

## Wisconsin:

### Northern Milwaukee/Ozaukee Shoreline 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)

##### 1.0 Summary

This technical support document (TSD) describes the EPA's final designation for the Northern Milwaukee/Ozaukee Shoreline Area, the Sheboygan (partial) County Area, the Manitowoc (partial) County Area, and the Door (partial) County Area in Wisconsin as nonattainment for the 2015 ozone National Ambient Air Quality Standards (NAAQS).

On October 1, 2015, the EPA promulgated revised primary and secondary ozone NAAQS (80 FR 65292; October 26, 2015). The EPA strengthened both standards to a level of 0.070 parts per million (ppm). In accordance with section 107(d) of the Clean Air Act (CAA), whenever the EPA establishes a new or revised NAAQS, the EPA must promulgate designations for all areas of the country for that NAAQS.

Under section 107(d), states were required to submit area designation recommendations to the EPA for the 2015 ozone NAAQS no later than 1 year following promulgation of the standards, i.e., by October 1, 2016. Tribes were also invited to submit area designation recommendations. On September 30, 2016, the Forest County Potawatomi Community (FCPC) Indian tribe recommended that the FCPC trust lands located within Forest County, Wisconsin be designated separately from adjacent lands as attainment for the 2015 ozone NAAQS based on air quality data from 2013-2015. In a September 21, 2016, letter from its governor, Wisconsin recommended that the entire state be designated as attainment for the 2015 ozone NAAQS, despite having violating monitors, since, in Wisconsin's opinion, elevated ozone levels in Wisconsin are primarily due to emissions originating from other states, recent ozone levels in Wisconsin have greatly improved, and Wisconsin has already significantly reduced ozone-causing emissions. Later in an April 20, 2017, supplemental submittal, Wisconsin submitted additional technical information to support the governor's recommendation, and asserted:

- Elevated ozone levels are confined to an extremely narrow band that follows Wisconsin's shoreline, with air quality improving dramatically just a few miles inland;
- Ozone concentrations measuring above the level of the 2015 ozone NAAQS at the state's lakeshore monitors occur almost exclusively when the wind is coming from over the lake, not from over Wisconsin;
- Ozone concentrations at Wisconsin's lakeshore monitors are primarily due to emissions originating from outside the state;
- Additional emissions reductions from the areas around Wisconsin's shoreline monitors, including the state's most populous areas, would not meaningfully change the design values at those monitors. In fact, in some cases such reductions would actually increase ozone concentrations.

Wisconsin included estimates of 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, the EPA should ensure that the geographic scope of these areas is minimized. 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 shoreline. Wisconsin estimated the geographic extent of the design values above 0.070 ppm in Ozaukee County, Sheboygan County, and Manitowoc County to be 2.9 miles from the lakeshore. Wisconsin estimated that 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 in its April 20, 2017, submittal that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS.

Subsequent to EPA's technical analyses and announcement of proposed nonattainment areas released on December 22, 2017, Wisconsin submitted a February 2018 comment letter and additional technical information (a TSD included in the docket for this action), indicating that it is critical that EPA rely on state-specific information submitted by Wisconsin when finalizing designations, as it is more refined than EPA's data and more accurately reflects the unique ozone characteristics of Wisconsin's lakeshore region. The information included revised estimates of the geographic extent where ozone concentrations may be above 0.070 ppm in Racine County as up to 4.2 miles inland and in Sheboygan County as up to 2.3 miles inland.

After considering the state's recommendations and associated technical analyses from April 2017 and February 2018, the EPA is designating the areas listed in column 3 of Table 1 as nonattainment for the 2015 ozone NAAQS. Detailed descriptions of the proposed nonattainment boundaries for these areas are found below for each area in Section 3, except for the Chicago-Naperville, IL-IN-WI area which is addressed in a separate TSD.

**Table 1. Wisconsin’s Recommended Nonattainment Areas and the EPA’s Final Designated Nonattainment Areas for the 2015 Ozone NAAQS**

Area	Wisconsin's Recommended Nonattainment Counties	EPA’s Final Nonattainment Counties
Chicago, IL-IN-WI*	Attainment	<p style="text-align: center;"><b>Wisconsin</b> Kenosha (partial)</p> <p style="text-align: center;"><b>Illinois</b> Cook DuPage Grundy (partial) Kane Kendall (partial) Lake Will</p> <p style="text-align: center;"><b>Indiana</b> Lake (partial)</p>
Door County, WI	Attainment	Door County (partial)
Manitowoc County, WI	Attainment	Manitowoc County (partial)
Sheboygan County, WI	Attainment	Sheboygan County (partial)
Northern Milwaukee/Ozaukee Shoreline, WI	Attainment	Milwaukee (partial) Ozaukee (partial)

\*Chicago, IL-IN-WI is a multi-state area composed of counties and/or partial counties in Illinois, Indiana, and Wisconsin. The technical analysis for this multi-state area is discussed in a separate TSD for the Chicago, IL-IN-WI nonattainment area.

On November 6, 2017 (82 FR 54232), the EPA signed a final rule designating most of the areas in the state as attainment/unclassifiable.<sup>1</sup> As part of that rulemaking, EPA designated the FCPC trust lands

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<sup>1</sup> In previous ozone designations and in the designation guidance for the 2015 ozone NAAQS, the EPA used the designation category label Unclassifiable/Attainment to identify both areas that were monitoring attainment and areas that did not have monitors but for which the EPA had reason to believe were likely attainment and were not contributing to a violation in a nearby area. The EPA is now reversing the order of the label to be Attainment/Unclassifiable so that the category is more clearly distinguished from the separate Unclassifiable category.

located within Forest County separately from adjacent lands as attainment/unclassifiable. EPA explains in section 2.0 the approach it is now taking to designate the remaining areas in the state.

## **2.0 Nonattainment Area Analyses and Boundary Determination**

The EPA evaluated and determined the intended boundaries for each nonattainment area on a case-by-case basis, considering the specific facts and circumstances of the area. In accordance with CAA section 107(d), the EPA intends to designate as nonattainment all areas with monitor[s] that is [are] violating the 2015 ozone NAAQS and nearby areas with emissions sources (i.e., stationary, mobile, and/or area sources) that the Administrator has determined contribute to the violation[s]. As described in the EPA's designations guidance for the 2015 NAAQS (hereafter referred to as the "ozone designations guidance"<sup>2</sup> 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)<sup>3</sup> 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.

On November 6, 2017, the EPA issued attainment/unclassifiable designations for approximately 85% of the United States and one unclassifiable area designation.<sup>4</sup> At that time, consistent with statements in the designations guidance regarding the scope of the area the EPA would analyze in determining nonattainment boundaries, EPA deferred designation for any counties in the larger of a CSA or CBSA where one or more counties in the CSA or CBSA was violating the standard and any counties with a violating monitor not located in a CSA or CBSA. In addition, the EPA deferred designation for any other counties adjacent to a county with a violating monitor. The EPA also deferred designation for any county that had incomplete monitoring data, any county in the larger of the CSA or CBSA where such a county was located, and any county located adjacent to a county with incomplete monitoring data.

The EPA is proceeding to complete the remaining designations 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. For those deferred areas where one

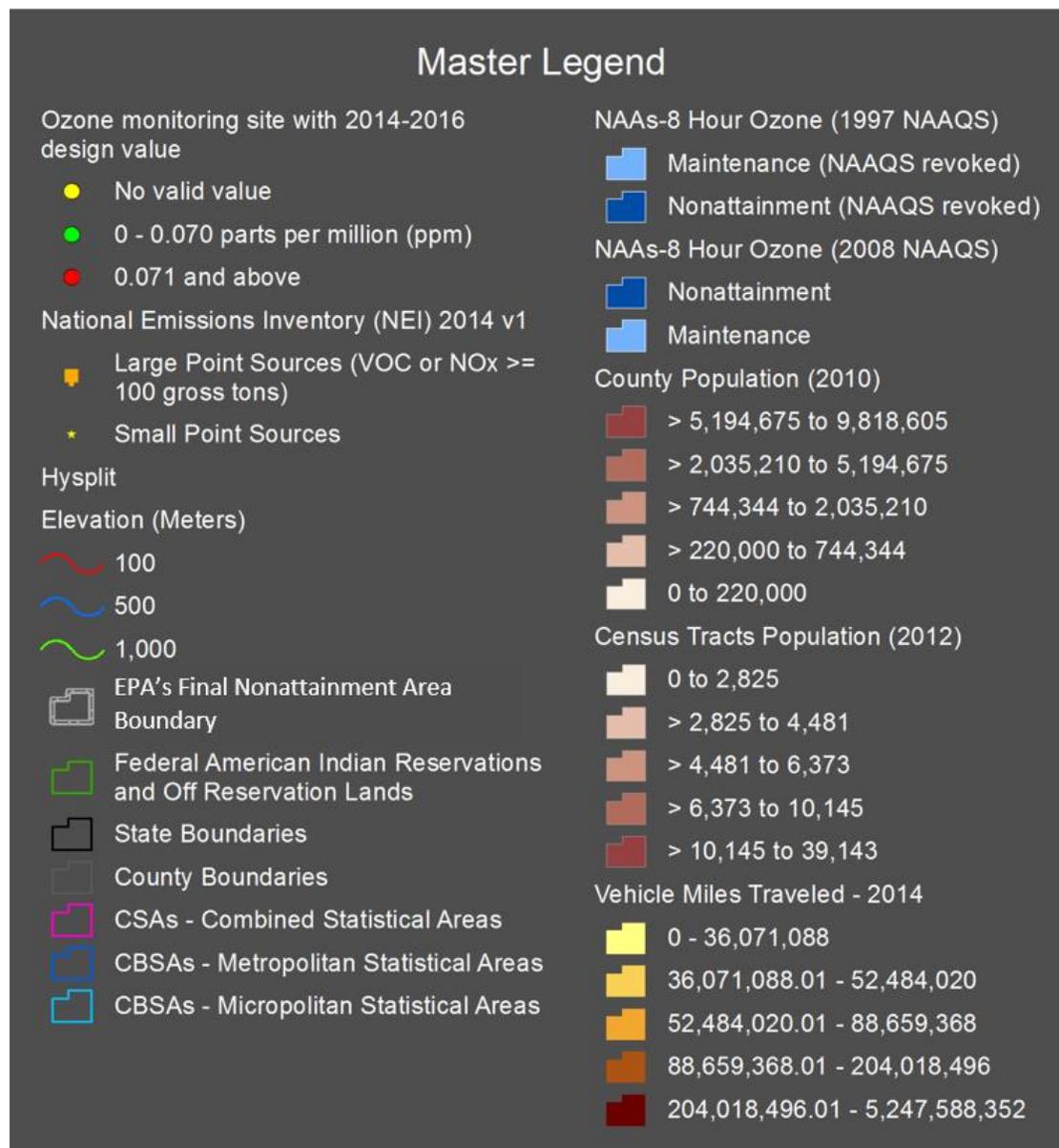
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<sup>2</sup> The EPA issued guidance on February 25, 2016 that identified important factors that the EPA intends to evaluate in determining appropriate area designations and nonattainment boundaries for the 2015 ozone NAAQS. Available at <https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs>

<sup>3</sup> Lists of CBSAs and CSAs and their geographic components are provided at [www.census.gov/population/www/metroareas/metrodef.html](http://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.

<sup>4</sup> Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards published on November 16, 2017(82 FR 54232).

or more counties violating the ozone NAAQS or with incomplete data are located in a CSA or CBSA, in most cases the technical analysis for the nonattainment area includes any counties in the larger of the relevant CSA or CBSA. For counties with a violating monitor not located in a CSA or CBSA, EPA explains in the 3.0 Technical Analysis section, its decision whether to consider in the five-factor analysis for each area any other adjacent counties for which EPA previously deferred action. We intend to designate all counties not included in five-factor analyses for a specific nonattainment or unclassifiable area analyses, as attainment/unclassifiable. These areas are identified in a separate document entitled “Designations for Deferred Counties and County Equivalents Not Addressed in the Technical Analyses” which is available in the docket.



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

### 3.0 Technical Analyses

The areas in Wisconsin must be evaluated with an understanding of the unique nature of meteorology surrounding Lake Michigan. The eastern boundaries of Kenosha, Racine, Milwaukee, Ozaukee, Sheboygan, Manitowoc, and Door Counties follow the shoreline of Lake Michigan. Due to their proximity to the lake, these counties have 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 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 offshore air, sometimes in a helical pattern. Daytime inversions over the lake 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 toward the land from nearby and upwind plumes, to nearby and downwind areas like Milwaukee, Ozaukee, Sheboygan and Manitowoc Counties where violations of the ozone standard can be measured at locations 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, because they can produce southerly and southeasterly flows over Lake Michigan, which can enhance the flow of photochemically aged air. The relative role of each (the land/lake breeze and synoptic flow) is episode-specific and not fully understood.<sup>5, 6, 7, 8, 9</sup>

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 from over Lake Michigan while the higher level trajectories represented by the green lines at 1,000 m AGL traveled over land. Scientific studies indicate ozone can be preferentially transported over the Great Lakes relative to

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<sup>5</sup> 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.

<sup>6</sup> 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.

<sup>7</sup> 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.

<sup>8</sup> Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, *J. Appl. Meteorol.*, 34, 670–678, 1995.

<sup>9</sup> Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, *Climate Research*, 13, 207–220, 1999.

the land surface.<sup>10, 11, 12, 13, 14, 15</sup> Milwaukee and Ozaukee Counties are downwind from the Chicago CSA Chicago CSA (total 2014 reported CSA NO<sub>x</sub> = 274,440 tons, VOC= 206,171 tons) Sheboygan, Manitowoc and Door Counties are downwind of two large CSAs including the Milwaukee-Racine-Waukesha CSA (total 2014 reported CSA NO<sub>x</sub> = 51,822 tons, VOC= 49,129 tons) and the Chicago CSA (total 2014 reported CSA NO<sub>x</sub> = 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 and Lake Michigan 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 downwind counties as corroborated by the studies cited above and by the HYSPLIT trajectories shown in Figure 6.

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. 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 specific to Lake Michigan collected mostly in the early 1990's.<sup>18, 19, 20, 21, 22</sup> 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 understood. Specific details on the factors and mechanisms by which a large body of water like Lake Michigan can impact photochemical ozone production are not well-known (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, the extent to which shallow inversions above the cool lake water prevent vertical mixing, etc.).<sup>16</sup>

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<sup>10</sup> 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.

<sup>11</sup> Lyons, W. A. and Cole, H. S., Fumigation and plume trapping on the shores of Lake Michigan during stable onshore flow, *J. Appl. Meteor.*, 12, 494–510, 1973.

<sup>12</sup> Lyons, W. A. and Cole, H. S.: Photochemical oxidant transport–mesoscale lake breeze and synoptic-scale aspects, *J. Appl. Meteor.*, 15, 733–743, 1976.

<sup>13</sup> Sillman, S., Samson, P. J., and Masters, J. M.: Ozone formation in urban plumes transported over water: photochemical model and case studies in the northeastern and midwestern U.S., *J. Geophys. Res.*, 98, 12687–12699, 1993.

<sup>14</sup> Lyons, W. A., Pielke, R. A., Tremback, C. J., Walko, R. L., Moon, D. A., and Keen, C. S.: Modeling impacts of mesoscale vertical motions upon coastal zone air pollution dispersion, *Atmos. Environ.*, 29, 283–301, 1995a.

<sup>15</sup> Lyons, W. A., Tremback, C. J., and Pielke, R. A.: Applications of the Regional Atmospheric Modeling System (RAMS) to provide input to photochemical grid models for the Lake Michigan Ozone Study (LMOS), *J. Appl. Meteor.*, 34, 1762–1786, 1995b.

<sup>16</sup> 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.

While there are many 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.

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\***

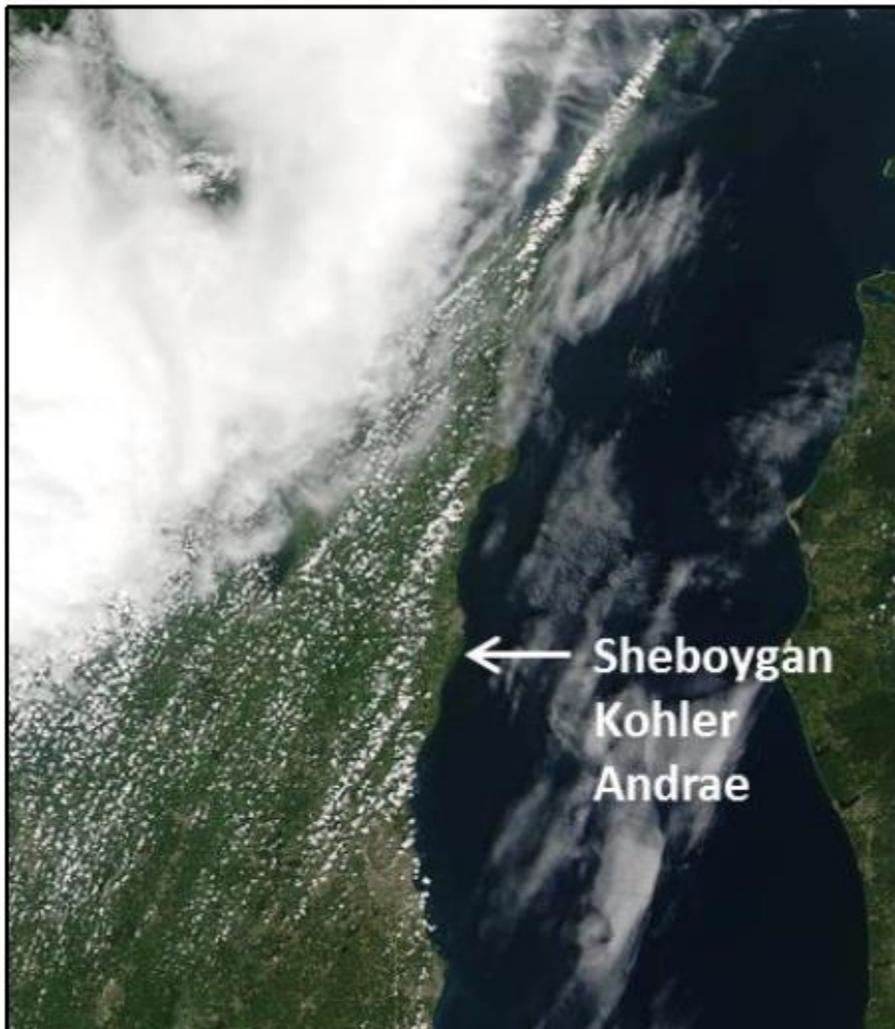
	<b>Deep lake breeze</b>	<b>Shallow lake breeze</b>	<b>No lake breeze</b>	<b>Unclear</b>	<b>Total days</b>
Sheboygan	33 (67%)	5 (10%)	11 (22%)	8	57 (2014-16)

\*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,

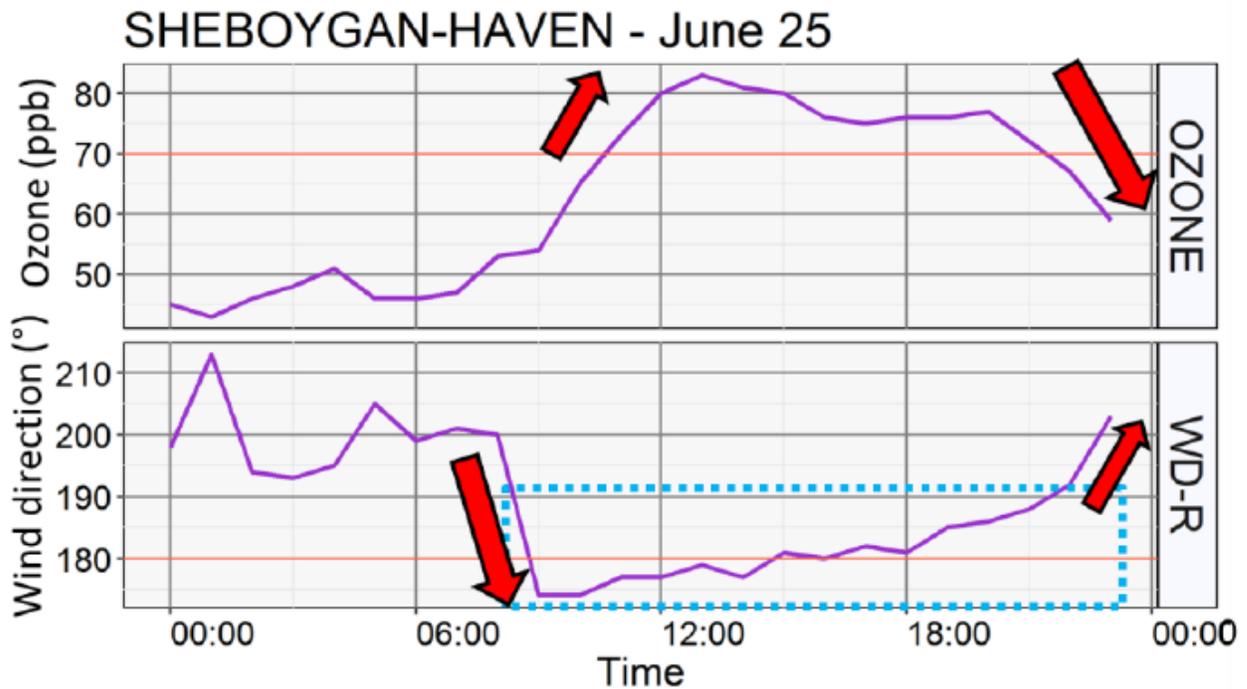
Wisconsin looked for additional confirmation by examining the synoptic meteorology of that day or wind patterns at nearby airports or air quality monitors.

