# Mid-Course Review for 1-Hour Ozone in the Lake Michigan Region:

# Summary (Draft)

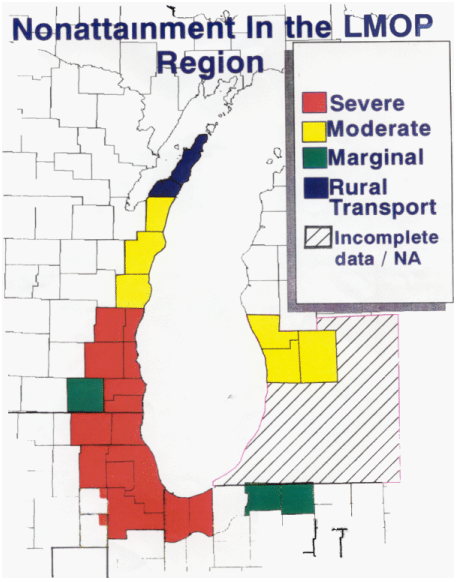
**Lake Michigan Air Directors Consortium**

October 26, 2004

This document summarizes an analyses to determine if the States of Illinois, Indiana, and Wisconsin are "on track" toward attaining the 1-hour National Ambient Air Quality Standard (NAAQS) for ozone in the Lake Michigan area. This review was required by the U.S. Environmental Protection Agency (USEPA) as part of their approval of the 1-hour ozone State Implementation Plans (SIPs) for these states. The document was prepared in accordance with USEPA guidance.

**Introduction**

In November 1991, USEPA designated portions of the Lake Michigan region as nonattainment for 1-hour ozone NAAQS (see figure to right). (The desiganations were based on monitoring data for the period 1987-1989.) In particular, six counties in southeastern Wisconsin, six in northeastern Illinois, and two in northwestern Indiana were classified as severe nonattainment. Under the Clean Air Act Amendments of 1990, severe nonattainment areas are required to adopt certain mandatory controls, and submit a demonstration of attainment (i.e., a modeling-based demonstration that the ozone control plan will provide for attainment of the NAAQS). Furthermore, these severe nonattainment counties are required to comply with the 1-hour ozone NAAQS by 2007.




In April 1998 (and December 2000), the States of Illinois, Indiana, and Wisconsin submitted their 1-hour ozone SIPs to USEPA. The States' 1-hour ozone attainment demonstration consists of local VOC emission reductions in the urban nonattainment areas, plus regional NOx emission reductions. In November 2001, USEPA approved in final the ozone SIPs for the three states.

