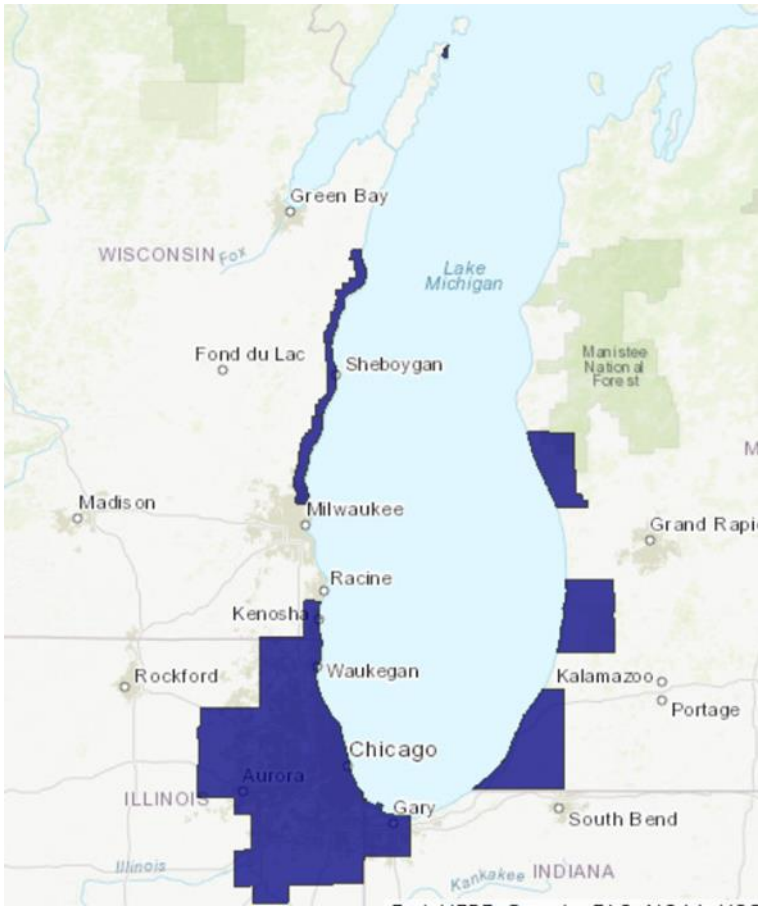
2015 Ozone NAAQS Attainment Challenge
For Lake Michigan Basin

Reaching attainment with the National Ambient Air Quality Standard (NAAQS) for ozone has proven to be a vexing issue for areas near the shores of Lake Michigan, despite substantial reductions in precursor emissions over the past several decades and will prove to be even more difficult with the adoption of the 2015 standard.