**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.

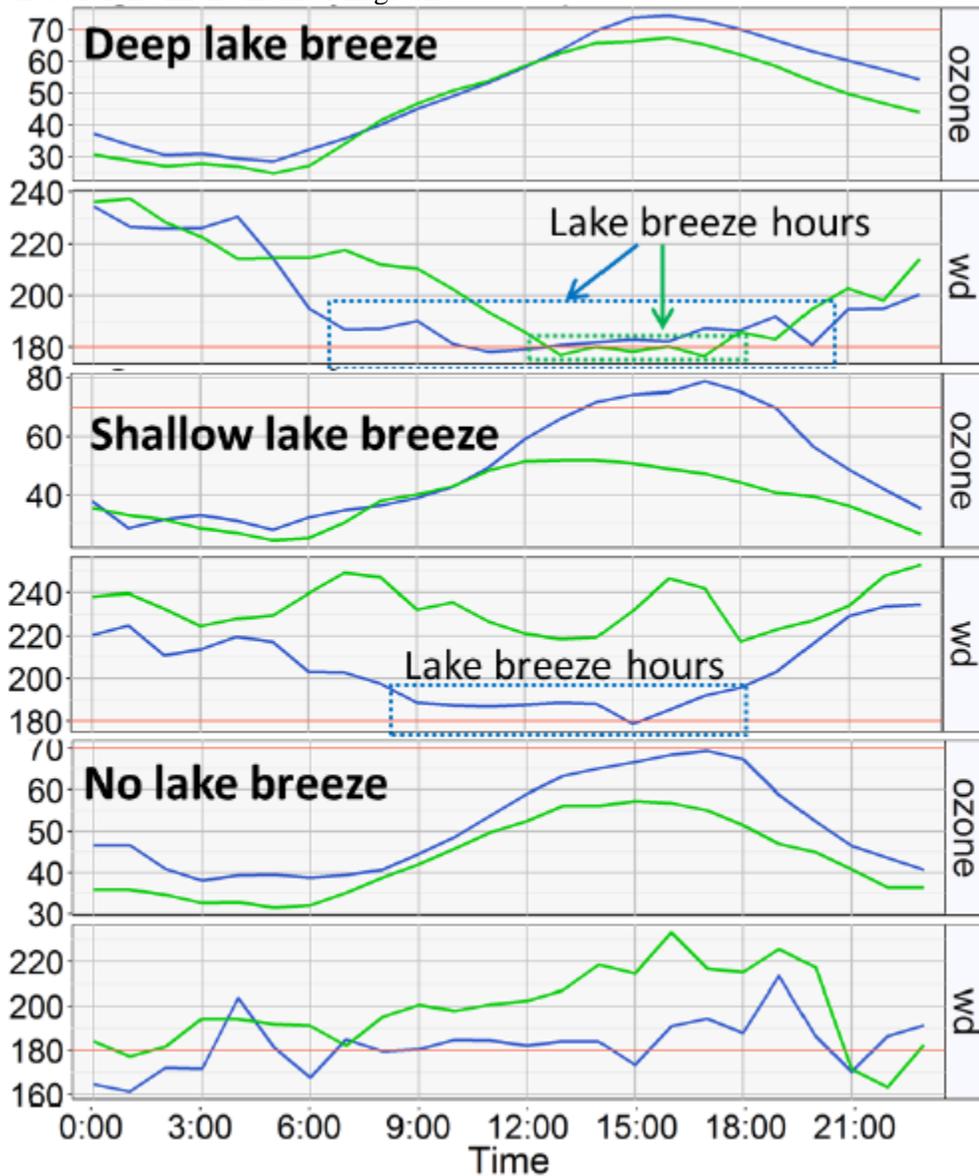
**Figure 8. Hourly ozone concentrations (top) and wind directions (bottom) for an example day (June 25, 2016) at the Sheboygan Haven monitor.** The red arrows show the onset and cessation of the lake breeze and when ozone concentrations rose and declined. The blue box encloses the hours with a lake breeze.



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.<sup>17</sup>

**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.**



To summarize, many details of the various factors regarding how the local lake breeze (alone or combined with synoptic-scale meteorology) influences ozone production and transport around Lake Michigan are

<sup>17</sup> 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.

episode-specific and not well-understood. 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 place significant weight on the effects of lake area meteorology on the analysis of both the area determined to violate the ozone NAAQS and emissions contribution from nearby sources. 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.

The information above concerning lake breeze effects and subregional/regional ozone transport from upwind areas along the western and southern shore of Lake Michigan is common to and relevant to all of the Wisconsin counties evaluated below, and is not fully repeated in each of the individual sections.

### **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 latest 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).<sup>18</sup> In addition, the EPA considered any additional 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. 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)).

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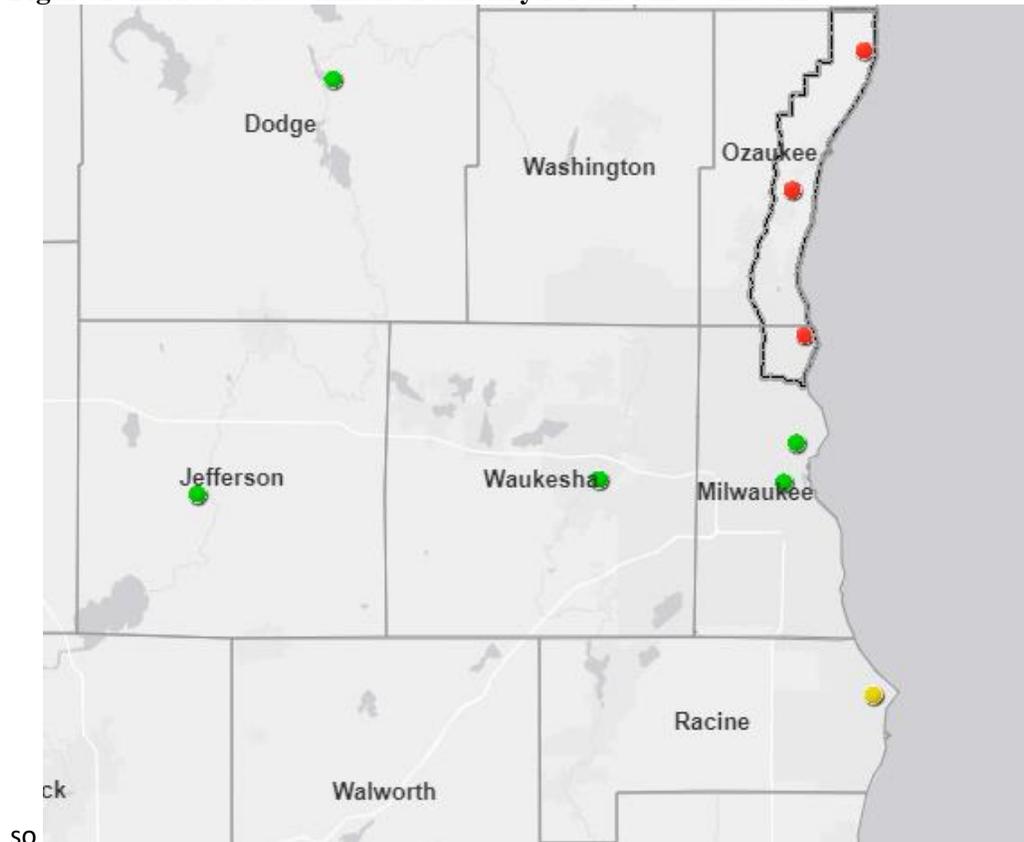
<sup>18</sup> The EPA's Ozone Designations Guidance and Data web page can be found at <https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data>.

Figure 1 is a map of the EPA’s final 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, five counties of the Milwaukee CSA were designated nonattainment, including the entire counties of Milwaukee, Ozaukee, Racine, Washington, Waukesha, and Kenosha. For the purposes of the 2008 ozone NAAQS, the entire counties of Milwaukee, Ozaukee, Racine, Washington, and Waukesha were designated as unclassifiable/attainment due to a lack of violating monitors at the time of designation. A portion of Kenosha County was designated with the Chicago area as nonattainment for the 2008 ozone NAAQS, as explained in the Chicago TSD, since Kenosha County is part of the Chicago CSA.

On December 22, 2017, EPA notified the State of Wisconsin that based on its initial 5-factor analysis, the EPA intended to include the following five counties as the Milwaukee nonattainment area for the 2015 ozone NAAQS: Ozaukee, Washington, Milwaukee, Waukesha, and Racine. In February 2018, Wisconsin provided additional technical information that EPA has reviewed and considered as part of its technical analysis included in this final TSD. This information includes an assessment of the unique lake-effect meteorology affecting ozone formation and transport in the area (See Section 3.0), including the overwhelming contributions to ozone levels in the Milwaukee area from emissions sources that are not nearby.

**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 in full or part are included in the final nonattainment area.

The following sections present information on the five-factors EPA considers in designating areas. 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). This is the most recent three-year period with fully-certified air quality data. The design value is the 3-year average of the annual 4<sup>th</sup> highest daily maximum 8-hour average ozone concentration.<sup>19</sup> 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.<sup>20</sup> 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<sup>21</sup> 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 most recent 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

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<sup>19</sup> 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.

<sup>20</sup> 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.

<sup>21</sup> 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>.

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).

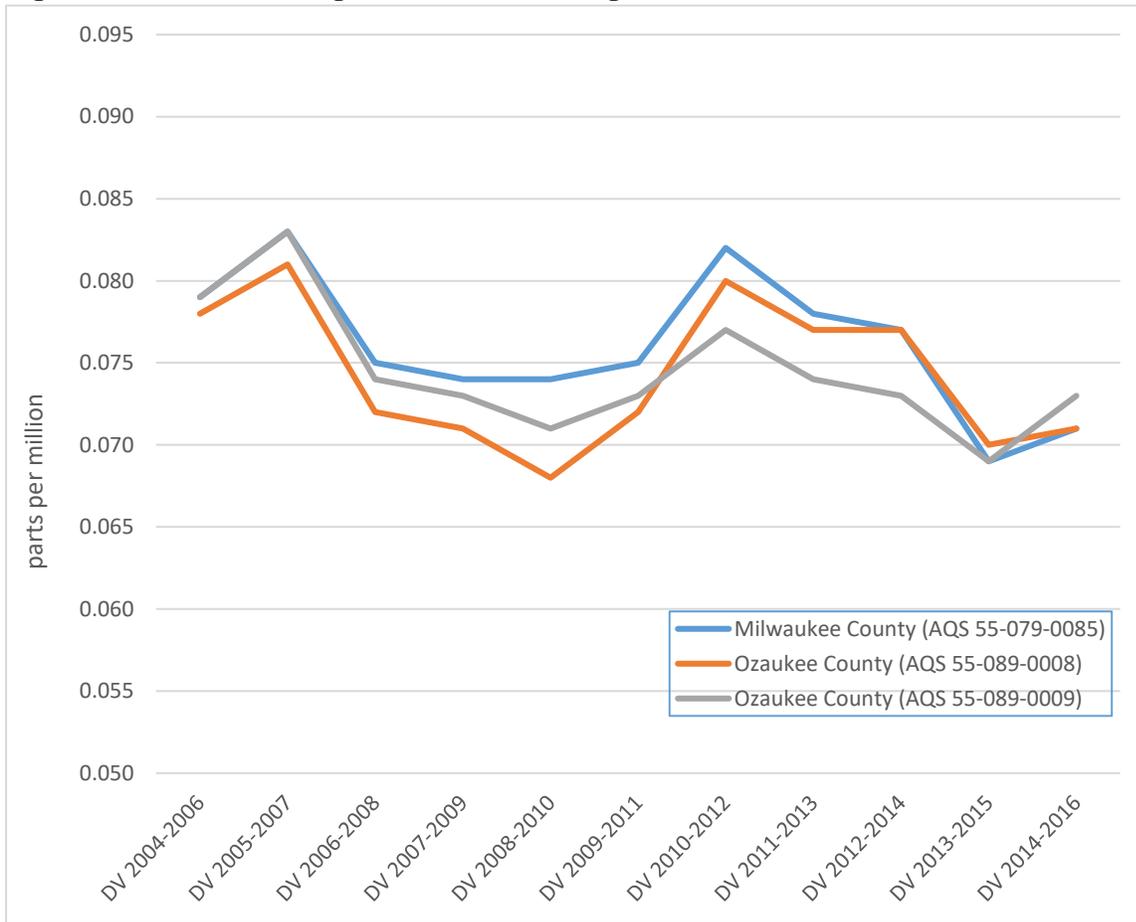
The 2016 design values for counties in the Milwaukee-Racine-Waukesha CSA are shown in Table 2.

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

County, State	State Recommended Nonattainment?	AQS Site ID	2014 -2016 DV	2014 4 <sup>th</sup> highest daily max value	2015 4 <sup>th</sup> highest daily max value	2016 4 <sup>th</sup> 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	<b>0.071</b>	0.069	0.068	0.077	
		55-079-0010	0.064	0.062	0.063	0.068	
Ozaukee, WI	No	55-089-0008	<b>0.071</b>	0.074	0.070	0.071	
		55-089-0009	<b>0.073</b>	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	

Figure 1, shown previously, identifies the Milwaukee nonattainment area and the violating monitors. Table 2 identifies the 2016 design value for all 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 are three violating monitors that are located in the Milwaukee-Racine-Waukesha CSA. Two of the violating monitors are located in Ozaukee County, including one in the northeast portion of the county approximately 0.9 miles from the shoreline of Lake Michigan and one in the east-central portion of the county approximately 2.0 miles from the shoreline of Lake Michigan. The third violating monitor is located in the northeastern portion of Milwaukee County approximately 0.8 miles from the shoreline of Lake Michigan. As shown in Figure 2, the violating monitors have historically high ozone design values, which have been generally decreasing in recent years; 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 in full or part are included in the final 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<sub>x</sub>) 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<sub>x</sub> 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.

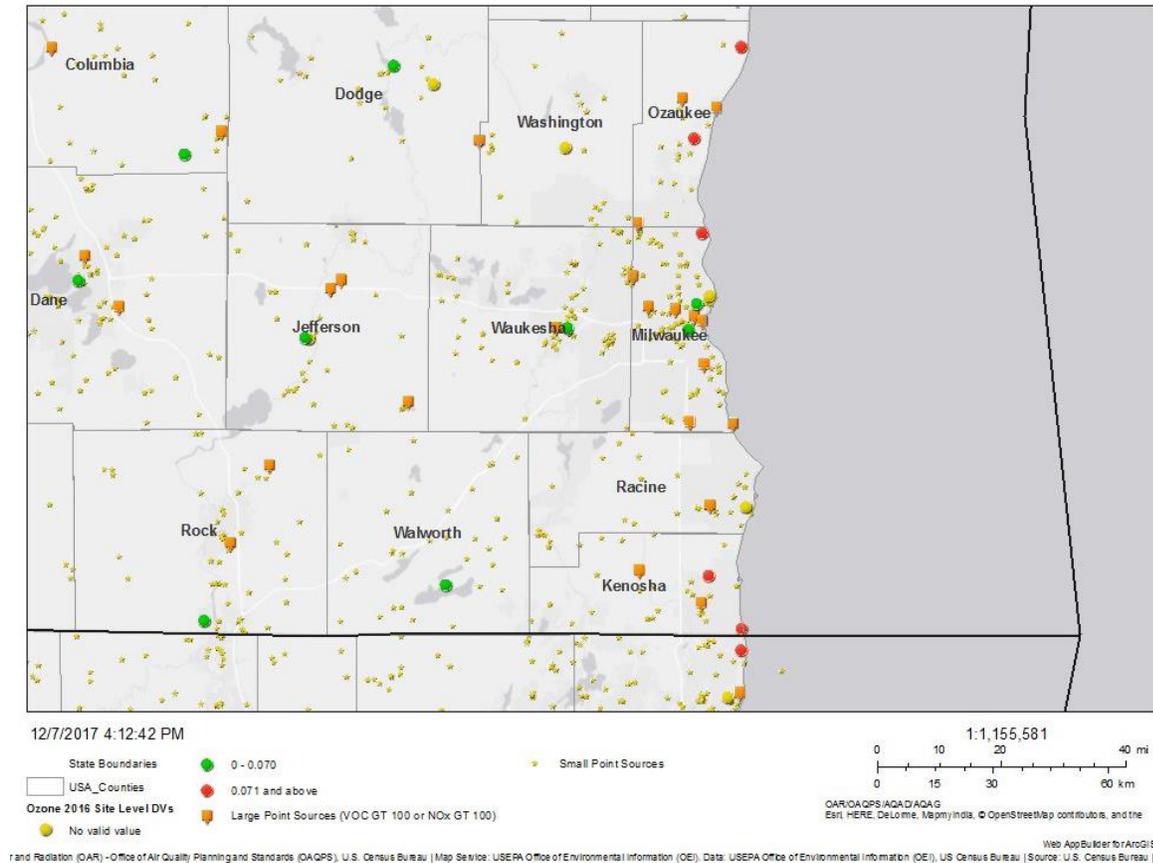
Table 3 provides a county-level emissions summary of total NO<sub>x</sub> and VOC (given in tons per year (tpy)) emissions from all types of emissions sources for the area of analysis considered for inclusion in the Milwaukee nonattainment area. The location of both larger and smaller point sources that emit NO<sub>x</sub> and VOC emissions are shown in Figure 3.

**Table 3. Total County-Level NO<sub>x</sub> and VOC Emissions.**

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

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

**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<sub>x</sub> emissions in the Milwaukee-Racine-Waukesha CSA, Milwaukee County has the highest NO<sub>x</sub> emissions on the order of 22,000 tpy, followed by Waukesha County with approximately 9,000 tpy, Racine County with 4,000 tpy and Washington, Jefferson, Ozaukee, Dodge, and Walworth counties, each on the order of 3,000 tpy. In terms of VOC emissions, Milwaukee County has the greatest emissions on the order of 17,000 tpy, followed by Waukesha County with approximately 10,000 tpy, Dodge and Racine Counties, each on the order of 4,000 tpy, and Jefferson, Ozaukee, Washington, and Walworth counties, each on the order of 3,000 tpy. Ozaukee has the lowest VOC emissions on the order of 2,000 tpy.

