, including Bay Shipbuilding Co., Marine Travel Lift, Door County Cherryland Airport, and Palmer Johnson Yachts, LLC, combined, emitted a reported 9 tons of NO_x and 80 tons of VOC in 2014.

The largest of these sources, Bay Shipbuilding Co., emitted a reported 51.26 tons of VOC and 2.58 tons of NO_x in 2014. Bay Shipbuilding Co. and Palmer Johnson Yachts, LLC are located north of the Sturgeon Bay canal, whereas Marine Travel Lift and Door County Cherryland Airport are located just south of the Sturgeon Bay canal. The majority of the VMT activity is concentrated just north of the canal (Figure 5). Further, Door County is a peninsula that juts out into Lake Michigan and is susceptible to ozone transport from upwind, high precursor emitting urban areas (Factor 4: Meteorology, Figure 6, Figure 7). Therefore, in light of Wisconsin's April 2017 recommendation that if EPA designates the area as nonattainment due to the violating monitor that EPA minimize the extent of the area included in the nonattainment area boundary, and in light of the above analysis, the EPA is designating the northern portion of Door County (north of the Sturgeon Bay canal) as nonattainment for the 2015 ozone NAAQS. The canal is an easily identifiable clearly defined geographical boundary. Kewaunee County, just south of Door County, does not contain a violating monitor for the 2015 ozone NAAQS. Given the lake breeze inland penetration distance analysis described in the Sheboygan County section (Section 3.2) and given that the Kewaunee County monitor, which is located near the Lake Michigan shoreline, is not violating the 2015 ozone NAAQS, it is reasonable to assume the spatial extent of the violating area in Door County may not extend to the southern portion of Door County (south of the Sturgeon Bay canal).

Based on the assessment above, the EPA is revising its previous partial-county boundary and designating the northern portion of Door County (north of the Sturgeon Bay canal) as nonattainment for the 2015 ozone NAAQS. The Door County air quality monitor, which is located in the northern portion of the county indicates a violation of the 2015 ozone NAAQS based on the 2016 design value; therefore, this portion of the county was included in the nonattainment area, but only the Newport State Park portion was included in a nonattainment area, which was designated as nonattainment on April 30, 2018, and redesignated to attainment and maintenance based on 2017-2019 clean data on June 10, 2020 (85 FR 35377). Therefore, EPA is designating the remaining portion of the county located north of the Sturgeon Bay Canal but excluding the Newport State Park as nonattainment of the 2015 ozone NAAQS based on the original record and in response to the court remand. Door County emissions are relatively low, and the county also has a relatively small population and low population density. HYSPLIT trajectories suggest that emissions from upwind areas with higher emissions (approximately 4 times higher from Brown County and 14 times higher from the Milwaukee nonattainment area) are contributors to air quality at the violating monitor.

Rural Transport Area (RTA) Analysis

Section 182(h) of the Clean Air Act identifies a category of ozone nonattainment areas referred to as rural transport areas (RTAs). An RTA is treated as a Marginal area for purposes of ozone-related planning and control requirements, regardless of the area's classification. In order for an area to qualify as an RTA, the nonattainment area must meet two criteria. First, the nonattainment area cannot be adjacent to or include any part of a metropolitan statistical area, as defined by the U.S. Office of Management and Budget (OMB). Second, the NO_x and VOC emissions from sources within the area cannot make a significant contribution to ozone concentrations in the area itself, or in other areas.

For the first criterion, while Door County is adjacent to Kewaunee County which is part of the Green Bay-Shawano, Wisconsin CSA, the portion of Door County that EPA is designating as nonattainment (the

portion of Door County which is north of the Sturgeon Bay canal) is not adjacent to or part of a metropolitan statistical area, as defined by the OMB. Thus, the nonattainment area meets the first criterion.

Regarding the second criterion, the EPA has provided in the designations guidance that a multi-factor, weight-of-evidence approach should be used to demonstrate that emissions within a potential RTA do not contribute significantly to the local ozone nonattainment or to ozone nonattainment downwind. While there is limited monitoring data north and east of Door County (the direction in which wind typically flows in this area of the country), there is one ozone monitor approximately 87 miles downwind (northeast) of the violating monitor in Door County, Wisconsin. This monitor is located on the upper peninsula of the state of Michigan in Schoolcraft County, Michigan. This monitor is not violating the 2015 ozone NAAQS based on fully certified 2014-2016 data. Since Door County precursor emissions are relatively low, and since the monitor in Schoolcraft County, Michigan is not violating the 2015 ozone standard, there is little evidence to indicate that Door County precursor emissions are significantly contributing to ozone nonattainment downwind.