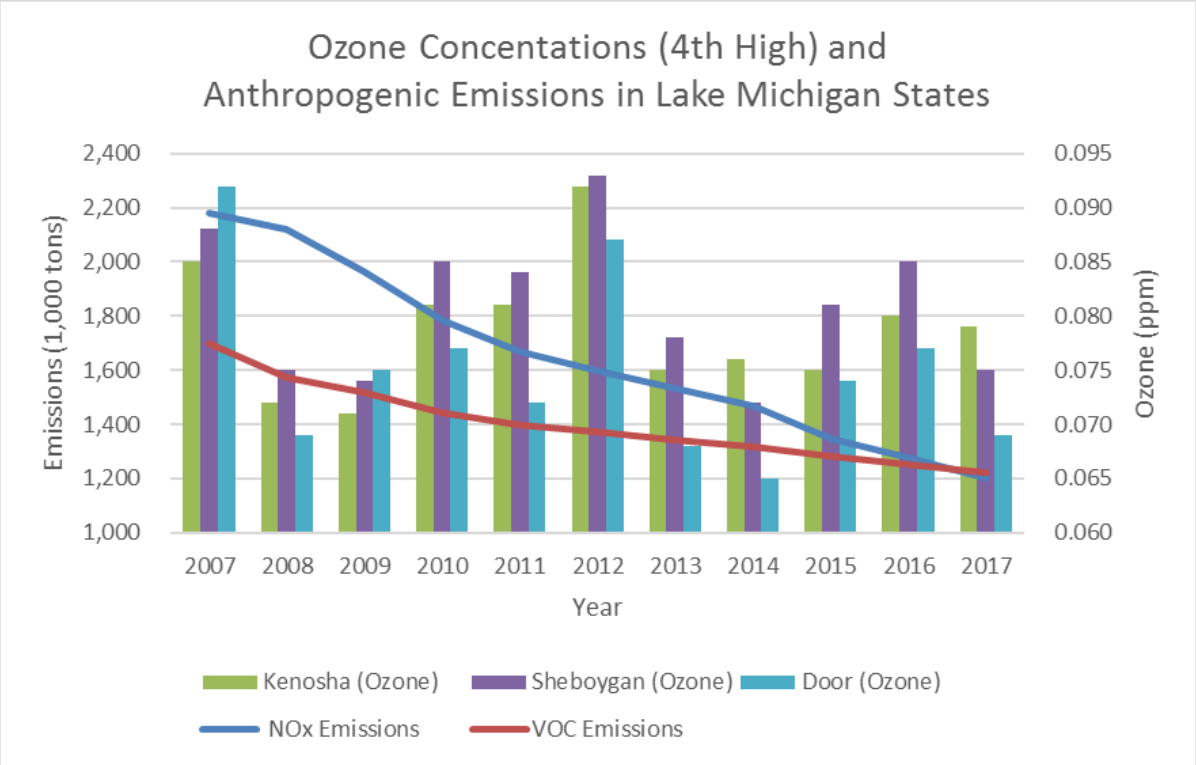
Ozone concentrations in the Lake Michigan basin are a function of complex interactions associated with precursor emissions, meteorology, and chemical reaction and transport processes. Monitors located near the far southern shore in Indiana have current design values slightly lower than the standard of 0.070 parts per million (ppm) while those further north within three to four miles of the lakeshore in Wisconsin as far north as the tip of Door County, and those in southwestern Michigan north to Muskegon within about 20 miles virtually all exceed the standard. Monitors located further from the lakeshore in both states demonstrate attainment with the standard. The following map depicts the areas designated as nonattainment with the 2015 ozone standard, based primarily on air quality monitoring data from the years 2014 - 2016, which were the most recent data that states were required to certify at the time USEPA notified the states of its intended modifications to their recommendations:



Persistently high levels of ozone near the lakeshore continue despite the significant reductions of anthropogenic precursor pollutant emissions. Since adoption of the Clean Air Act Amendments of 1990, a review of USEPA's Air Pollutant Emissions Trends Data[1] reveals that total anthropogenic emissions of Nitrogen Oxide (NOx) in the four states bordering Lake Michigan have been reduced by over 64 percent; Volatile Organic Compound (VOC) emissions have been reduced by nearly 58 percent. Industrial sources, including the utility sector, have reduced NOx and VOC emissions by 74 percent and 50 percent, respectively, in this same period. In the past ten years, (2007 – 2017) anthropogenic VOC emissions in the four states have dropped by 28 percent; NOx emissions have been reduced by 45 percent. Industrial sources including the utility sector currently account for approximately 30 percent of the total NOx emissions in the four-state area; less than 20 percent of the total VOC emissions in the four-state area.

Despite these precursor emission reductions, EPA's data for ozone design values in counties adjacent to the lake have only decreased on average by 14 percent during this same period, with individual monitoring sites seeing reductions of 8 to 22 percent.[2] In Illinois lakeshore counties, ozone levels have been reduced by only slightly more than 9 percent, while in Wisconsin lakeshore counties, the reduction has been just over 13 percent, and in both Indiana and Michigan, the reduction has been more than 16 percent. The lowest reductions in the region have been experienced at lakeshore monitors located near the Illinois – Wisconsin state line (Illinois Beach State Park and the Chiwaukee Prairie State Line monitoring sites).