In terms of NO<sub>x</sub> emissions, Milwaukee County accounts for 43% of the total CSA NO<sub>x</sub> emissions, following by Waukesha County (19%); Racine, Washington, Jefferson, Ozaukee, Dodge, and Walworth each account for between 5% and 8% of total CSA NO<sub>x</sub> emissions. In terms of VOC emissions, Milwaukee County accounts for 35% of the total CSA VOC emissions, followed by Waukesha County (21%); Racine, Washington, Jefferson, Ozaukee, Dodge, and Walworth each account for between 4% and 9% of 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<sub>x</sub> 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<sub>x</sub> 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.**

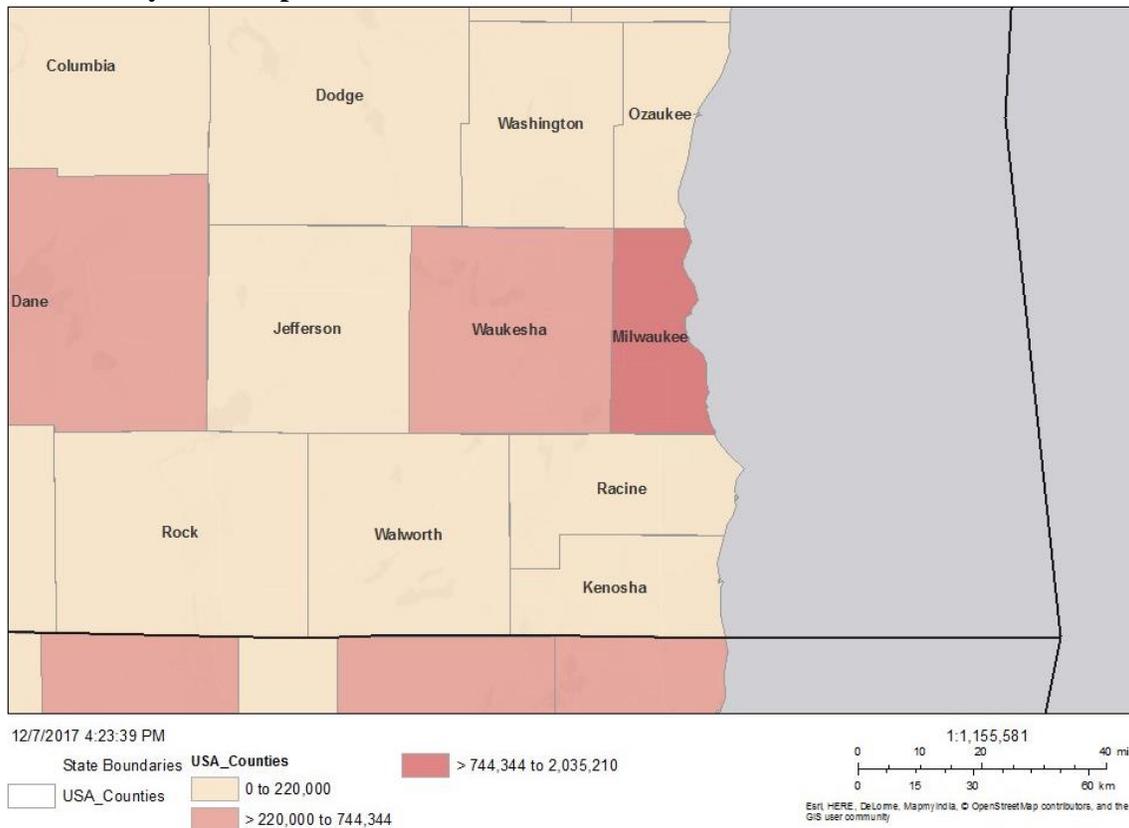
Source: U.S. Census Bureau population estimates for 2010 and 2015. [www.census.gov/data.htm](http://www.census.gov/data.htm).

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	3,967	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<sup>22</sup> 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.

**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)
<b>Milwaukee, WI</b>	<b>No*</b>	<b>6,102</b>	<b>433,062</b>	<b>313,985</b>	<b>73%</b>
Waukesha, WI	No	3,613	206,449	73,735	36%
Racine, WI	No	1,357	97,523	23,445	24%
Washington, WI	No	1,330	72,126	22,484	31%
Jefferson, WI	No	989	42,341	3,405	8%
Walworth, WI	No	979	47,254	4,212	9%
Dodge, WI	No	942	43,001	1,769	4%
<b>Ozaukee, WI</b>	<b>No*</b>	<b>903</b>	<b>45,289</b>	<b>31,852</b>	<b>70%</b>
Total:		16,215	987,045	474,887	48%

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

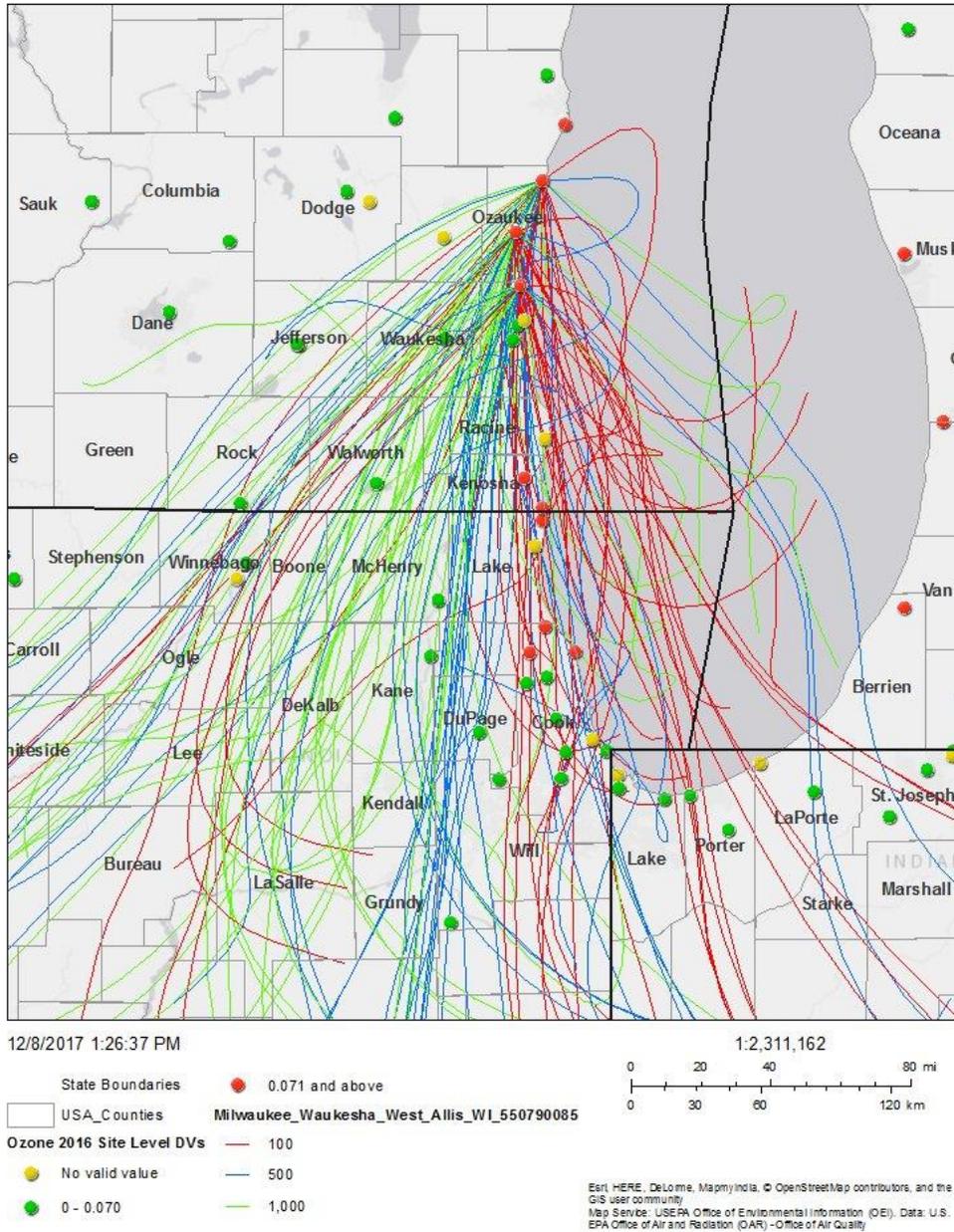
\*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

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



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.**



Web App Builder for ArcGIS  
Map Service: USEPA Office of Environmental Information (OEI), Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, Garmin, NGA, USGS, NPS |

The unique dynamics of Lake Michigan ozone-formation and transport is previously discussed in section 3.0. In their February 2018 TSD, WI indicates that the unique dynamics of Lake Michigan ozone-formation and transport make coarse-grained HYSPLIT trajectories less reliable indicators of fine-scale meteorological processes associated with lake breezes, and that only the 100 m trajectories (represented

by the red lines in Figure 6) are relevant in lakeshore areas for assessing the potential impact of regional air movements on monitored ozone concentrations. The 100 m trajectories show that, on exceedance days, air parcels traveled almost exclusively from the south with most passing over Lake Michigan and originating in upwind areas over the lake and along the southern shore of Lake Michigan.

#### **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 section 3.0, areas geographically located along the shoreline of Lake Michigan, including Manitowoc County, can be impacted by lake breeze meteorology which transports photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind coastal areas along Lake Michigan.

#### **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 and Wisconsin’s recommendation, the final nonattainment area boundary includes the sub-county areas encompassing the violating monitors and is based on a distance-from-shoreline approach corresponding to WDNR’s determination of the 70 ppb ozone design value contour.

**Additional Information**

As shown in Table 2 (below) from Wisconsin’s February 2018 TSD, ozone-forming emissions from upwind Chicago areas are more than 5 times greater than the emissions levels in the 5-county Milwaukee area. In light of lake meteorology, the magnitude of these emissions in relation to the magnitude of emissions from sources in the Milwaukee area is an important consideration.

**Table 2. Comparison of 2014 NOx and VOC emissions from sources in the southern and western Lake Michigan area.** Emissions are shown for whole-county areas and are from the 2014 National Emissions Inventory (NEI) v1.

Area	Emissions (tons)		% of Total Emissions	
	NOx	VOC	NOx	VOC
Chicago NAA - Cook County, IL	95,864	86,253	33%	37%
Chicago NAA - Other IL	87,982	71,749	30%	31%
Chicago NAA - IN	45,572	21,399	16%	9%
Kenosha County	6,034	3,290	2%	1%
<b>Total Chicago Area</b>	<b>235,452</b>	<b>182,691</b>	<b>81%</b>	<b>79%</b>
Racine County	4,153	4,296	1%	2%
Milwaukee County	22,012	17,016	8%	7%
Waukesha County	9,685	10,526	3%	5%
Ozaukee County	3,107	2,003	1%	1%
Washington County	3,543	3,625	1%	2%
<b>Total Milwaukee Area</b>	<b>42,500</b>	<b>37,466</b>	<b>15%</b>	<b>16%</b>

WI has provided information suggesting emissions reductions from sources in the Milwaukee area have little to no impact on high ozone values at the violating monitors Milwaukee and Ozaukee Counties. Some aspects of these claims are difficult to fully evaluate because EPA does not have the details necessary to fully review the emissions reduction modeling analyses that these claims are based on. WI’s ozone source apportionment modeling<sup>23</sup> shows the Wisconsin contributions to the Milwaukee area

<sup>23</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not provide any details on the source apportionment modeling. No information was provided on specific methods used to calculate design value contributions from the source apportionment modeling outputs.

violating monitors range from 7 – 15 percent<sup>24</sup>; much larger portions came from out-of-state (e.g., 26 percent from Illinois plus 8.5 percent from Indiana to Milwaukee’s Bayside monitor) and from international sources (roughly 20 percent, identified as boundary conditions which represent a combination of international, natural, and to a lesser extent US sources). Wisconsin claims that because of the overwhelming impact of transported emissions, there is no evidence that local emissions reductions meaningfully improve local air quality in the Milwaukee area (see WDNR TSD Table 3, p.16). Modeling hypothetical 10% reductions<sup>25</sup> in man-made NO<sub>x</sub> and VOC emissions from stationary and nonroad sources (not including highway vehicles) across a 10-county area that includes five Milwaukee-area counties produced no meaningful reduction in ozone design values at any of the Milwaukee-area monitors, with impacts ranging from -0.1 ppb to +0.2 ppb. Further, they indicate emissions of NO<sub>x</sub> and VOCs from the 5-county Milwaukee area decreased by 25 and 33 percent, respectively, from 2008 to 2014, while ozone design values (unadjusted for meteorological variability) in the Milwaukee area have remained relatively flat during this period<sup>26</sup>.

### **Conclusion for Milwaukee Area**

Based on the assessment of factors described above, in addition to analysis provided by WI in their February 2018 and their April 20, 2017 submissions, EPA is finalizing a nonattainment area for the Milwaukee area with boundaries consistent with those provided by the state in the February 2018 submission. This is the area that includes the violating monitors and the immediate vicinity around those monitors in Milwaukee and Ozaukee Counties expected to have air quality that does not meet the NAAQS. As provided below, after considering the State submissions and the five-factor analysis above, the EPA does not believe that there is sufficient evidence of contribution from the other areas in the area of analysis and thus a designation consisting of the area violating the standard is appropriate.

In Wisconsin’s February 2018 submittal included in the docket, the state requested that any nonattainment boundary cover a distance inland from the ordinary high water mark (OHWM). For purposes of managing air quality-related regulatory requirements, EPA is specifying a boundary based on identifiable roadways rather than the OHWM (see responses to comments (RTC) accompanying this final action). Therefore, EPA selected roadways that were roughly the distance inland from the shoreline requested by the state, which was 2.9 miles inland from the shoreline in Ozaukee and Milwaukee counties and 2.8 miles south of the violating monitor in Milwaukee County. Wisconsin submitted a demonstration that ozone concentrations above 0.070 ppm in these counties is confined to a distance of 2.9 miles inland from the shoreline in Ozaukee and Milwaukee counties and 2.8 miles south of the violating monitor in Milwaukee

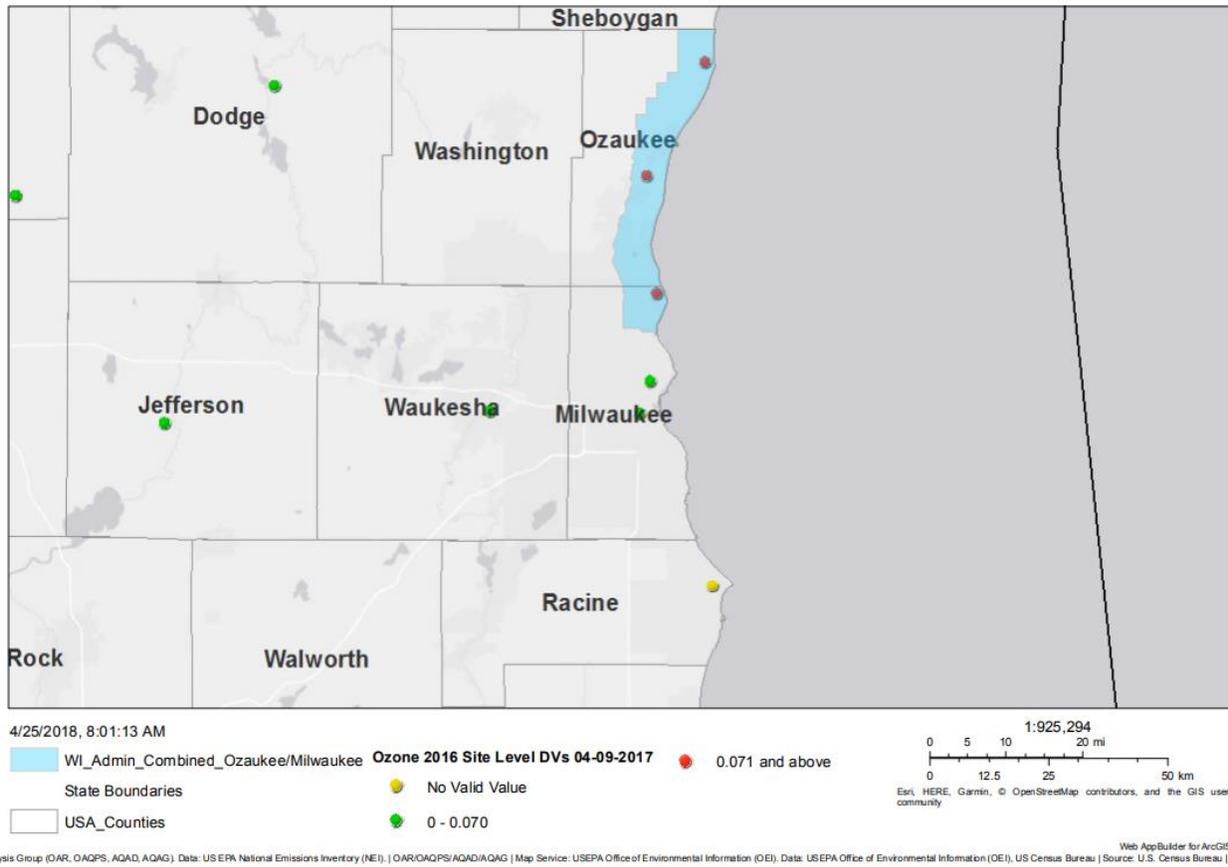
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<sup>24</sup> Bayside monitor = 7%, Grafton monitor = 15%, and Harrington Beach monitor = 12%

<sup>25</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not cover the 10 percent reduction scenario. EPA notes that the base case inventories in the WI TSD appendix A show that approximately 40% of the NO<sub>x</sub> emissions and 25% of the VOC emissions in the 10-county area are from onroad sources, which are not included in the 10% reduction scenario. Rough calculations would indicate that the total reduction in anthropogenic emissions in the 10-county area would be less than 10%, probably on the order of 6-8%.

<sup>26</sup> Note that the reference in the WI TSD provided meteorology-adjusted ozone trends covering a longer time-period (2000-2015) which do show decreasing trends in Milwaukee. Wisconsin did not provide any information on meteorology-adjusted trends for the relatively short time-period (2008-2014) discussed in their submission or address changes in contributing sources outside of the Milwaukee area over this time-period.

County. This area includes all three of the violating monitors in the CSA. The EPA does not believe there is sufficient information to disagree with the State’s assessment showing minimal impact on violating lakeshore monitors when NOx and VOC emissions across a 10-county area are reduced.



The roadways for the Ozaukee County boundary are inclusive and east of 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.

The roadways for the Milwaukee County boundary are 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.

### 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 latest 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).<sup>27</sup> In addition, the EPA considered any additional data or information provided to the EPA by states or tribes.

The area of analysis is 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)).