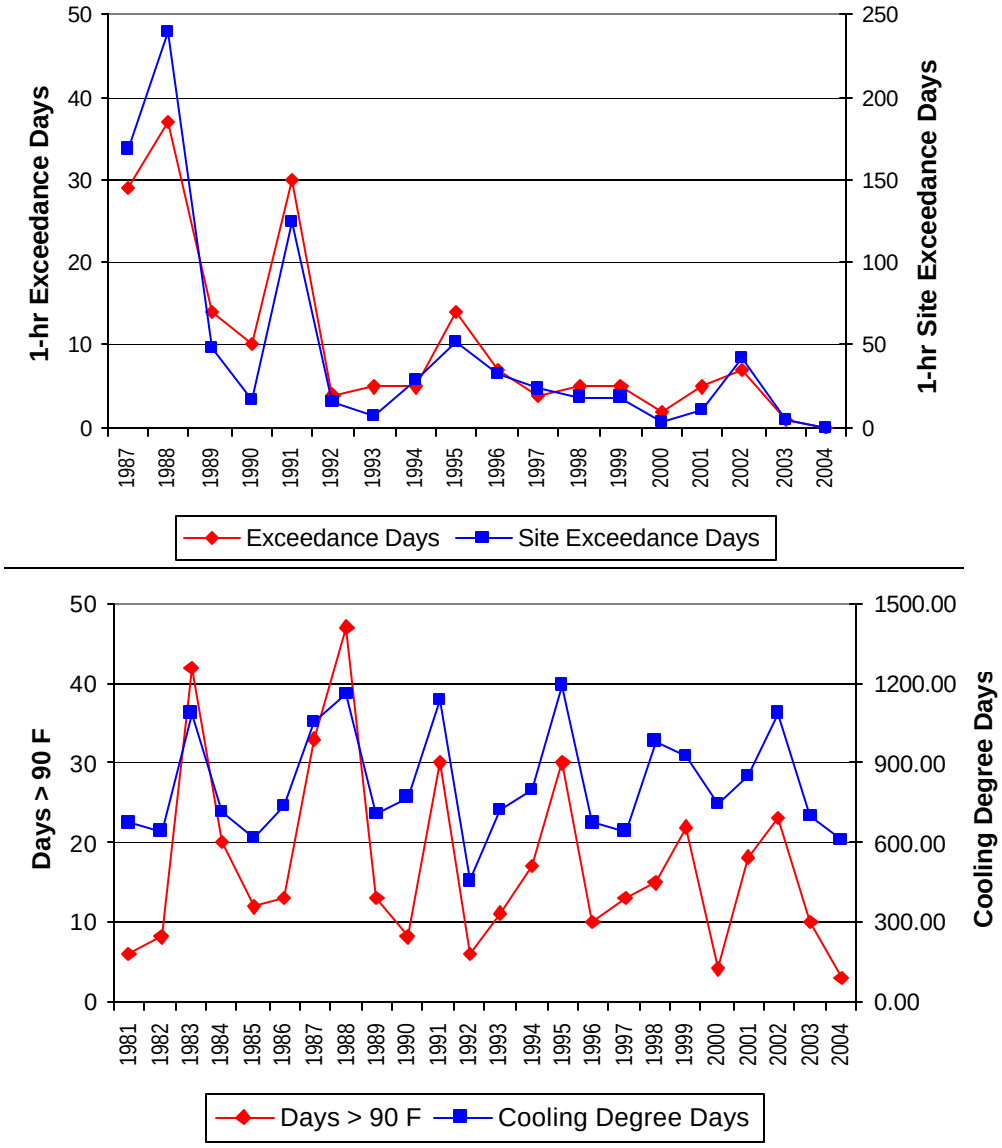
As discussed below, the VOC emissions reductions, which have mostly been achieved, have resulted in lower ozone levels and the NOx emission reductions, which are just starting to come into effect, will further reduce ozone levels. Based on the emission reductions and air quality improvements to date, the States are "on track" to meet the 1-hour ozone by the attainment date (2007).

**Ozone Air Quality**

The change in ozone air quality since 1987-1989 is summarized below in terms several metrics: number of exceedance days, number of monitored violations, and design values. These metrics are used to assess attainment of the 1-hour NAAQS[1].

[1] The ozone NAAQS is attained when the number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1.0, averaged over a 3-year period. An alternative means of judging attainment is to take the 4$^{th}$ highest daily 1-hour value over a 3-year period (i.e., the design value). An exceedance is defined as a peak daily 1-hour ozone concentration equal to or greater than 0.12 ppm (125 ppb) and a violation is defined as a design value equal to or greater than 0.12 ppm (125 ppb).

Number of Exceedance Days: The figures below show the number of exceedance days and exceedance site days (top), and the number of hot days and cooling degree days (bottom).



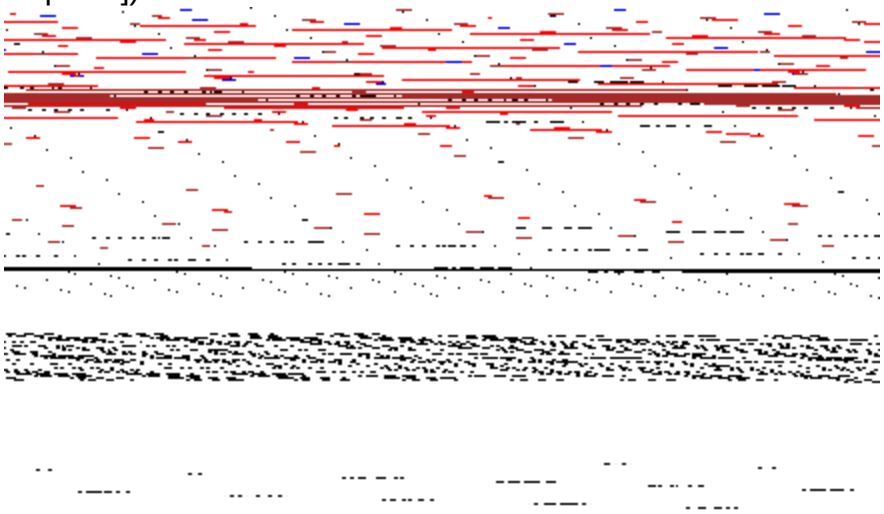

**1-Hour Ozone and Weather Statistics (Lake Michigan Area)**

These figures show:

- Ozone is strongly influenced by meteorology (i.e., the number of exceedance days is generally higher during the hotter summers). However, in comparison to prior hot summers (1988), there were substantially fewer exceedance days during recent hot summers (2002).

- The ratio of exceedance days to hot days has changed dramatically. During the 1980's, there were generally more exceedance days than hot days; whereas during the 1990's and 2000's there were generally more hot days than exceedance days.

Given the influence of meteorology on ozone, more rigorous statistical analyses should be considered. One such analysis grouped days by similar meteorological conditions. Examining concentration changes by group minimizes the influence of meteorology and reveals trends in ozone in response to emission control programs. The results presented below for Chicago show a clear downward trend for the more ozone-conducive meteorology group of days (e.g., groups plotted in green [top line] and blue [line below top line]).



**Ozone Trends by Group of Meteorologically Similar Days for Chicago**

Number of Monitored Violations: The number of monitors in violation of the 1-hour ozone NAAQS for each 3-year period since 1987-1989 is as follows:

| *3-Year Period* | *Sites in Violation* |
|---|---|
| 1987 - 1989 | 30 |
| 1988 - 1990 | 21 |
| 1989 - 1991 | 13 |
| 1990 - 1992 | 10 |
| 1991 - 1993 | 8 |
| 1992 - 1994 | 1 |
| 1993 - 1995 | 5 |
| 1994 - 1996 | 11 |
| 1995 - 1997 | 12 |
| 1996 - 1998 | 8 |
| 1997 - 1999 | 6 |
| 1998 - 2000 | 2 |
| 1999 - 2001 | 0 |
| 2000 - 2002 | 4 |
| 2001 - 2003 | 4 |
| 2002 - 2004 | 4 |

These results demonstrate the decrease in the number of monitors in violation of the 1-hour NAAQS. It should be noted that the current nonattainment situation at the four monitors noted above is due to a single, severe ozone episode in 2002 (June 22-24).

Since then, there have only been a few 1-hour ozone exceedance days in the Lake Michigan region.

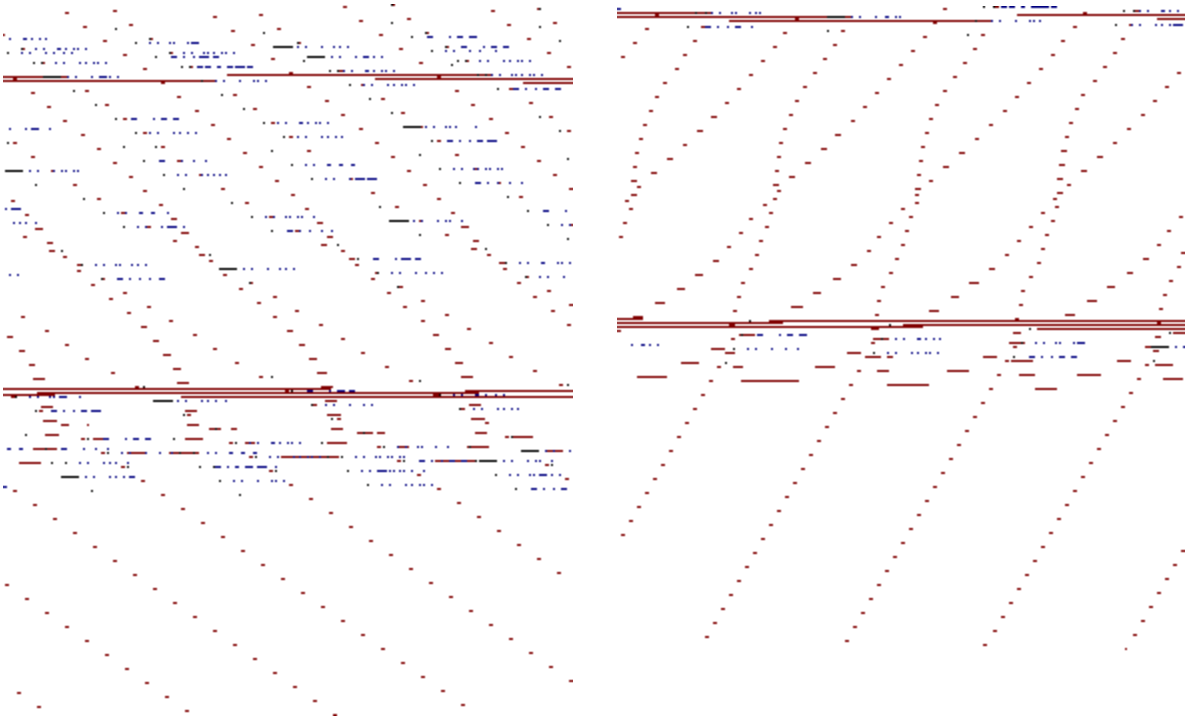
Design Values**:** The figure below shows the design values for sites in violation of the standard for 1987-1989 and 2002-2004. This figure further shows the improvement in ozone air quality:

- The spatial extent of ozone violations has decreased considerably over the past 15 years, from 30 sites in violation in the late 1980's to only 4 for the most recent 3-year period.

- The magnitude of peak ozone design value has decreased considerably over the past 10 years, from 190 ppb in the late 1980's to 134 ppb for the most recent 3-year period.

**1-Hour Ozone Design Values (≥ 0.12 ppm)**

**1987 – 1989** **2002-2004**

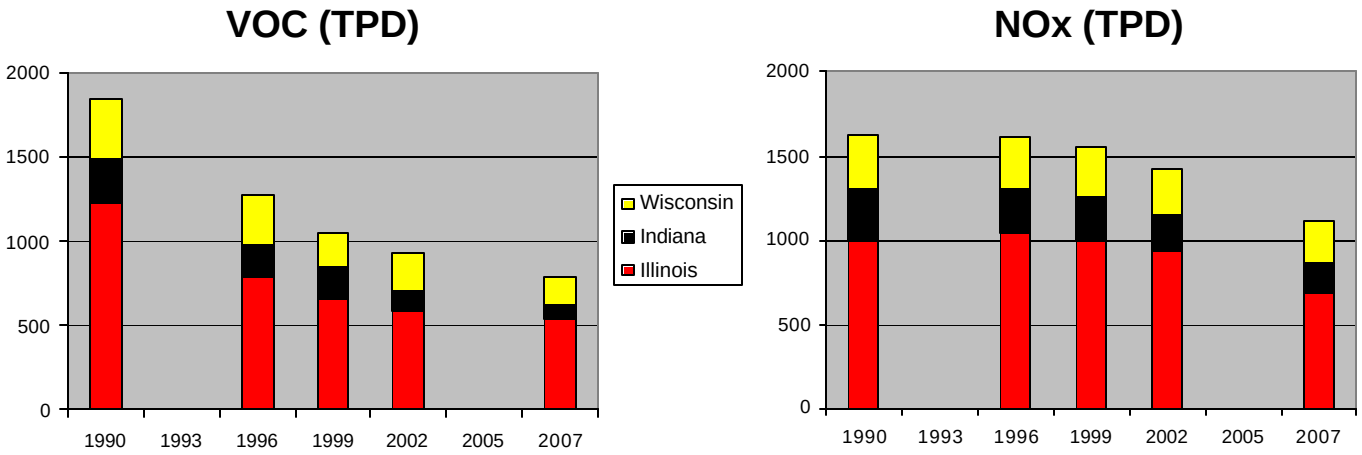


**Ozone Precursor Emissions**

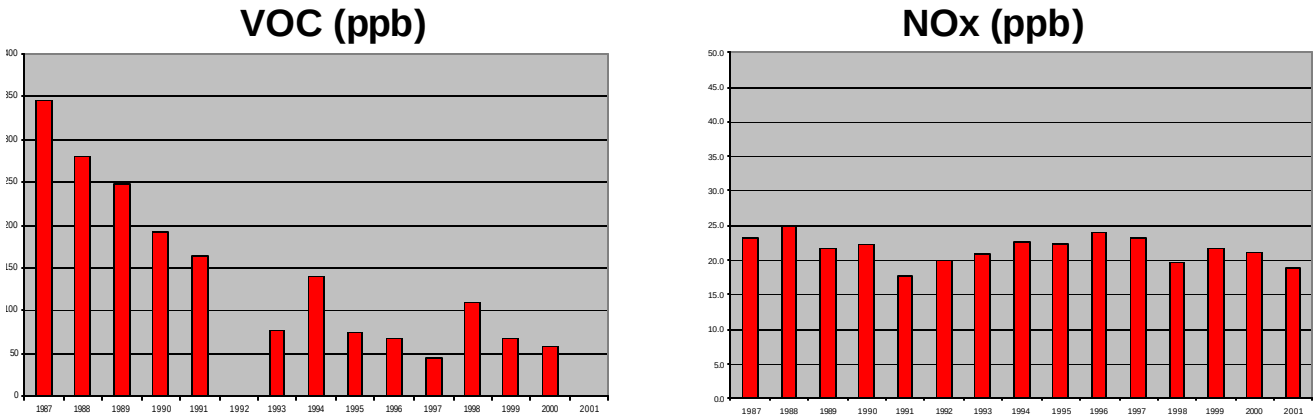
Ozone is formed in the atmospheric through a series of photochemical reactions involving two main precursors: volatile organic compounds (VOCs) and oxides of nitrogen (NOx). A summary of VOC and NOx emissions since 1990 for the severe nonattainment counties in the Lake Michigan region is presented in the figure below.[2]

[2] Emissions data are based on the periodic emissions inventories prepared by the States since 1990. It should be noted that these inventories are developed only on a 1-in-3 year schedule, and that no 1993 emissions inventory was developed.

As can be seen, local VOC emissions have decreased significantly over the past decade. Local NOx emissions, on the other hand, have remained fairly steady.