EPA's 2015 designations guidance indicates that the first step in demonstrating that the NO_x and VOC emissions in a potential RTA do not significantly contribute to ozone in the area itself is the development of a conceptual description of the nature of ozone exceedances in the area. The section above entitled Factor 3: Meteorology, includes a conceptual description of lake breeze meteorology and its potential to influence ozone production and transport to areas along the shoreline of Lake Michigan, like Door County. EPA's 2015 designations guidance states that if the NO_x and VOC inventories for a particular area are appreciably less than those for other areas for which there is evidence demonstrating contribution to ozone nonattainment (i.e. from the ambient and meteorological analyses), this provides support for concluding that the transport component is overwhelming any local ozone production. A simple approach to assessing the potential importance of local emissions is to compile county-level emission inventory estimates for each county potentially along the trajectories that are expected to contribute to ozone in the potential RTA. If the emissions from upwind contributing counties are substantially larger than what is being emitted locally, then perhaps the impact of the local emissions may not be significant. The EPA analyzed the highest emitting areas that are upwind of Door County as evidenced by the HYSPLIT trajectories presented in Figures 6 and 7. Results of this analysis are presented in Table 6, which shows the precursor emissions from some of the highest emitting counties in Wisconsin that are upwind of Door County and over which the HYSPLIT trajectories to the Door County monitor travel.

Table 6. Precursor emissions from some of the highest emitting upwind areas relative to Door County, Wisconsin, precursor emissions as reported for 2014.

Geographic Area	NO_x (tpy)	VOC (tpy)
Door County, Wisconsin	3,066	2,439
Brown County, Wisconsin	12,078	7,813
Milwaukee Nonattainment Area (Ozaukee, Washington, Waukesha, Milwaukee, and Racine Counties, WI)	42,499	37,467
Chicago Nonattainment Area Cook, DuPage, Grundy (partial), Kane, Kendall (partial), Lake, McHenry, and Will Counties, IL Lake and Porter Counties, IN Kenosha County, WI (partial)	274,440	206,171

Brown County, which is immediately southwest of Door County, and over which many HYSPLIT trajectories travel prior to reaching the Door County monitor (Figure 6), has relatively high NO_x and VOC emissions (2014 reported NO_x = 12,078 tons, VOC = 7,813 tons). Brown County emissions are four times greater than Door County NO_x emissions and three times greater than Door County VOC emissions. For reference Wisconsin statewide emissions were 228,843 tons of NO_x and 235,708 tons of VOC reported for 2014.

Figure 7 indicates that the HYSPLIT back trajectories to the violating monitor in Door County also travel from as far south as the Milwaukee area and the Chicago area. The five counties that make up the historical Milwaukee nonattainment area under the 1997 ozone NAAQS that are also included in the Milwaukee nonattainment area explained earlier in this TSD for the 2015 ozone NAAQS, which include Ozaukee, Washington, Waukesha, Milwaukee, and Racine counties collectively have emissions are 14 times greater than the Door County NO_x emissions and 15 times greater than the Door County VOC emissions. The counties that make up the Chicago nonattainment area (which is a multi-state nonattainment area covered in a separate TSD) collectively have emissions are approximately 89 times greater than the Door County NO_x emissions and approximately 84 times greater than the Door County VOC emissions. For the reasons discussed above, EPA has determined that the emissions in Door County do not significantly contribute to ozone concentrations in the area itself or to other areas.

Therefore, in light of Wisconsin's April 2017 recommendation for an RTA category for Door and also in light of Wisconsin's April 2017 recommendation that if EPA designates the area as nonattainment due to the violating monitor that EPA minimize the extent of the area included in the nonattainment area boundary, and in light of the above analysis, the EPA is designating the northern portion of Door County (north of the Sturgeon Bay canal) as a nonattainment RTA for the 2015 ozone NAAQS.

Additional Information

The Newport State Park area, which was designated nonattainment on April 30, 2018, was redesignated to attainment with an approved maintenance plan effective June 10, 2020 (85 FR 35377) based on clean data

for the 2017-2019 design value period. However, the redesignation action and maintenance plan did not include analysis of any other portion of Door County. As such, EPA does not believe it is appropriate to extend the effects of the redesignation action to the area beyond the Newport State Park. However, while EPA is revising its previous nonattainment area boundary to designate as nonattainment the portion of Door County north of the Sturgeon Bay canal including offshore islands as addressed in the Response to Comments associated with this action, the Newport State Park will remain in attainment, consistent with the June 10, 2020 redesignation action. The final nonattainment area boundary, then, is the portion of Door County north of Sturgeon Bay Canal excluding Newport State Park.