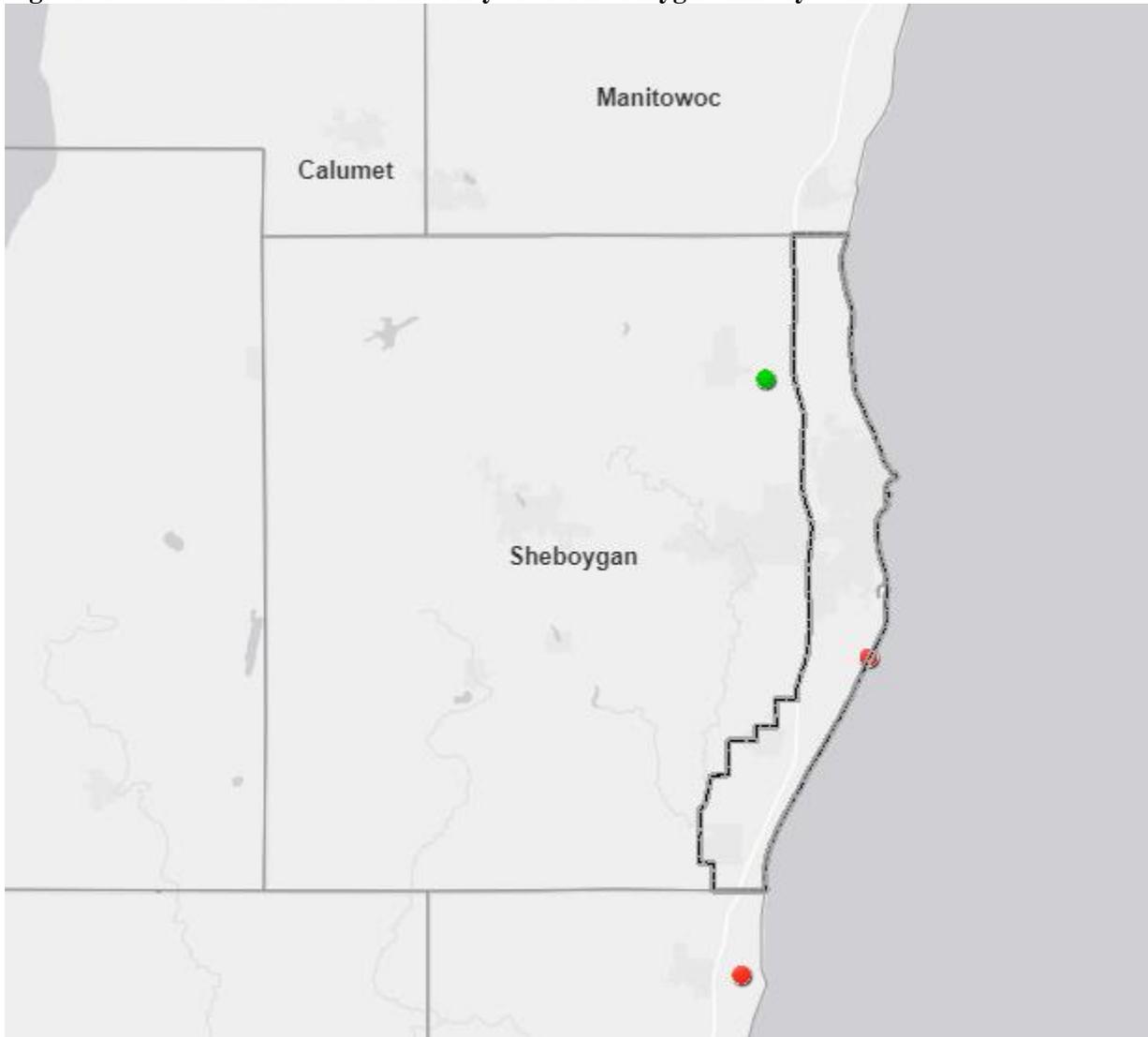
Figure 1 is a map of the EPA's nonattainment boundary for the Sheboygan County area. The map shows the location of the ambient air quality monitors, county, and other jurisdictional boundaries.

For purposes of both the 1997 ozone NAAQS and the 2008 ozone NAAQS, the entirety of Sheboygan County was designated nonattainment. On December 22, 2017, EPA notified the State of Wisconsin that based on its initial 5-factor analysis, that EPA intended to designate a portion of Sheboygan County as nonattainment for the 2015 ozone NAAQS – the portion of the county roughly 2.3 miles inland from the shoreline. In February 2018, Wisconsin provided additional technical information that EPA has reviewed and considered as part of its technical analysis included in this final TSD. This information includes an assessment of the unique lake-effect meteorology affecting ozone formation and transport in the area (described above in section 3.0), including the overwhelming contributions to ozone levels in the Sheboygan area from emissions sources that are not nearby.

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<sup>27</sup> 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 present information on the five-factors EPA considers in designating areas. 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). This is the most recent three-year period with fully-certified air quality data. The design value is the 3-year average of the annual 4<sup>th</sup> highest daily maximum 8-hour average ozone concentration.<sup>28</sup> 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.<sup>29</sup> 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<sup>30</sup> 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 most recent 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).

The 2016 design values for Sheboygan County are shown in Table 2.

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<sup>28</sup> 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.

<sup>29</sup> 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.

<sup>30</sup> 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).**

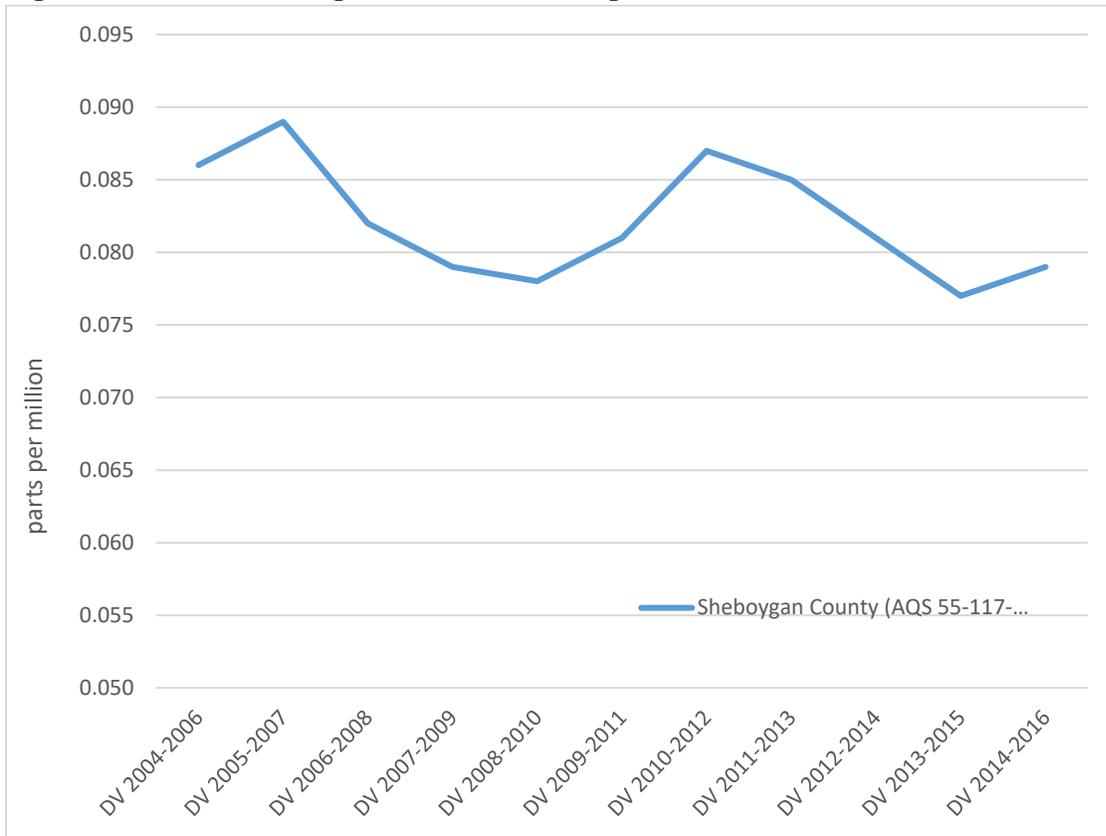
County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4 <sup>th</sup> highest daily max value	2015 4 <sup>th</sup> highest daily max value	2016 4 <sup>th</sup> highest daily max value
Sheboygan, WI	No	55-117-0006	<b>0.079*</b>	0.072	0.081	0.085
		55-117-0009	0.069	0.068	0.067	0.074

\*Despite violating monitors, in a September 21, 2016, letter from its governor, Wisconsin recommended attainment for the entire state. Later in an April 20, 2017, supplemental submittal, which Wisconsin explains contains technical information to support the governor’s recommendation and which contains Wisconsin’s estimates of 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 EPA should ensure that the geographic scope of these areas is minimized. 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 in its April 20, 2017, submittal that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS.

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 values for the monitors in Sheboygan County 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 is 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 (2007-2016).**



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<sub>x</sub>) 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<sub>x</sub> 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.

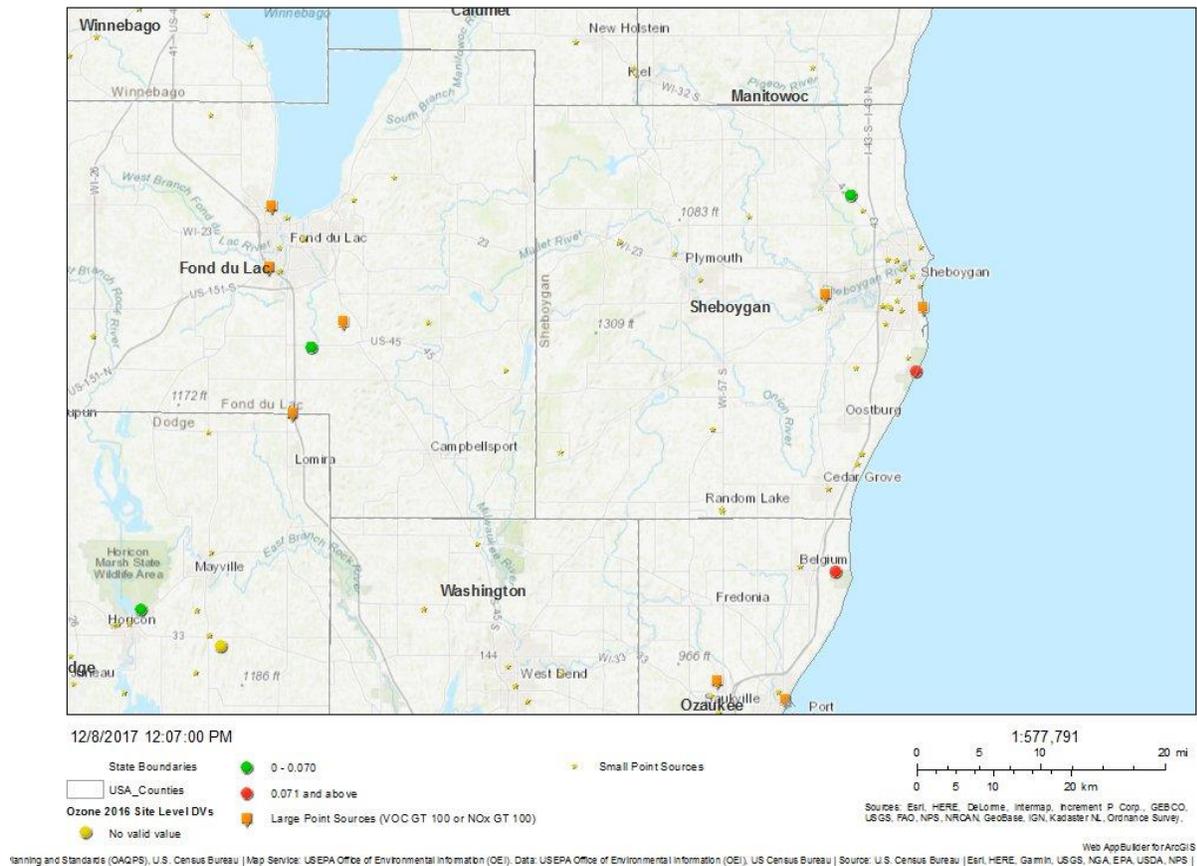
Table 3 provides a county-level emissions summary of NO<sub>x</sub> and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for Sheboygan County. The location of both larger and smaller point sources that emit NO<sub>x</sub> and VOC emissions are shown in Figure 3.

**Table 3. Total County-Level NO<sub>x</sub> and VOC Emissions.**

<b>County, State</b>	<b>State Recommended Nonattainment?</b>	<b>Total NO<sub>x</sub> (tpy)</b>	<b>Total VOC (tpy)</b>
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.

**Figure 3. Point Sources in the Area of Analysis.**



Examination 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<sub>x</sub> and 37.47 tons of VOC emitted in 2014. Bemis-Plant B reported 5.04 tons of NO<sub>x</sub> and 183.89 tons of VOC emitted in 2014. Approximately 23 small point sources in Sheboygan County, 18 of which reported NO<sub>x</sub> 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<sub>x</sub> and 329.64 tons of VOC in 2014. The largest NO<sub>x</sub> emitter of these sources, Nemark Gateway Plant, emitted a reported 45.39 tons of NO<sub>x</sub> and the largest VOC emitter of these sources, Plymouth Foam Inc., emitted a reported 56.67 tons of VOC in 2014.

**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<sub>x</sub> 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<sub>x</sub> 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](http://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

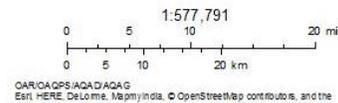
\*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

**Figure 4. County-Level Population.**



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State Boundaries USA\_Counties  
 USA\_Counties 0 to 220,000



g and Standards (OAGPS), U.S. Census Bureau | Map Service: USEPA Office of Environmental Information (OEI); Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, Garmin, NGA, USGS, NPS | Esri, HERE, NPS |

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<sub>x</sub> and 1,405 tons of VOC. The on-road

emissions reported to the 2014 NEI were 1,384 tons of NO<sub>x</sub> and 676 tons of VOC. The non-road emissions reported to the 2014 NEI were 708 tons of NO<sub>x</sub> and 775 tons of VOC.

**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<sup>31</sup> 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.**

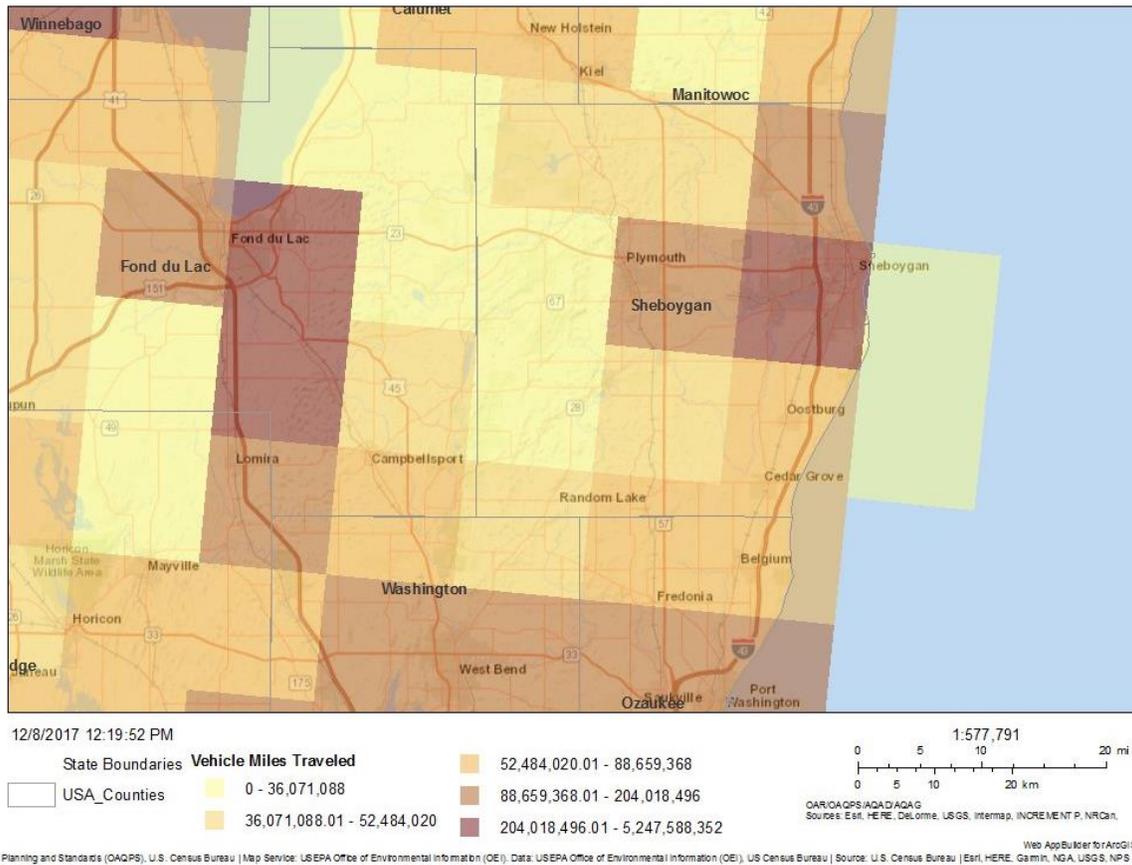
<b>County</b>	<b>State Recommended Nonattainment?</b>	<b>2014 Total VMT (Million Miles)</b>	<b>Number of County Residents Who Work</b>	<b>Number of County Residents Commuting Within the County</b>	<b>Percentage of County Residents Commuting Within the County</b>
Sheboygan, WI	No*	928	58,178	39,848	68%

\*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.

<sup>31</sup> The worker data can be accessed at: <http://onthemap.ces.census.gov/>.

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

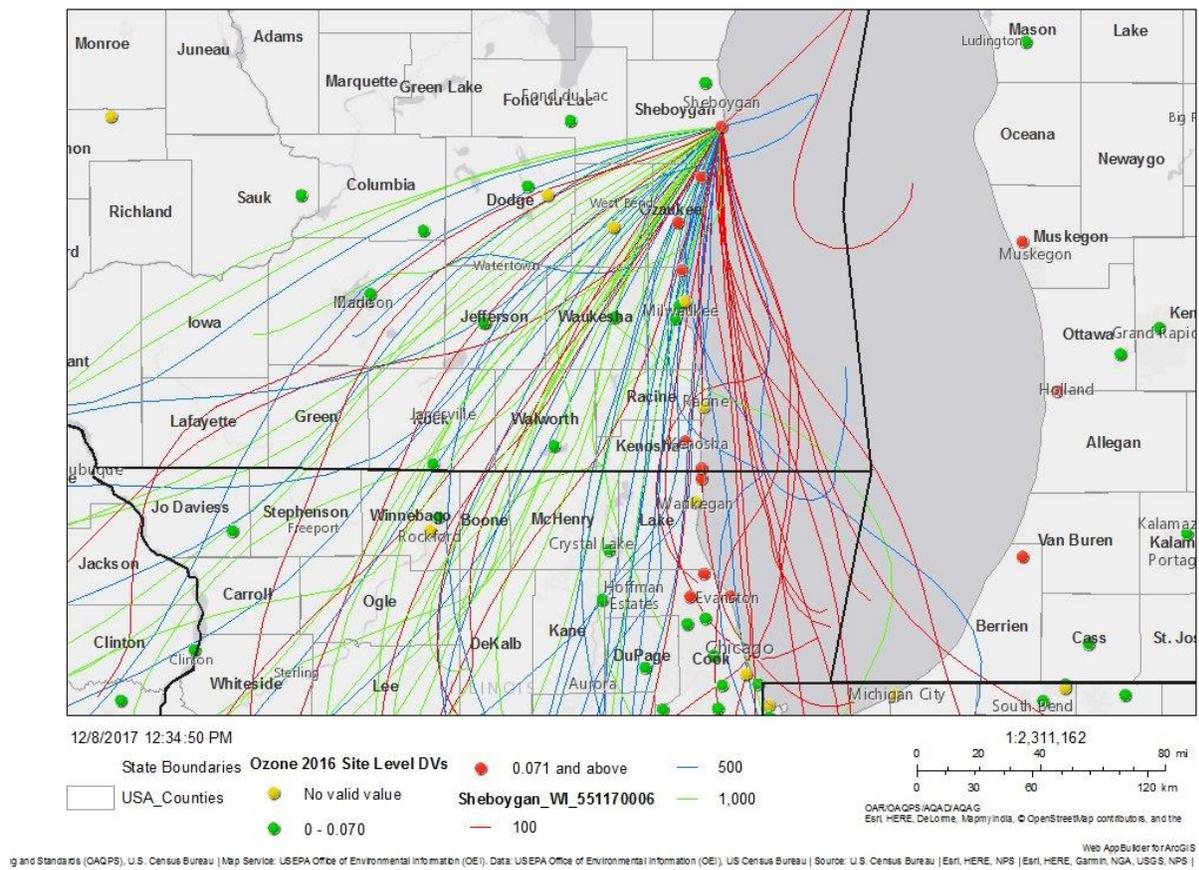


Sheboygan County has a relatively low population density and degree of urbanization. The reported vehicle miles traveled (VMT) for 2014 were 928 million miles, and the on-road emissions reported to the 2014 NEI were 1,384 tons of NO<sub>x</sub> and 676 tons of VOC. The majority of the VMT are concentrated 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.