The following graphic depicts the precursor emission reductions and the changes in measured ozone concentrations over the period of 2007 to 2017:



[1] https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data
[2] https://www.epa.gov/air-trends/air-quality-design-values#previous

As this graphic depicts, the 4th high ozone concentration, which is used in the 3-year average to determine attainment with the standard, increased significantly in certain years despite the continual decrease in precursor emission rates. Higher ozone concentrations have been noted in the region in years with maximum daily temperatures higher than average for the season.[3] For example, the region experienced warmer than normal summer weather in the three-year period of 2010 to 2012 and ozone concentrations in this three-year period increased sharply. Because the design value, which is the basis for determining attainment with the standard is based on 3-year periods, the influence of ozone concentrations in 2012 impacts the design values for years ending 2012, 2013, and 2014. In contrast, the region experienced cooler than normal daily high temperatures in the summers of 2013 through 2015 and ozone concentrations were substantially lower. Ozone concentrations in 2016 and 2017 have again increased to levels comparable to 2010 – 2011 despite the continuing emission reduction. Preliminary data for the 2018 ozone season suggests that ozone concentrations in Wisconsin lakeshore counties have risen once again to levels comparable to 2016.

The available models have also proven to be questionable at best, inadequate at worst, for predicting ozone levels in the Lake Michigan basin. Modeling was performed by the Lake Michigan Air Director's Consortium (LADCO) and EPA for 2017 to predict regional ozone concentrations for ozone nonattainment areas for the 2008 standard (0.075 ppm). These model runs resulted in a prediction that Sheboygan County would continue to exceed the standard, but that

> "all monitoring sites in the Chicago nonattainment area, including sites in northwest Indiana, northeast Illinois, and southeast Wisconsin, are expected to meet the 2008 ozone air quality standard by the 2017 ozone season." [4]

Based on the data obtained for the 2017 ozone season, this proved not be the case, with the Chiwaukee Prairie monitor at the Illinois – Wisconsin state line in Kenosha County, Wisconsin coming in with a design value of 0.078 ppm compared with a predicted value of less than 0.067 ppm. A comparison of actual design values for the region following the 2017 ozone season with the model predicted results shows a consistent and significant under-prediction of the actual results. The modeled prediction and actual design values differed by up to 24 percent, averaging 12 percent across this region. The ability to accurately model ozone concentrations presents an ongoing challenge with respect to predicting emission control strategies needed to attain the 2015 ozone standard.

To address the science of ozone formation and impacts in the Lake Michigan basin, and the issues with respect to the ability of available models to provide more accurate predictions of ozone concentrations, the Lake Michigan Ozone Study 2017 was conducted during May and June 2017. The objectives of this study included the following:[5]

- Quantify the relative contributions of inter- and intra-state precursor emissions and emission sources on ozone production along Lake Michigan;
- Evaluate and improve the meteorological and chemical transport models;

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[3] Lake Michigan Air Directors Consortium; Modeling Demonstration for the 2008 Ozone National Ambient Air Quality Standard for the Lake Michigan Region Technical Support Document; February 3, 2017; pages 1-2.
[4] Ibid.; page 2.
[5] Zac Adelman, Lake Michigan Air Directors Consortium; Lake Michigan Ozone Study; presented at the Federation of Environmental Technologists Annual Conference; October 26, 2017

- Study the link between lake breeze circulations and ozone concentrations;
- Analyze the causes of concentration differences between coastal and inland monitoring sites; and
- Develop best practices for ozone attainment planning models

Whether Wisconsin counties can ultimately reach attainment in the coming years remains uncertain. Hopefully, this latest study will provide a roadmap to attainment.

Zac Adelman, the Executive Director of LADCO will be discussing observations and preliminary results of this study. In addition, Gail Good, Director, Air Management, Wisconsin Department of Natural Resources, will be discussing the implications of ozone nonattainment for Wisconsin, and the attainment planning activities of the Department.