**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 unique dynamics of Lake Michigan ozone-formation and transport is previously discussed in section 3.0. In their February 2018 TSD, WI indicates that the unique dynamics of Lake Michigan ozone-formation and transport make coarse-grained HYSPLIT trajectories less reliable indicators of fine-scale meteorological processes associated with lake breezes, and that only the 100 m trajectories (represented by the red lines in Figure 6) are relevant in this areas for assessing the potential impact of regional air movements on monitored ozone concentrations. The 100 m trajectories show that, on exceedance days, air parcels traveled almost exclusively from the south with most passing over Lake Michigan and originating in upwind areas over the lake and along the southern shore of Lake Michigan.

#### **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 Section 3.0, areas geographically located along the shoreline of Lake Michigan, including Sheboygan County, can be impacted by lake breeze meteorology which transports photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind coastal areas along Lake Michigan.

#### **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 proposed 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 proposed designated areas.

The area of analysis was Sheboygan County, which is not part of a CSA and which is its own CBSA. For purposes of both the 1997 ozone NAAQS and the 2008 ozone NAAQS, the entirety of Sheboygan County was designated nonattainment.

#### **Additional Information**

As shown in Table 2 (below) from Wisconsin's February 2018 TSD, ozone-forming emissions from upwind Chicago areas are more than 50 times greater than the emissions levels in Sheboygan County. In light of lake meteorology, the magnitude of these emissions in relation to the magnitude of emissions from sources in the Sheboygan area is an important consideration.

**Table 2. Comparison of 2014 NOx and VOC emissions from sources in the southern and western Lake Michigan area.** Emissions are shown for whole-county areas and are from the 2014 National Emissions Inventory (NEI) v1.

Area	Emissions (tons)		% of Total Emissions	
	NOx	VOC	NOx	VOC
Chicago NAA - Cook County, IL	95,864	86,253	33%	37%
Chicago NAA - Other IL	87,982	71,749	30%	31%
Chicago NAA - IN	45,572	21,399	16%	9%
Kenosha County	6,034	3,290	2%	1%
<b>Total Chicago Area</b>	<b>235,452</b>	<b>182,691</b>	<b>81%</b>	<b>79%</b>
Sheboygan County	4,585	3,421	2%	1%
Manitowoc County	3,253	2,812	1%	1%
Kewaunee County	1,141	1,291	0%	1%
Door County*	3,066	2,439	1%	1%

WI has provided information suggesting emissions levels from sources in the immediate area are not highly correlated with high ozone values at the violating monitor in Sheboygan County. Some aspects of these claims are difficult to fully evaluate because EPA does not have the details necessary to fully review the emissions reduction modeling analyses that these claims are based on. WI’s ozone source apportionment modeling<sup>32</sup> shows the Wisconsin contributions to the Sheboygan County violating monitor is about 12 percent; larger portions came from out-of-state (e.g., 23 percent from Illinois plus 10 percent from Indiana) and from international sources (roughly 20 percent, identified as boundary conditions which represent a combination of international, natural, and to a lesser extent US sources). WI claims that because of the overwhelming impact of transported emissions, there is no evidence that local emissions reductions meaningfully improve local air quality (see WDNR TSD Table 3, p.16). Modeling hypothetical 10% reductions<sup>33</sup> in man-made NOx and VOC emissions from stationary and nonroad sources (not including highway vehicles) across a 10-county area that includes Sheboygan County produced no meaningful reduction in ozone design values at the Kohler Andrae monitor, with a change of -0.1 ppb. Further a “zero-out Sheboygan run” that completely eliminated man-made emissions from all emissions source sectors in Sheboygan county produced no improvement in the ozone design value at the Kohler Andrae monitor.

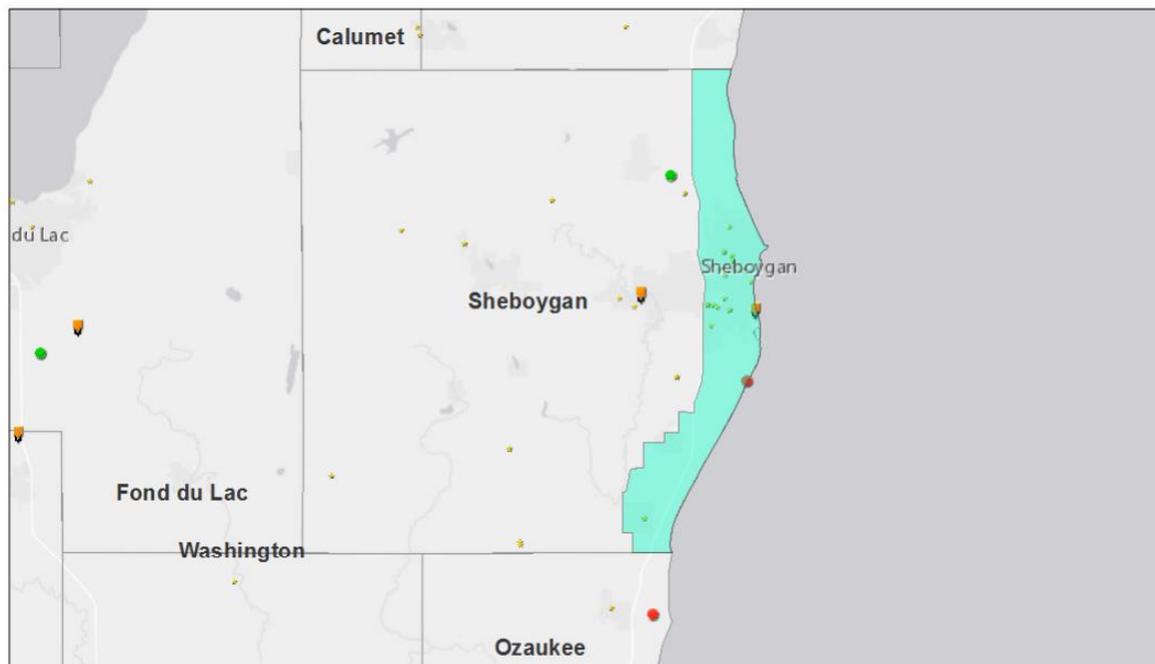
<sup>32</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not provide any details on the source apportionment modeling. No information was provided on specific methods used to calculate design value contributions from the source apportionment modeling outputs.

<sup>33</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not cover the 10 percent reduction scenario. EPA notes that the base case inventories in the WI TSD appendix A show that approximately 40% of the NOx emissions and 25% of the VOC emissions in the 10-county area are from onroad sources, which are not included in the 10% reduction scenario. Rough calculations would indicate that the total reduction in anthropogenic emissions in the 10-county area would be less than 10%, probably on the order of 6-8%.

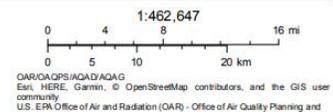
## Conclusion for Sheboygan County Area

Based on the assessment of factors described above, in addition to analysis provided by WI in their February 2018 and their April 20, 2017 submissions, EPA is finalizing nonattainment boundaries consistent with the boundaries provided by the state which includes the violating monitors and the immediate vicinity around the monitor in Sheboygan County expected to have air quality that does not meet the NAAQS. As provided by the States, ozone concentrations above 0.070 ppm in Sheboygan County is confined to a distance of 2.3 miles inland from the shoreline. The EPA is designating all remaining portions of Sheboygan County as attainment/unclassifiable. Considering the information submitted by the State regarding overwhelming transport from upwind areas along the lakeshore and modeling demonstrating that reducing Sheboygan area emissions would not affect ozone concentrations at the Kohler Andrae monitor, EPA does not believe there is sufficient evidence that these other portions of Sheboygan County contribute to air quality at the violating monitor.

In the February 2018 submittal included in the docket, the state requested that the nonattainment boundary be established as a distance inland from the ordinary high water mark (OHWM). For purposes of managing air quality-related regulatory requirements, EPA is specifying a boundary based on identifiable roadways rather than the OHWM (see responses to comments (RTC) accompanying this final action). Therefore, EPA selected roadways that were roughly the distance inland (2.3 miles) from the shoreline most recently requested by the state.



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Web AppBuilder for ArcGIS  
 ational Emissions Inventory (NEI) | QAR/QGPS/AQAD/AQAG | Map Service: USEPA Office of Environmental Information (OEI), Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, Garmin, NGA, USGS, NPS | Esri, HERE, NPS |

The final nonattainment boundary is inclusive and east of the following roadways going from the northern county boundary to the southern county boundary: Highway 43, Wilson Lima Road, Minderhau 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.

### 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 latest 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).<sup>34</sup> In addition, the EPA considered any additional 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)).

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. 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. On December 22, 2017, EPA notified the State of Wisconsin that based on its initial 5-factor analysis, that EPA intended to designate a portion of Manitowoc County as nonattainment for the 2015 ozone NAAQS – the portion of the county roughly 3.2 miles inland from the shoreline.<sup>35</sup> In

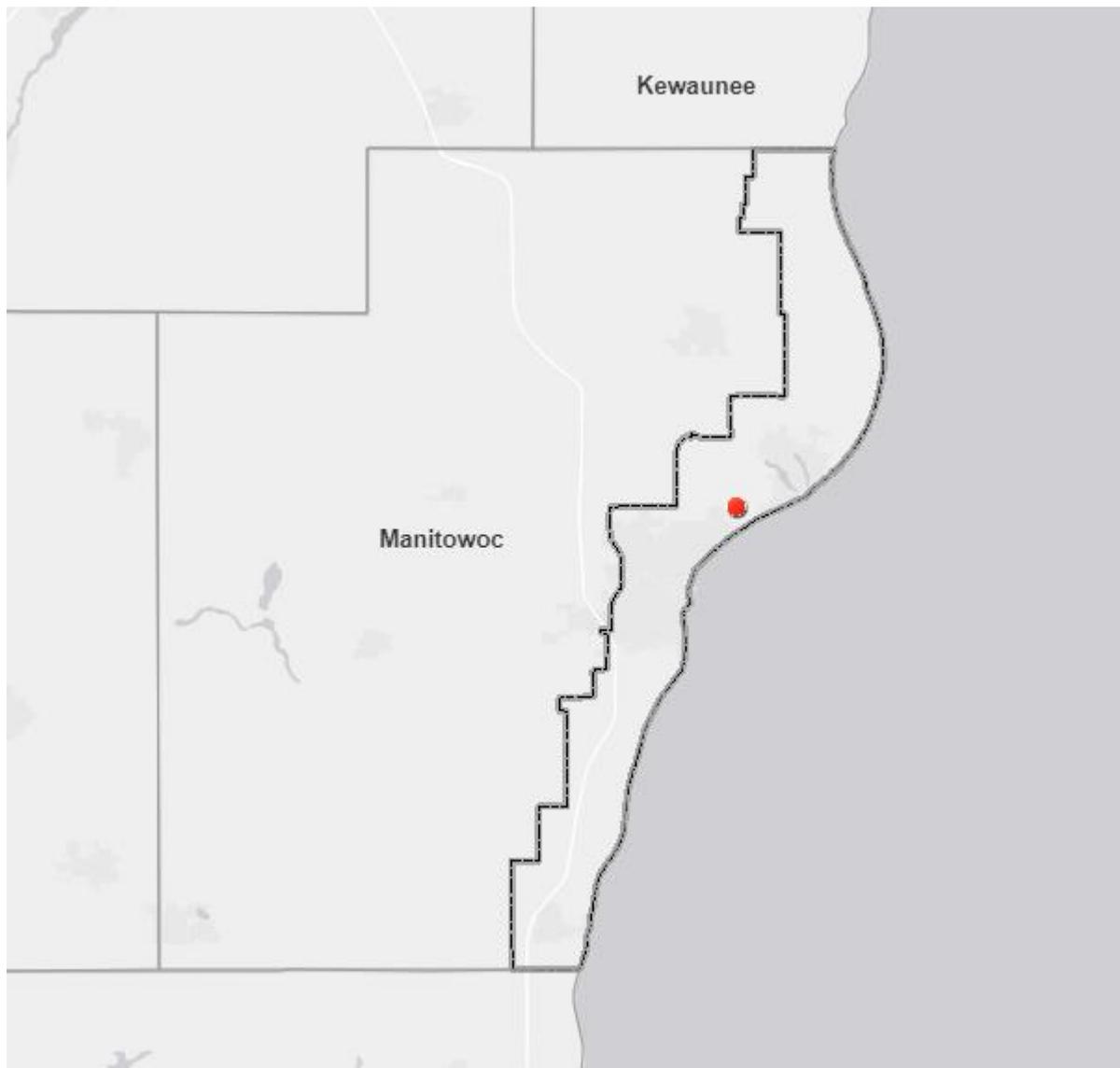
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<sup>34</sup> The EPA's Ozone Designations Guidance and Data web page can be found at <https://www.epa.gov/ozone-designations/ozone-designations-guidance-and-data>.

<sup>35</sup> 3.2 miles is the inland distance of the attaining monitor in Sheboygan County, which is just south of Manitowoc County. Manitowoc County only has one monitor, and it is violating. In other words, Manitowoc County does not have a second inland attaining monitor on which to conduct a lake breeze inland penetration distance analysis, like the one conducted for Sheboygan County.

February 2018, Wisconsin provided additional technical information that EPA has reviewed and considered as part of its technical analysis included in this final TSD. This information includes an assessment of the unique lake-effect meteorology affecting ozone formation and transport in the area (See Section 3.0), including the overwhelming contributions to ozone levels in the Manitowoc County area from emissions sources that are not nearby.

**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. EPA's final conclusions are based on the analysis provided by Wisconsin

demonstrating that modeled emissions reductions from the other portions of Manitowoc County had minimal, if any, impact on projected ozone concentrations along the lakeshore.

The following sections present information on the five-factors EPA considers in designating areas. 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). This is the most recent three-year period with fully-certified air quality data. The design value is the 3-year average of the annual 4<sup>th</sup> highest daily maximum 8-hour average ozone concentration.<sup>36</sup> 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.<sup>37</sup> 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<sup>38</sup> 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.

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<sup>36</sup> 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.

<sup>37</sup> 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.

<sup>38</sup> 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>.

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

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

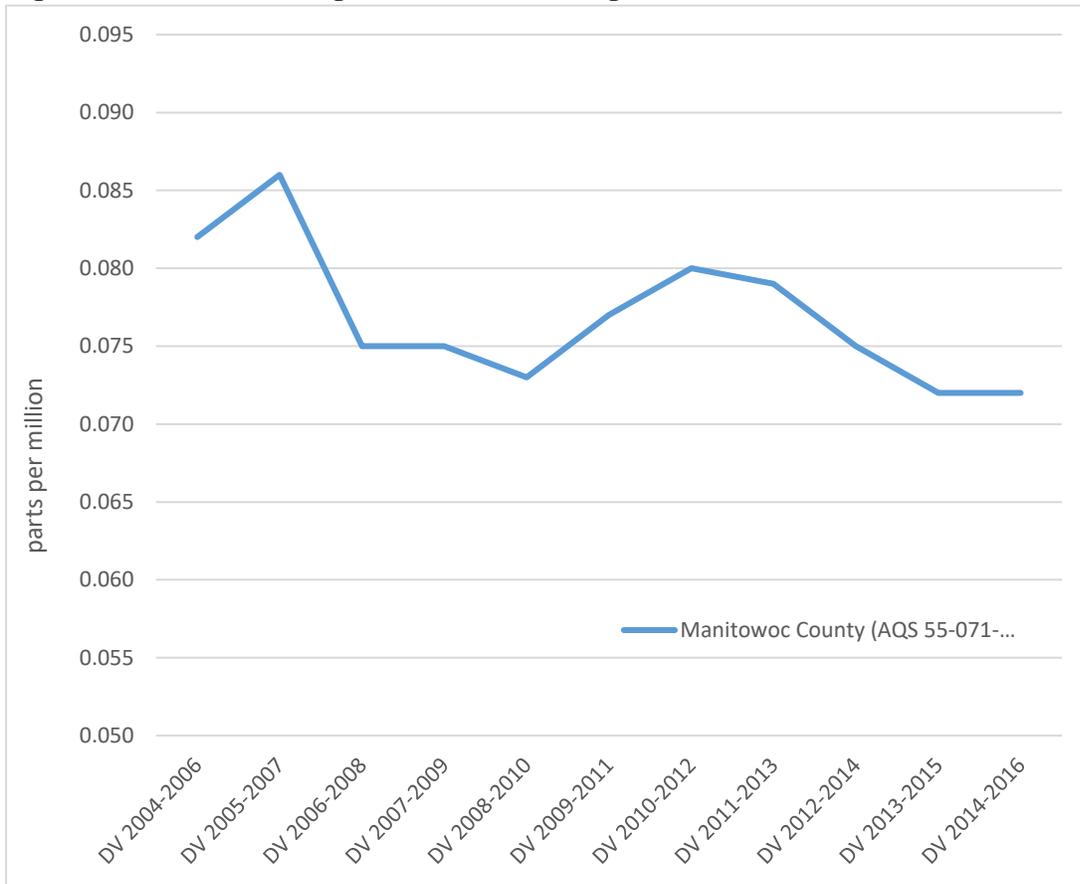
County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4 <sup>th</sup> highest daily max value	2015 4 <sup>th</sup> highest daily max value	2016 4 <sup>th</sup> highest daily max value
Manitowoc, WI	No	55-071-0007	<b>0.072*</b>	0.066	0.077	0.074

\*Despite violating monitors, in a September 21, 2016, letter from its governor, Wisconsin recommended attainment for the entire state. Later in an April 20, 2017, supplemental submittal, which Wisconsin explains contains technical information to support the governor’s recommendation and which contains Wisconsin’s estimates of 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 EPA should ensure that the geographic scope of these areas is minimized. 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 in its April 20, 2017, submittal that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS.

Manitowoc County shows a violation of the 2015 ozone NAAQS, therefore a portion of this county containing the violating monitor is included in the 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. Since Sheboygan County is its own CBSA-Metropolitan Statistical Area it has been addressed separately in this TSD. 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 (2007-2016).**



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 designated 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<sub>x</sub>) 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<sub>x</sub> 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.

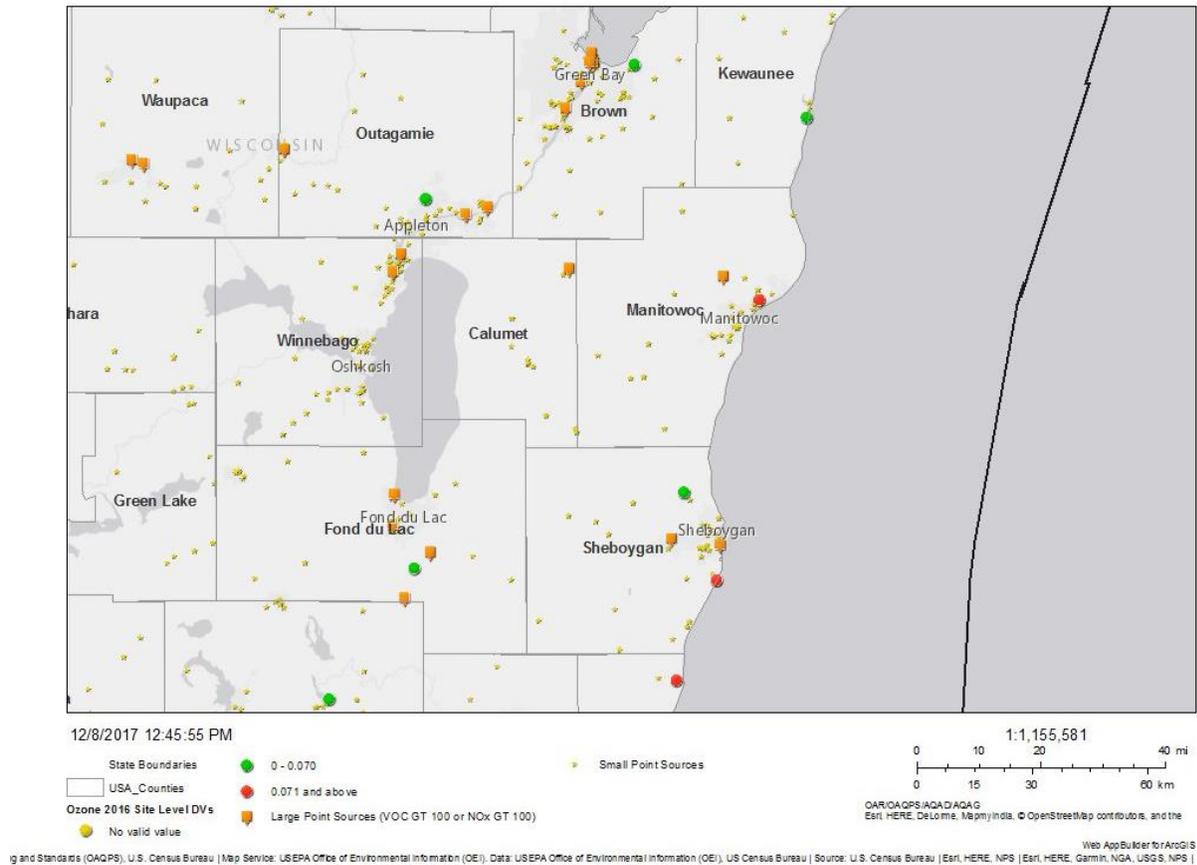
Table 3 provides a county-level emissions summary of NO<sub>x</sub> and VOC (given in tons per year (tpy)) for Manitowoc County. The location of both larger and smaller point sources that emit NO<sub>x</sub> and VOC emissions are shown in Figure 3.

**Table 3. Total County-Level NO<sub>x</sub> and VOC Emissions.**

<b>County, State</b>	<b>State Recommended Nonattainment?</b>	<b>Total NO<sub>x</sub> (tpy)</b>	<b>Total VOC (tpy)</b>
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.

**Figure 3. Point Sources in the Area of Analysis.**



Examination of county-level emissions shows one large point source in Manitowoc County, which is the Carmeuse Lime and Stone-Rockwell Operation. This facility reported 423.42 tons of NO<sub>x</sub> and 0.10 tons of VOC in 2014. Approximately 27 small point sources in Manitowoc County, 23 of which reported NO<sub>x</sub> 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<sub>x</sub> and 467.17 tons of VOC in 2014. The largest NO<sub>x</sub> emitter of these sources, Manitowoc Public Utilities, emitted a reported 74.71 tons of NO<sub>x</sub> and the largest VOC emitter of these sources, Broadwind Towers, emitted a reported 76.57 tons of VOC in 2014.

**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<sub>x</sub> 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<sub>x</sub> 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.

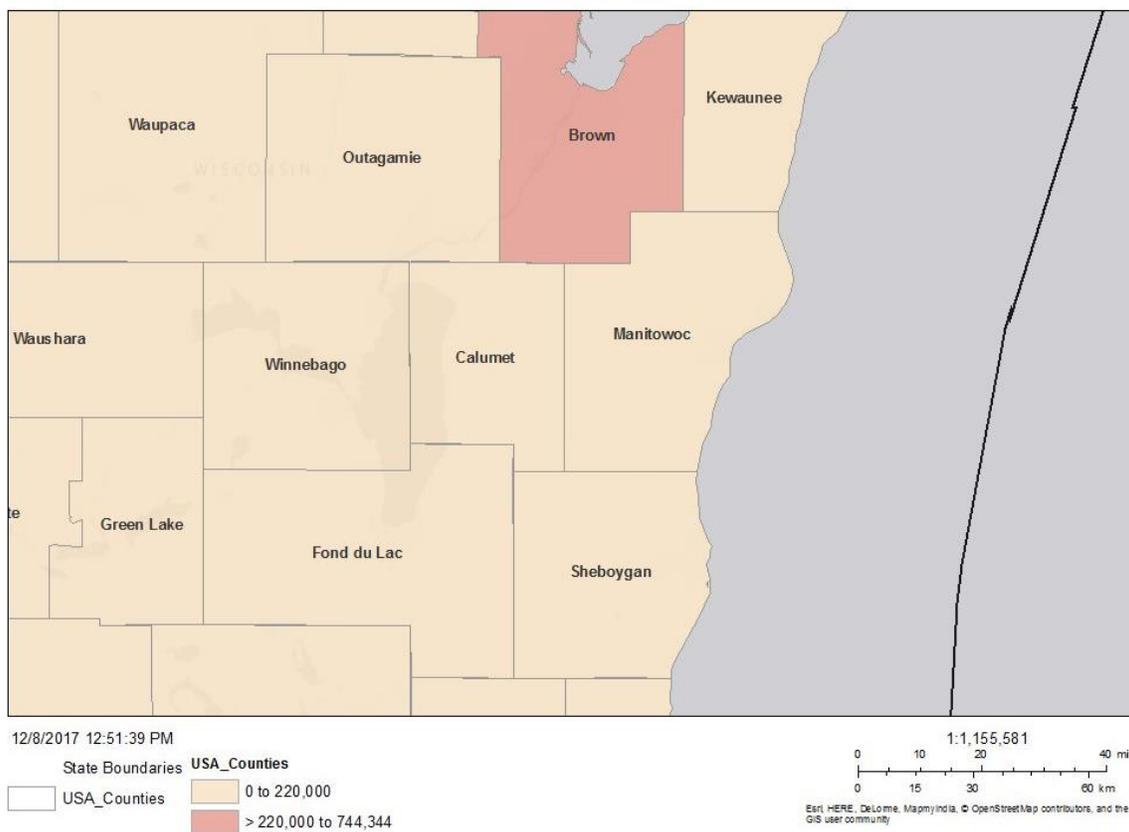
**Table 4. Population and Growth.**

Source: U.S. Census Bureau population estimates for 2010 and 2015. [www.census.gov/data.html](http://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.**



Web App Builder for ArcGIS  
 Air Quality Planning and Standards (QAQPS), U.S. Census Bureau | Map Service: USEPA Office of Environmental Information (OEI), Data: USEPA Office of Environmental Information (OEI), US Census Bureau | Source: U.S. Census Bureau | Esri, HERE, Garmin, NGA, USGS, NPS |

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<sub>x</sub> and 1,091 tons of VOC. The on-road emissions reported to the 2014 NEI were 1,372 tons of NO<sub>x</sub> and 699 tons of VOC. The non-road emissions reported to the 2014 NEI were 539 tons of NO<sub>x</sub> and 554 tons of VOC.

**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<sup>39</sup> 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.

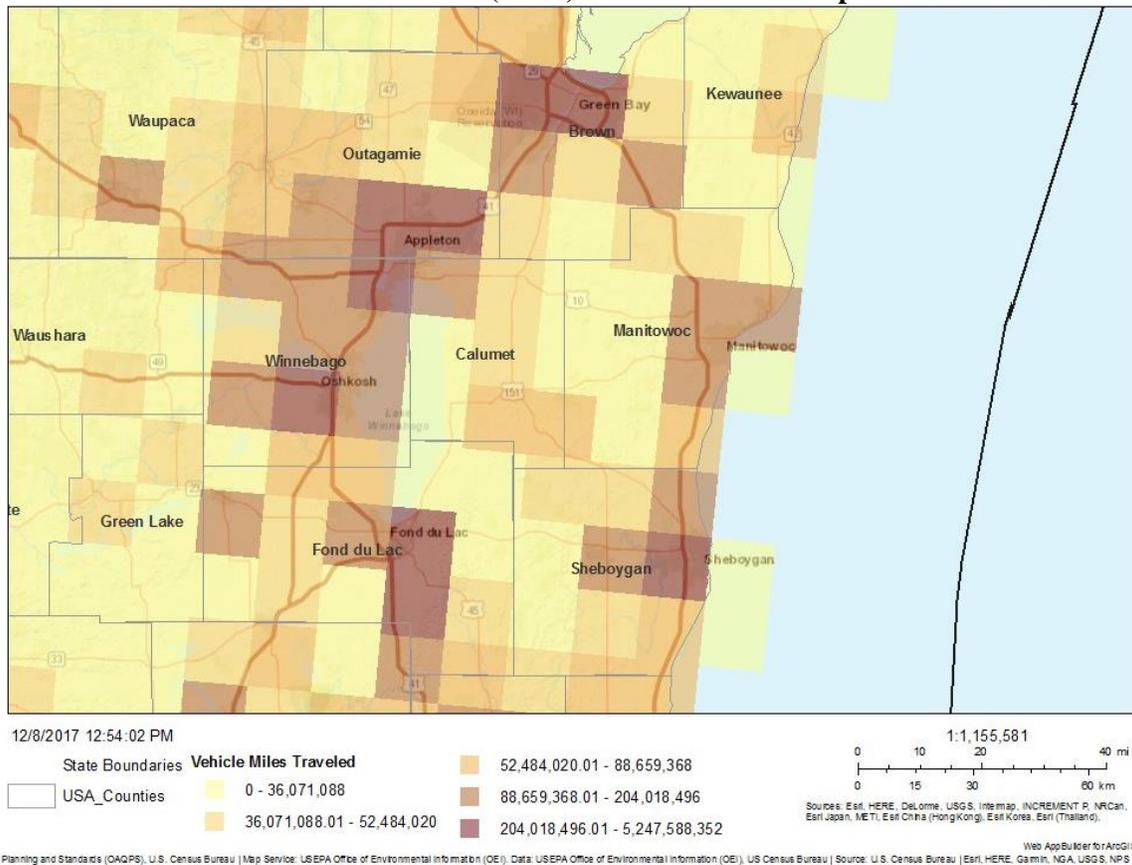
**Table 5. Traffic and Commuting Patterns.**

<b>County</b>	<b>State Recommended Nonattainment?</b>	<b>2014 Total VMT (Million Miles)</b>	<b>Number of County Residents Who Work</b>	<b>Number of County Residents Commuting Within the County</b>	<b>Percentage of County Residents Commuting Within the County</b>
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.

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

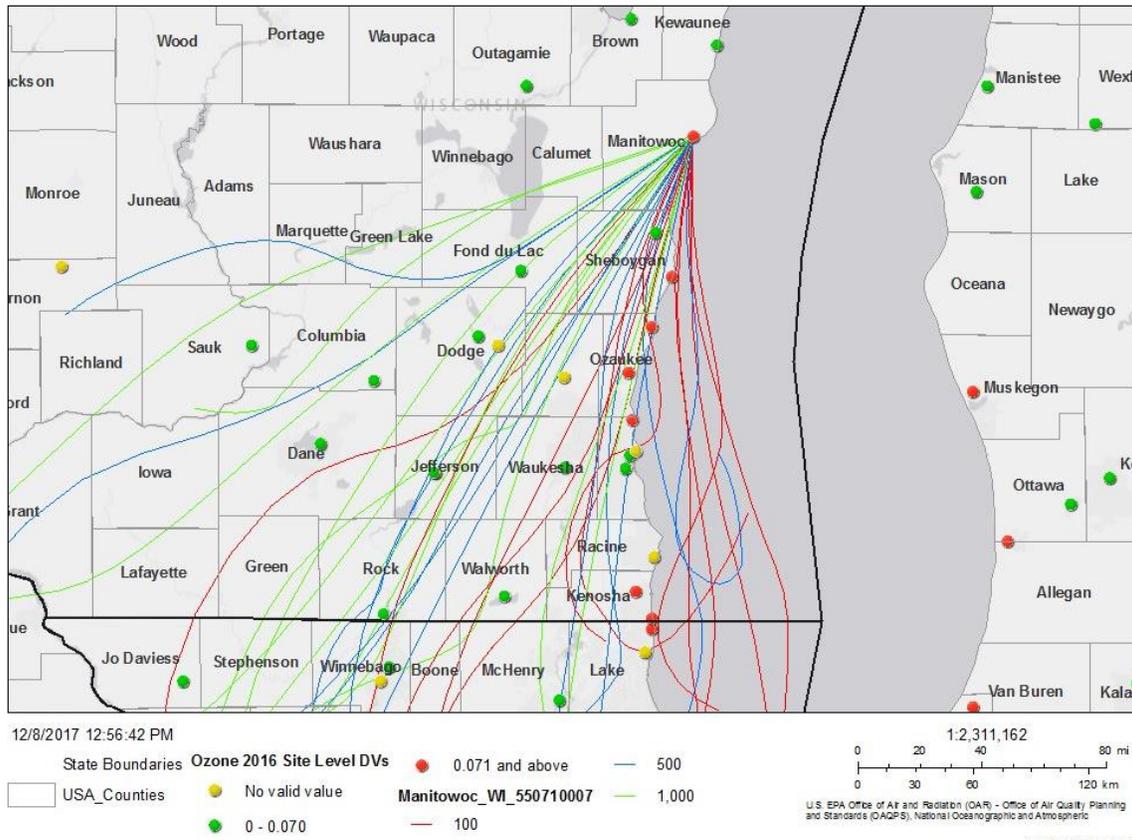


The reported vehicle miles traveled (VMT) for 2014 were 762 million miles, and the on-road emissions reported to the 2014 NEI were 1,372 tons of NO<sub>x</sub> and 699 tons of VOC. The majority of the VMT are concentrated in the central and eastern portions of the county, particularly around the I-43 corridor and the city of Manitowoc as seen in Figure 5.

**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 unique dynamics of Lake Michigan ozone-formation and transport is previously discussed in section 3.0. In their February 2018 TSD, WI indicates that the unique dynamics of Lake Michigan ozone-formation and transport make coarse-grained HYSPLIT trajectories less reliable indicators of fine-scale meteorological processes associated with lake breezes, and that only the 100 m trajectories (represented by the red lines in Figure 6) are relevant in this areas for assessing the potential impact of regional air movements on monitored ozone concentrations. The 100 m trajectories show that, on the 12 exceedance days, air parcels traveled almost exclusively from the south and southwest with 7 trajectories passing over Lake Michigan and originating in upwind areas over the lake and along the southern shore of Lake Michigan.

**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 section 3.0, areas geographically located along the shoreline of Lake Michigan, including Manitowoc County, can be impacted by lake breeze meteorology which transports photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind coastal areas along Lake Michigan.

#### **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 proposed 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 proposed designated areas.

The area of analysis was Manitowoc County, which is not part of a CSA and which is its own CBSA. For purposes of the 1997 ozone NAAQS, the entirety of Manitowoc County was designated nonattainment. 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

#### **Additional Information**

As shown in Table 2 (below) from Wisconsin's February 2018 TSD, ozone-forming emissions from upwind Chicago areas are more than 70 times greater than the emissions levels in Manitowoc County. In light of lake meteorology, the magnitude of these emissions in relation to the magnitude of emissions from sources in the Sheboygan area is an important consideration.

**Table 2. Comparison of 2014 NO<sub>x</sub> and VOC emissions from sources in the southern and western Lake Michigan area.** Emissions are shown for whole-county areas and are from the 2014 National Emissions Inventory (NEI) v1.

Area	Emissions (tons)		% of Total Emissions	
	NO <sub>x</sub>	VOC	NO <sub>x</sub>	VOC
Chicago NAA - Cook County, IL	95,864	86,253	33%	37%
Chicago NAA - Other IL	87,982	71,749	30%	31%
Chicago NAA - IN	45,572	21,399	16%	9%
Kenosha County	6,034	3,290	2%	1%
<b>Total Chicago Area</b>	<b>235,452</b>	<b>182,691</b>	<b>81%</b>	<b>79%</b>
Sheboygan County	4,585	3,421	2%	1%
Manitowoc County	3,253	2,812	1%	1%
Kewaunee County	1,141	1,291	0%	1%
Door County*	3,066	2,439	1%	1%

WI has provided information suggesting emissions reductions from sources in the Manitowoc area have little to no impact on high ozone values at the violating monitor in Manitowoc County. Some aspects of these claims are difficult to fully evaluate because EPA does not have the details necessary to fully review the emissions reduction modeling analyses that these claims are based on. WI's ozone source apportionment modeling<sup>40</sup> shows the Wisconsin contributions to the Manitowoc County violating monitor is about 12 percent; larger portions came from out-of-state (e.g., 19.5 percent from Illinois plus 12.5 percent from Indiana) and from international sources (roughly 20 percent, identified as boundary conditions which represent a combination of international, natural, and to a lesser extent US sources). WI claims that because of the overwhelming impact of transported emissions, there is no evidence that local emissions reductions meaningfully improve local air quality (see WDNR TSD Table 3, p.16). Modeling hypothetical 10% reductions<sup>41</sup> in man-made NO<sub>x</sub> and VOC emissions from stationary and nonroad sources (not including highway vehicles) across a 10-county area that includes Manitowoc County and several upwind Wisconsin counties produced no meaningful reduction in ozone design values at the Manitowoc monitor, with impact of -0.1 ppb to -0.2 ppb. Further a "zero-out Sheboygan run" that completely eliminated man-made emissions from all emissions source sectors in neighboring Sheboygan County directly to the south produced no meaningful change (-0.1 ppb) in the ozone design value at the Manitowoc monitor.

<sup>40</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not provide any details on the source apportionment modeling. No information was provided on specific methods used to calculate design value contributions from the source apportionment modeling outputs.

<sup>41</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not cover the 10 percent reduction scenario. EPA notes that the base case inventories in the WI TSD appendix A show that approximately 40% of the NO<sub>x</sub> emissions and 25% of the VOC emissions in the 10-county area are from onroad sources, which are not included in the 10% reduction scenario. Rough calculations would indicate that the total reduction in anthropogenic emissions in the 10-county area would be less than 10%, probably on the order of 6-8%.

Although Manitowoc County does not have an “inland” ozone monitor like Sheboygan County, the analysis of the lake breeze ozone inland penetration distance to the Sheboygan County monitors is the best information we have to assess this issue for Manitowoc County. 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. The Sheboygan County inland monitor located 3.2 miles from the Lake Michigan shoreline has a 2014-2016 design value of 0.069 ppm and a preliminary 2017 design value of 0.070 ppm. While it is important to realize that lake breeze ozone events are episodic and location-specific<sup>42</sup>, the experience in neighboring Sheboygan County is the best information we have to assess penetration distance for Manitowoc County. Wisconsin concludes that ozone concentrations above 0.070 ppm in Manitowoc County is confined to a distance of 2.9 miles inland from the shoreline.

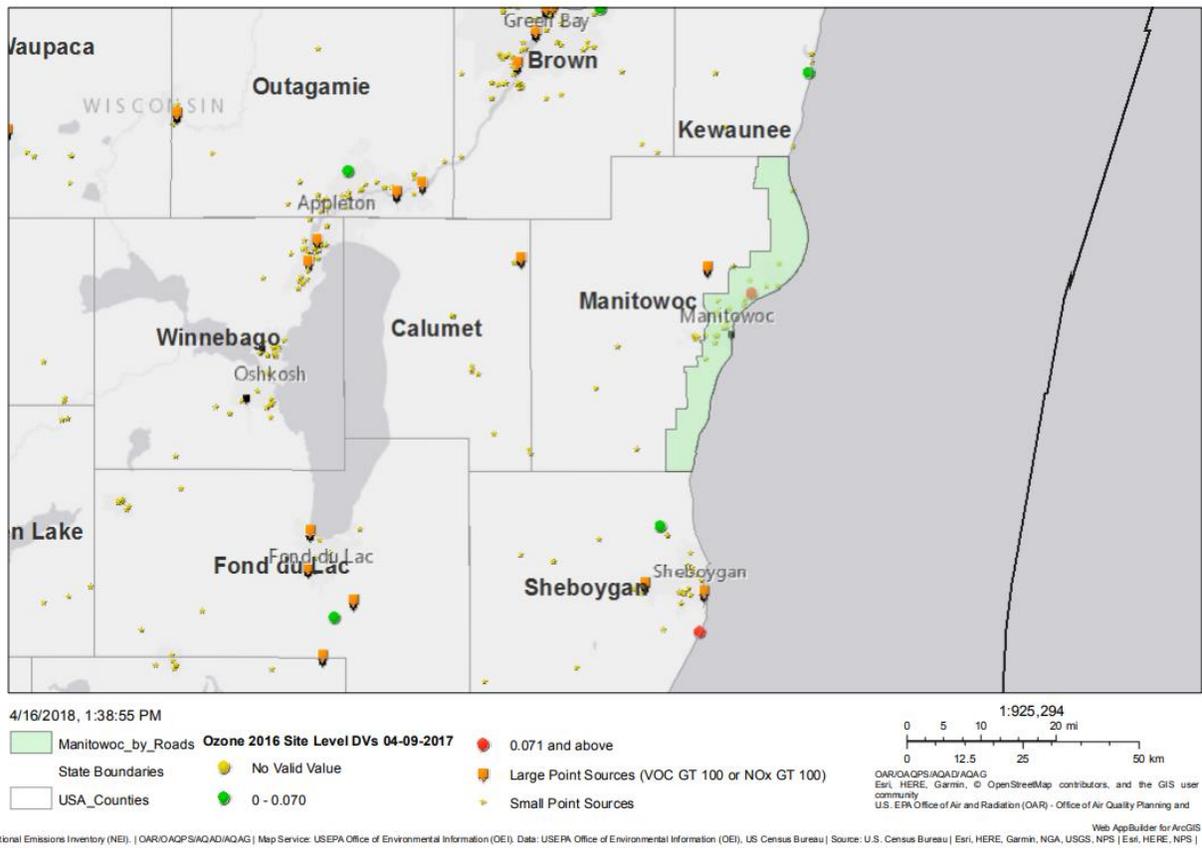
### **Conclusion for Manitowoc County Area**

Based on the assessment of factors described above, in addition to analysis provided by WI in their February 2018 and their April 20, 2017 submissions, EPA is finalizing nonattainment boundaries consistent with the boundaries provided by the state which includes the violating monitors and the immediate vicinity around the monitor in Manitowoc County expected to have air quality that does not meet the NAAQS. As provided by the state, ozone concentrations above 0.070 ppm in Manitowoc County is confined to a distance of 2.9 miles inland from the shoreline. After considering the State submissions and the five-factor analysis above, the EPA does not believe that there is sufficient evidence of contribution from the other areas in the area of analysis and thus a nonattainment designation consisting of the area violating the standard is appropriate. The EPA is designating all remaining portions of Manitowoc County as attainment/unclassifiable.

In the February 2018 submittal included in the docket, the state requested that the nonattainment boundary be established as a distance inland from the ordinary high water mark (OHWM). For purposes of managing air quality-related regulatory requirements, EPA is specifying a boundary based on identifiable roadways rather than the OHWM (see responses to comments (RTC) accompanying this final action). Therefore, EPA selected roadways that were roughly the distance inland (2.9 miles) from the shoreline most recently requested by the state.

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<sup>42</sup> 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.



The final nonattainment boundary is 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.

### 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 latest 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).<sup>43</sup> In addition, the EPA considered any additional data or information provided to the EPA by states or tribes.

<sup>43</sup> 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>.

The area of analysis was Door County, which is not part of a CSA or a CBSA. The Door County monitor is unique in the combination of its location on a peninsula between Lake Michigan and Green Bay, susceptibility to be impacted by lake breeze meteorology, its precursor emissions are relatively low, and it is located downwind of all other lakeshore counties and several large urban areas (e.g., Green Bay, Milwaukee, Chicago), making it a recipient of ozone transport from upwind urban areas with much high precursor emissions.

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

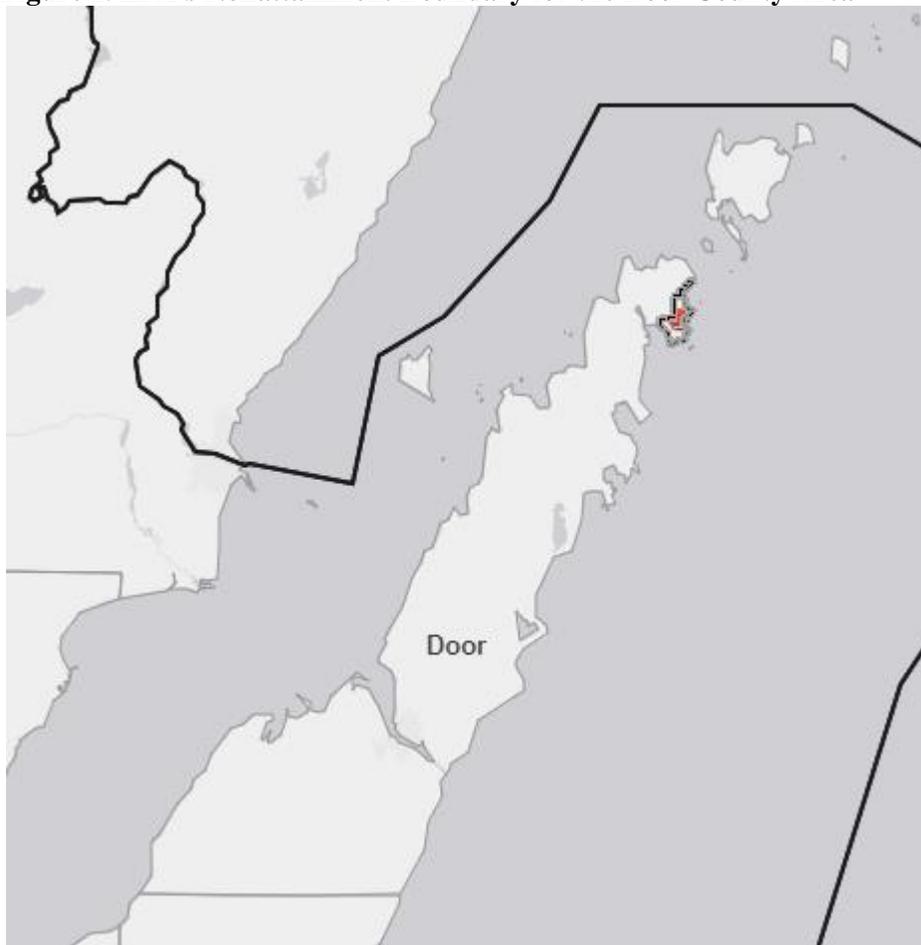
1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor);
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport 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 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. 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. On December 22, 2017, EPA notified the State of Wisconsin that based on its initial 5-factor analysis, the EPA intended to designate a portion of Door County as nonattainment for the 2015 ozone NAAQS - the portion of the county north of the Sturgeon Bay canal. In February 2018, Wisconsin provided additional technical information that EPA has reviewed and considered as part of its technical analysis included in this final TSD.

This information includes an assessment of the unique lake-effect meteorology affecting ozone formation and transport in the area (See Section 3.0), including the overwhelming contributions to ozone levels in the Door County area from emissions sources that are not nearby.

**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 has a monitor in violation of the 2015 ozone NAAQS, therefore this portion of the county is included in the proposed 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 monitor in Door County based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). This is the most recent three-year period with fully-certified air quality data. The design value is the 3-year average of the annual 4<sup>th</sup>

highest daily maximum 8-hour average ozone concentration.<sup>44</sup> 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.<sup>45</sup> 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<sup>46</sup> 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 most recent 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.

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<sup>44</sup> 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.

<sup>45</sup> 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.

<sup>46</sup> 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).**

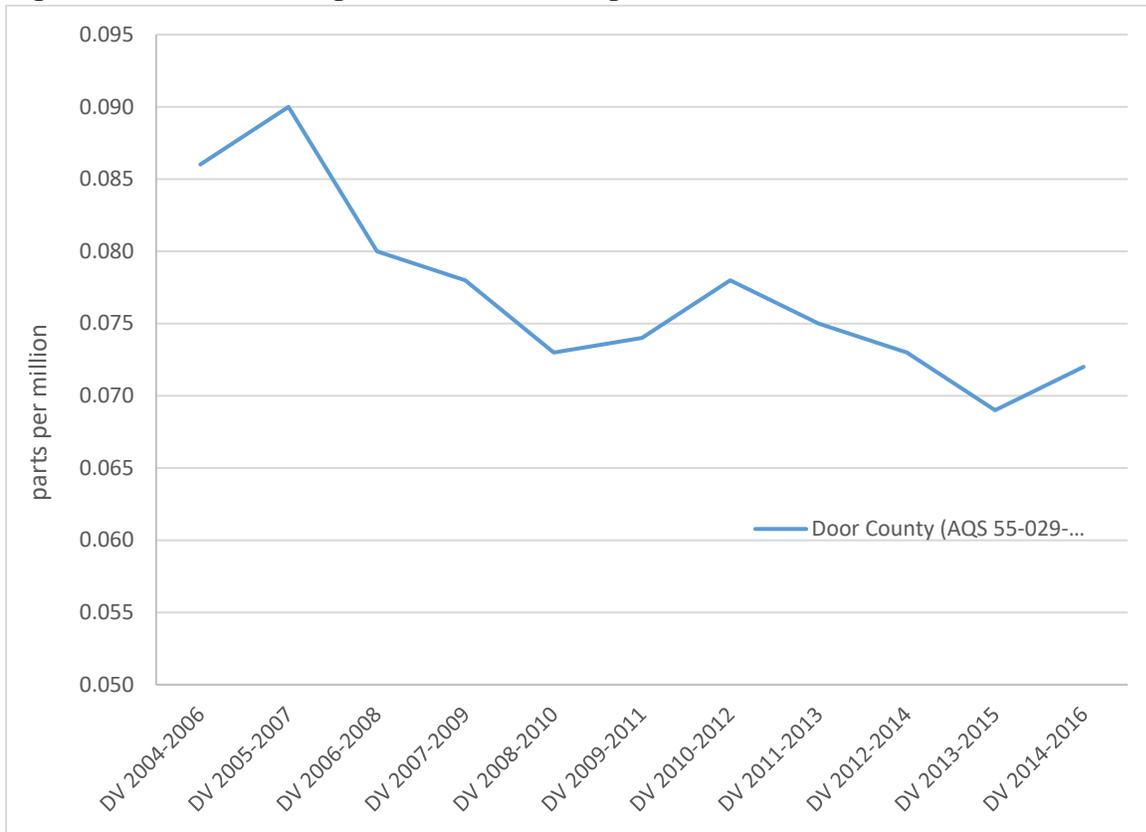
<b>County, State</b>	<b>State Recommended Nonattainment?</b>	<b>AQS Site ID</b>	<b>2014-2016 DV</b>	<b>2014 4<sup>th</sup> highest daily max value</b>	<b>2015 4<sup>th</sup> highest daily max value</b>	<b>2016 4<sup>th</sup> highest daily max value</b>
Door County, WI	No	55-029-0004	<b>0.072*</b>	0.065	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 an April 20, 2017, supplemental submittal, which Wisconsin explains contains technical information to support the governor’s recommendation and which contains Wisconsin’s estimates of 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 EPA should ensure that the geographic scope of these areas is minimized. 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 in its April 20, 2017, submittal that these descriptions should not be construed as a recommendation for a potential nonattainment area designation for the 2015 ozone NAAQS.

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 proposed 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 (2007-2016).**



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 proposed 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<sub>x</sub>) 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<sub>x</sub> 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.

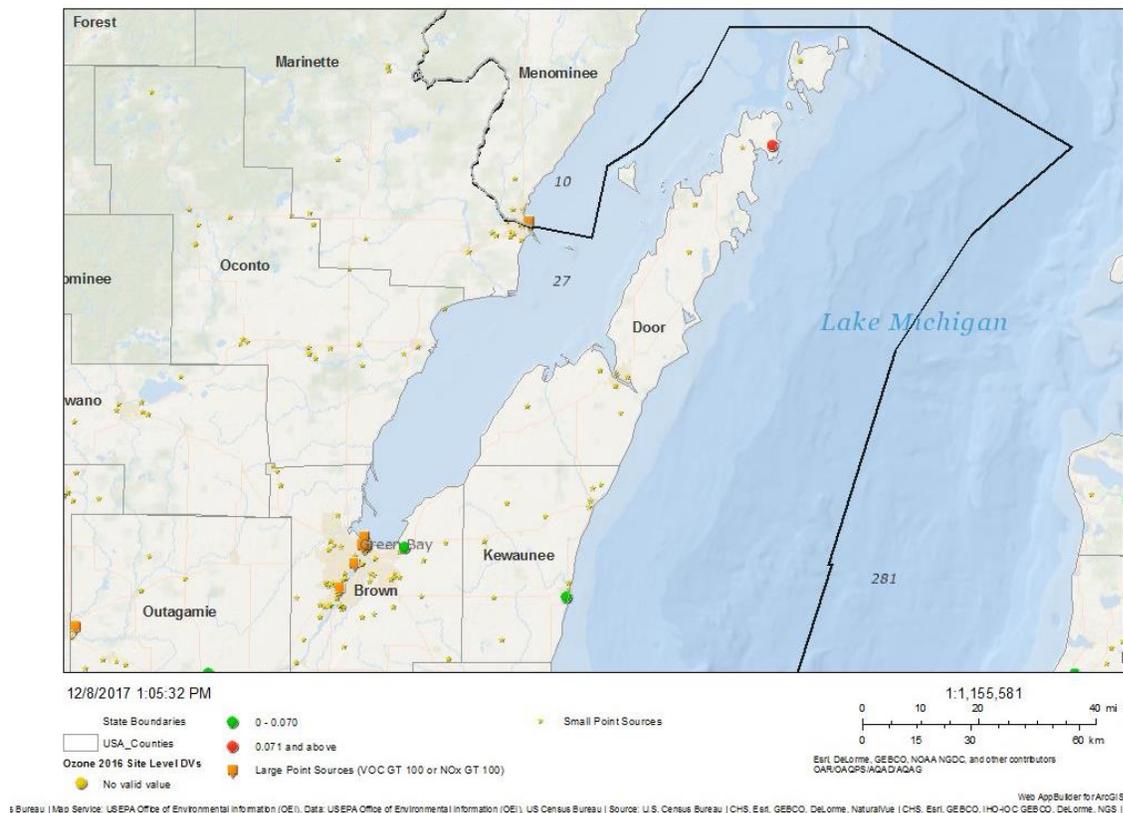
Table 3 provides a county-level emissions summary of NO<sub>x</sub> and VOC (given in tons per year (tpy)) emissions for the area of analysis considered for inclusion in the proposed Door County nonattainment area. The locations of the point sources are shown in Figure 3.

**Table 3. Total County-Level NO<sub>x</sub> and VOC Emissions.**

County, State	State Recommended Nonattainment?	Total NO <sub>x</sub> (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.

**Figure 3. Point Sources in the Area of Analysis.**



Examination of county-level emissions showed no large point sources in Door County and four out of approximately ten small point sources that reported NO<sub>x</sub> 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<sub>x</sub> 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<sub>x</sub> in 2014. Wisconsin notes that the state has no control over a significant portion of the emissions in the inventory attributed to Door County: 53 percent of NO<sub>x</sub> emissions came from commercial marine vessels on Lake Michigan, and 61 percent of VOC emissions came from recreational vehicles and pleasure craft (WI TSD page 13).

**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<sub>x</sub> 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<sub>x</sub> 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.

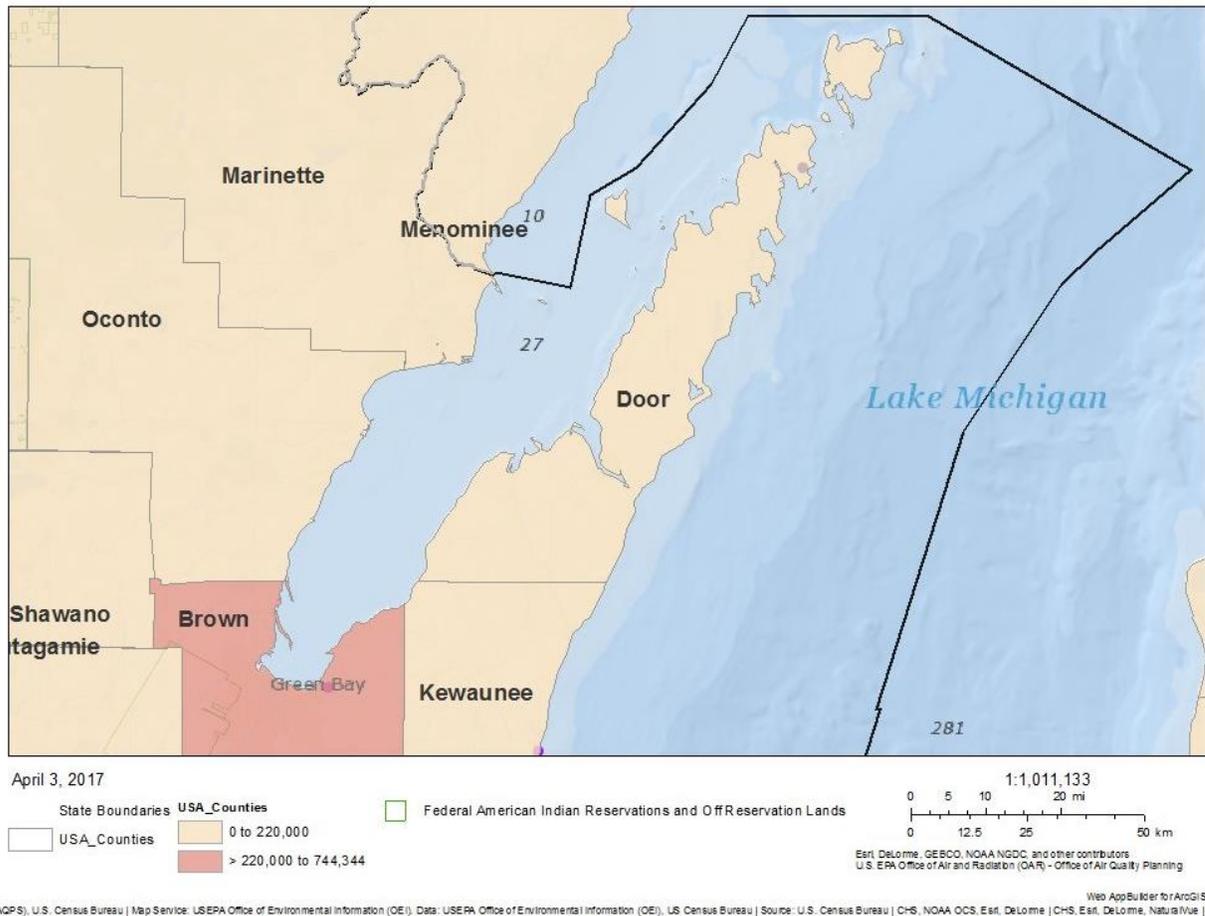
**Table 4. Population and Growth.**

Source: U.S. Census Bureau population estimates for 2010 and 2015. [www.census.gov/data.html](http://www.census.gov/data.html).

<b>County, State</b>	<b>State Recommended Nonattainment?</b>	<b>2010 Population</b>	<b>2015 Population</b>	<b>2015 Population Density (per sq. mi.)</b>	<b>Absolute change in population (2010-2015)</b>	<b>Population % change (2010-2015)</b>
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<sub>x</sub> and 491 tons of VOC. The on-road emissions reported to the 2014 NEI were 600 tons of NO<sub>x</sub> and 356 tons of VOC. The non-road emissions reported to the 2014 NEI were 706 tons of NO<sub>x</sub> and 1,512 tons of VOC.

**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<sup>47</sup> 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.**

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

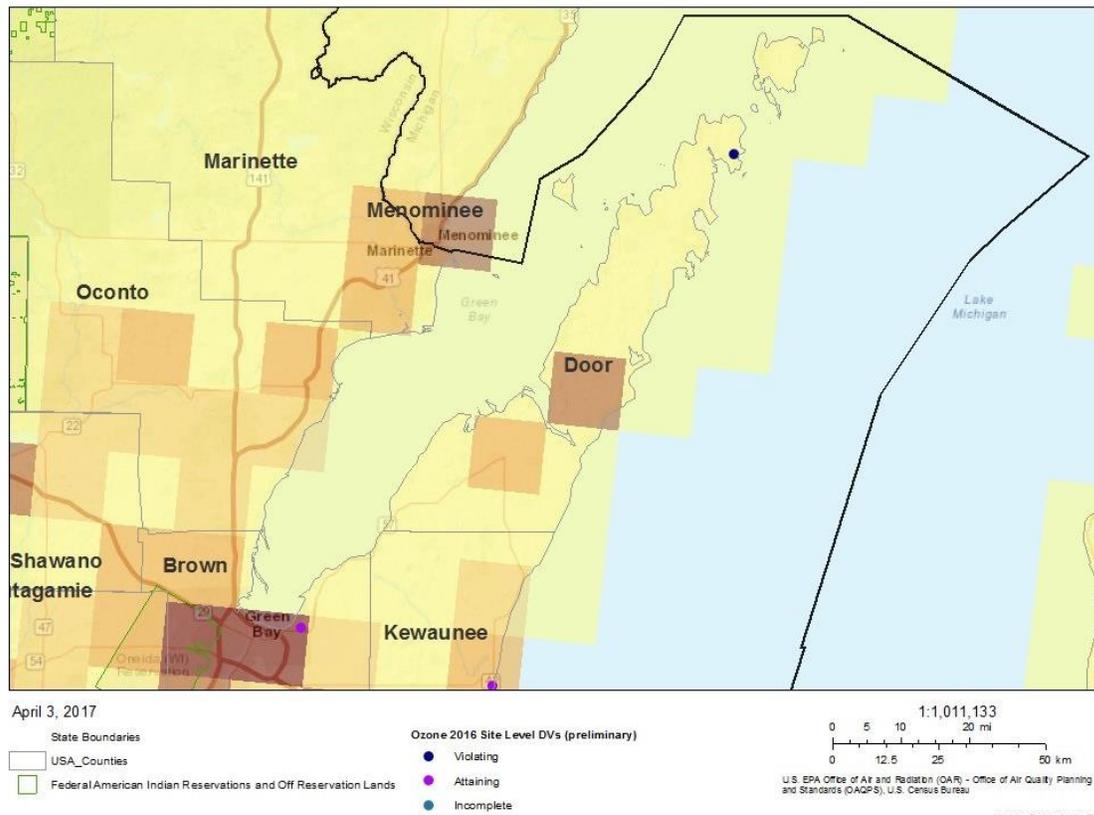
\*Wisconsin submitted a request that any nonattainment areas be limited in size but did not make formal recommendations of nonattainment.

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

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<sup>47</sup> The worker data can be accessed at: <http://onthemap.ces.census.gov/>.

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



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  $\text{NO}_x$  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.

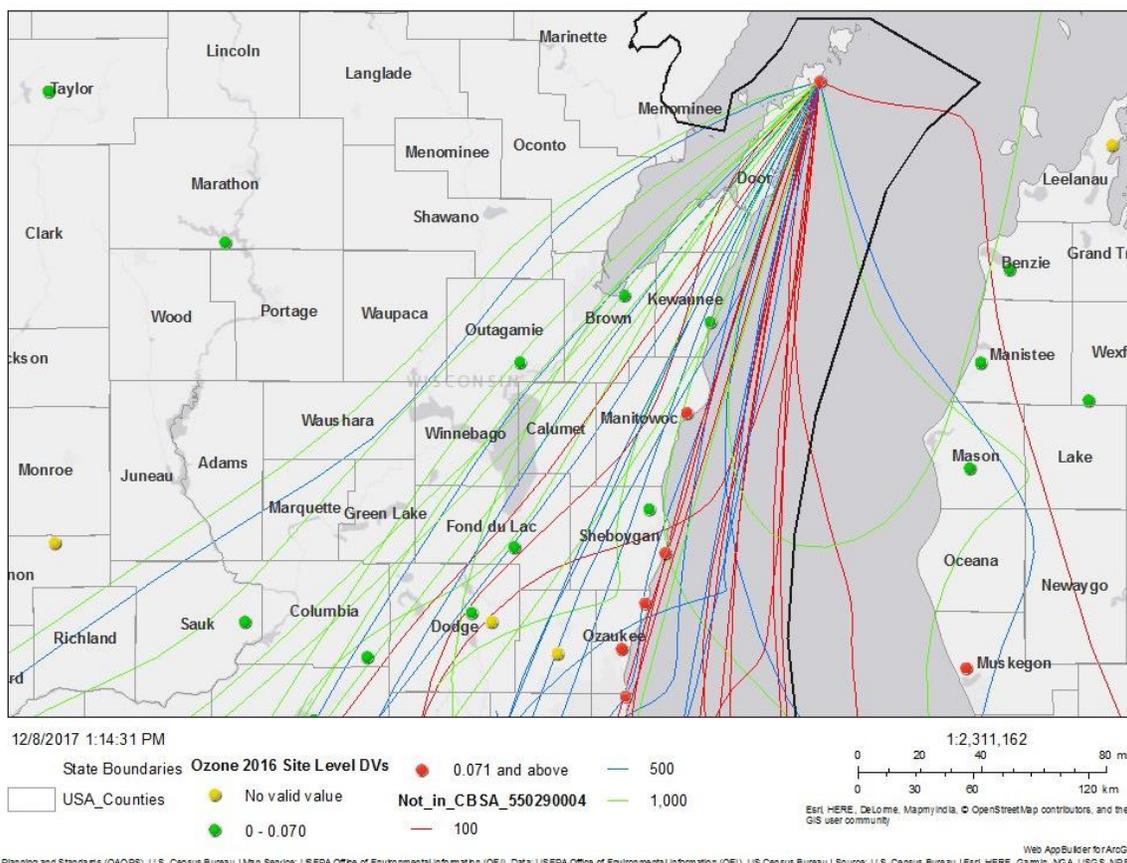
The Door County emissions and emissions-related data are not trivial. However, the  $\text{NO}_x$  and VOC emissions from the various source sectors, including point, non-point (area), on-road, and off-road, in Door County are relatively low, such that the county emissions and emissions-related data 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 6. 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.



The unique dynamics of Lake Michigan ozone-formation and transport is previously discussed in section 3.0. In their February 2018 TSD, WI indicates that the unique dynamics of Lake Michigan ozone-formation and transport make coarse-grained HYSPLIT trajectories less reliable indicators of fine-scale meteorological processes associated with lake breezes, and that only the 100 m trajectories (represented by the red lines in Figure 6) are relevant in this areas for assessing the potential impact of regional air movements on monitored ozone concentrations. The 100 m trajectories show that, on exceedance days, air parcels traveled almost exclusively from the south with most passing over Lake Michigan and originating in upwind areas over the lake and along the southern shore of Lake Michigan.

**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.

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 Section 3.0, areas geographically located along the shoreline of Lake Michigan, including Door County, can be impacted by lake breeze meteorology which transports photochemically aged air masses containing ozone-rich air originating from nearby and upwind precursor plumes to nearby and downwind coastal areas along Lake Michigan.

#### **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 proposed 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 proposed designated areas.

The area of analysis was Door County, which is not part of a CSA or a CBSA. 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.

#### **Additional Information**

As shown in Table 2 (below) from Wisconsin's February 2018 TSD, ozone-forming emissions from upwind Chicago areas are more than 74 times greater than the emissions levels in Door County.

**Table 2. Comparison of 2014 NO<sub>x</sub> and VOC emissions from sources in the southern and western Lake Michigan area.** Emissions are shown for whole-county areas and are from the 2014 National Emissions Inventory (NEI) v1.

Area	Emissions (tons)		% of Total Emissions	
	NO <sub>x</sub>	VOC	NO <sub>x</sub>	VOC
Chicago NAA - Cook County, IL	95,864	86,253	33%	37%
Chicago NAA - Other IL	87,982	71,749	30%	31%
Chicago NAA - IN	45,572	21,399	16%	9%
Kenosha County	6,034	3,290	2%	1%
<b>Total Chicago Area</b>	<b>235,452</b>	<b>182,691</b>	<b>81%</b>	<b>79%</b>
Sheboygan County	4,585	3,421	2%	1%
Manitowoc County	3,253	2,812	1%	1%
Kewaunee County	1,141	1,291	0%	1%
Door County*	3,066	2,439	1%	1%

WI has provided information suggesting emissions reductions from sources in Door County and other upwind lakeshore counties have little to no impact on high ozone values at the violating monitor. Some aspects of these claims are difficult to fully evaluate because EPA does not have the details necessary to fully review the emissions reduction modeling analyses that these claims are based on. WI’s ozone source apportionment modeling<sup>48</sup> shows the Wisconsin contributions to the Door County violating monitor is about 7 percent; larger portions came from out-of-state (e.g., 16 percent from Illinois and 9 percent from Indiana) and from international sources (roughly 20 percent, identified as boundary conditions which represent a combination of international, natural, and to a lesser extent US sources). WI claims that because of the overwhelming impact of transported emissions, there is no evidence that local emissions reductions meaningfully improve local air quality (see WDNR TSD Table 3, p.16). Modeling hypothetical 10% reductions<sup>49</sup> in man-made NO<sub>x</sub> and VOC emissions from stationary and nonroad sources (not including highway vehicles) across a 10-county area that includes Door County produced no meaningful reduction in ozone design values at the Door County monitor, with an impact of -0.1 ppb. Wisconsin also points out that there are three ozone monitors, to the south and southwest of Door County, that are not violating the 2015 ozone NAAQS. These monitors are located in Brown County (on the University of Wisconsin Green-Bay Campus), Outagamie County (southwest of Door County), and Kewaunee County (immediately south of Door County and near the shoreline of Lake Michigan). They

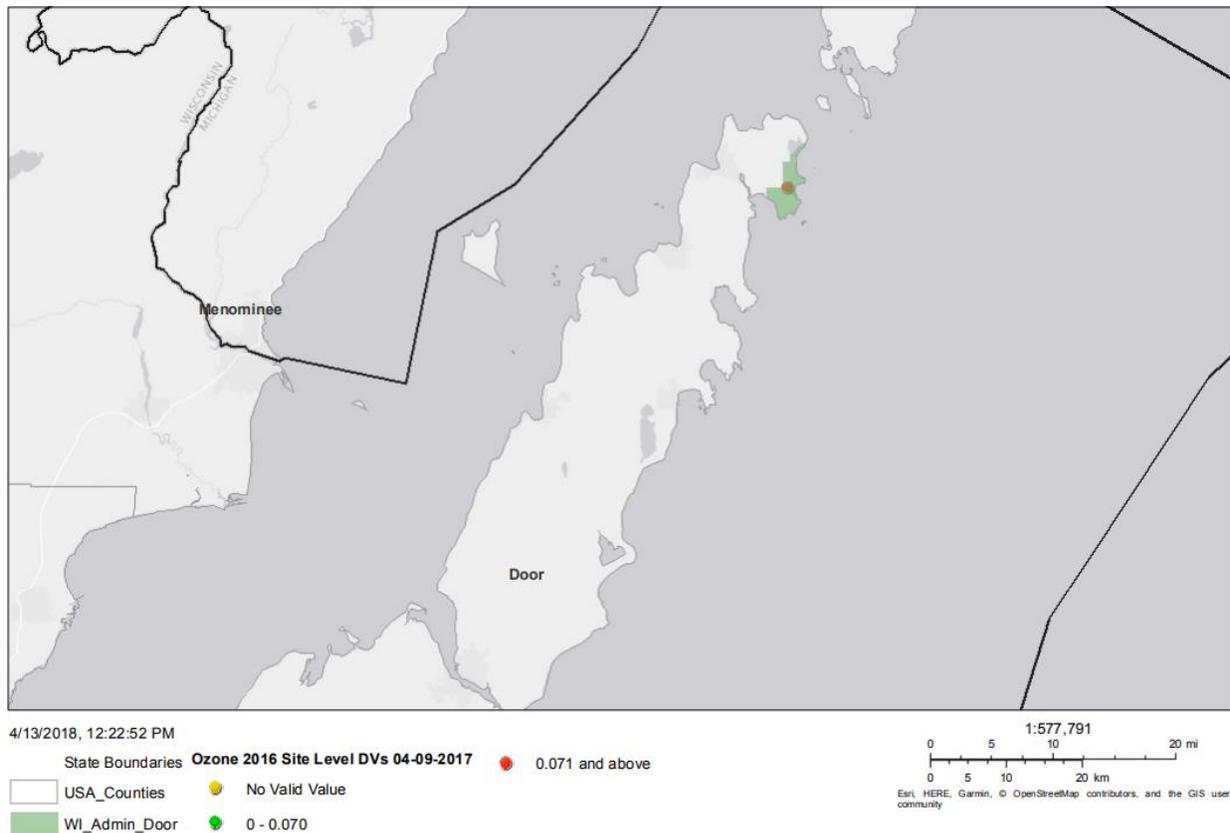
<sup>48</sup>The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not provide any details on the source apportionment modeling. No information was provided on specific methods used to calculate design value contributions from the source apportionment modeling outputs.

<sup>49</sup> The reference in the WI TSD provided details on the LADCO 2017 base case modeling, but did not cover the 10 percent reduction scenario. EPA notes that the base case inventories in the WI TSD appendix A show that approximately 40% of the NO<sub>x</sub> emissions and 25% of the VOC emissions in the 10-county area are from onroad sources, which are not included in the 10% reduction scenario. Rough calculations would indicate that the total reduction in anthropogenic emissions in the 10-county area would be less than 10%, probably on the order of 6-8%.

conclude that the area with design values attaining the standard extends north into Door County, supporting a conclusion that violating ozone values are confined to the area around Newport State Park where the monitor is located.

### Conclusion for Door County Area

Based on the assessment of factors described above, in addition to analysis provided by WI in their February 2018 and their April 20, 2017 submissions, EPA is finalizing nonattainment boundaries consistent with the boundaries provided by the state, which includes the violating monitors and the immediate vicinity around the monitor in Door County expected to have air quality that does not meet the NAAQS. In the February 2018 submittal included in the docket, as provided by the state, the state indicates that ozone concentrations above 0.070 ppm in Door County are confined to an approximately 3.7 square mile area boundary of Newport State Park. The EPA is designating as nonattainment the portion of Door County surrounding the violating ozone monitors based on 2014-2016 ozone data. All remaining portions of the Door County are designated attainment/unclassifiable because EPA does not believe there is sufficient evidence that these other portions of Door County contribute 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<sub>x</sub> 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 in Newport State Park) 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.

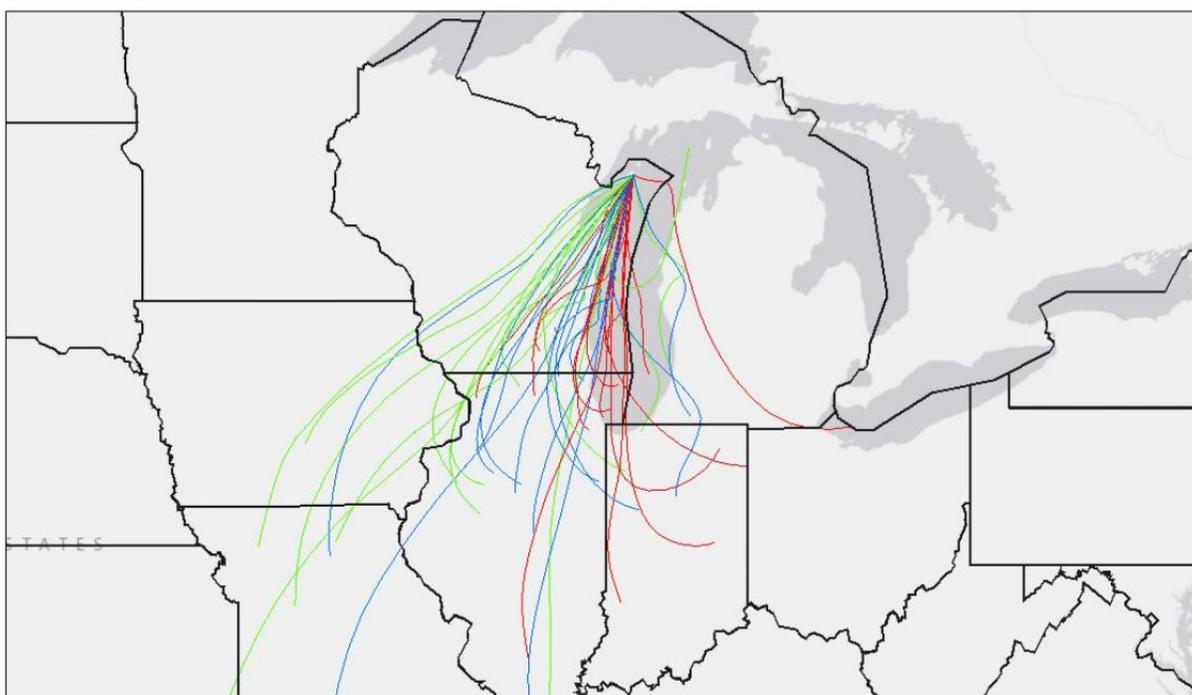
EPA's 2015 designations guidance indicates that the first step in demonstrating that the NO<sub>x</sub> and VOC emissions in a potential RTA do not significantly contribute to ozone in the area itself is the development of a conceptual description of the nature of ozone exceedances in the area. Section 3.0 above 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<sub>x</sub> 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 long-range contributing counties are substantially larger than what is being emitted locally, then this suggests that 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 Figure 7. Results of this analysis are presented in Table 6, which shows the precursor emissions from some of the highest emitting counties and area that are upwind of Door County

and over which the HYSPLIT trajectories to the Door County monitor travel. Even though Wisconsin contends that only the lower level trajectories (100 m) are indicative of the localized nearby impacts associated with the lake breeze effects, we accept that the higher level HYSPLIT trajectories (500 m and 1000 m) traversing land areas in Wisconsin have some value in detecting the potential impacts from longer-range “not nearby” sources for purposes of assessing RTA status.

**Table 6. Precursor emissions from some of the highest emitting upwind areas relative to Door County, Wisconsin, precursor emissions as reported for 2014.<sup>50</sup>**

Geographic Area	NO <sub>x</sub> (tpy)	VOC (tpy)
Door County, Wisconsin <sup>51</sup>	3,066	2,439
Brown County, Wisconsin	12,078	7,813
Milwaukee Area Counties	42,500	37,466
Chicago Area Counties (IL-IN-WI)	235,452	182,691

**Figure 7. Regional HYSPLIT Trajectories for Newport State Park monitor.**



Brown County (containing the city of Green Bay) southwest of Door County, and over which some higher level HYSPLIT trajectories travel prior to reaching the Door County monitor (Figure 7), has NO<sub>x</sub> and VOC emissions four and three times greater (respectively) than Door County (2014 reported NO<sub>x</sub> =

<sup>50</sup> Area emissions summaries from WI DNR TSD, February 2018, Table 2, page 13.

<sup>51</sup> Wisconsin notes that emissions in the inventory attributed to Door County include 53 percent of NO<sub>x</sub> emissions came from commercial marine vessels on Lake Michigan, and 61 percent of VOC emissions came from recreational vehicles and pleasure craft, which the state has no control over (WI TSD page 13).

12,078 tons, VOC = 7,813 tons). For reference Wisconsin statewide emissions were 228,843 tons of NO<sub>x</sub> 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 in the Milwaukee area collectively have emissions 14 times greater than the Door County NO<sub>x</sub> emissions and 15 times greater than the Door County VOC emissions. The counties in the Chicago area collectively have emissions approximately 89 times greater than the Door County NO<sub>x</sub> emissions and approximately 84 times greater than the Door County VOC emissions. Further, as indicated in the previous section of this TSD covering the Door County nonattainment area boundary, the Newport State Park nonattainment boundary does not itself contain significant emissions sources. Further the modeled 10 percent emissions reductions scenario (presented above) from the entire 10-county area potentially upwind of the Newport State Park nonattainment area (including emissions from Door County) does not show meaningful improvements in ozone concentrations at the violating Door County monitor. For the reasons discussed above, EPA 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 the above analysis, the EPA recognizes the portion of Door County (boundary around Newport State Park) to be treated as a Rural Transport Area under CAA section 182(h).