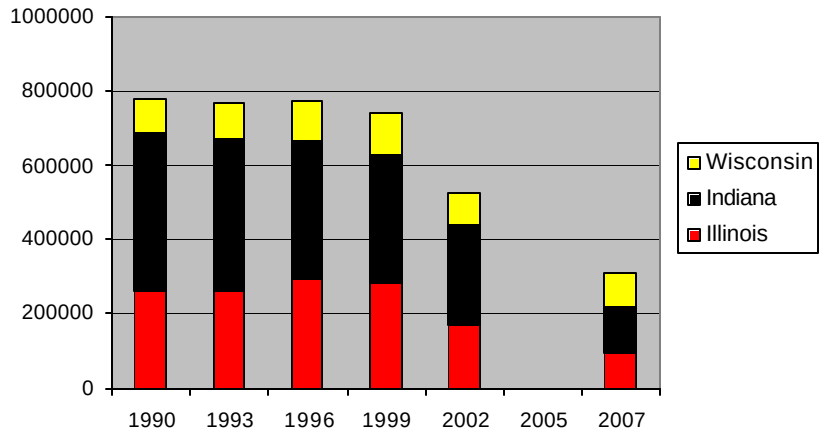



The emissions trends are confirmed by monitoring data. That is, the VOC and NOx ambient concentrations for each year since 1987 from a site in Milwaukee (the only site with such a long-term record of data) show a similar downward trend in VOC levels and little change in NOx levels.




As noted above, the States' 1-hour ozone attainment demonstration consists of local VOC emission reductions, plus regional NOx emission reductions. The VOC emissions chart above shows that there has been considerable reduction in VOC emissions emissions due to motor vehicle control programs, including inspection and maintenance, and reformulated gasoline; area source control programs; and stationary source controls (i.e., current emission totals approach those included in the modeled attainment demonstration, which are represented by the 2007 values in the chart). The NOx emissions chart, however, shows that there has only been a small reduction in NOx emissions. Several regional NOx control programs are just coming into effect, including USEPA's NOx SIP Call, Tier 2/low sulfur gasoline, heavy-duty highway, and clean air nonroad diesel rules, and Wisconsin's NOx Rule. In particular, power plant

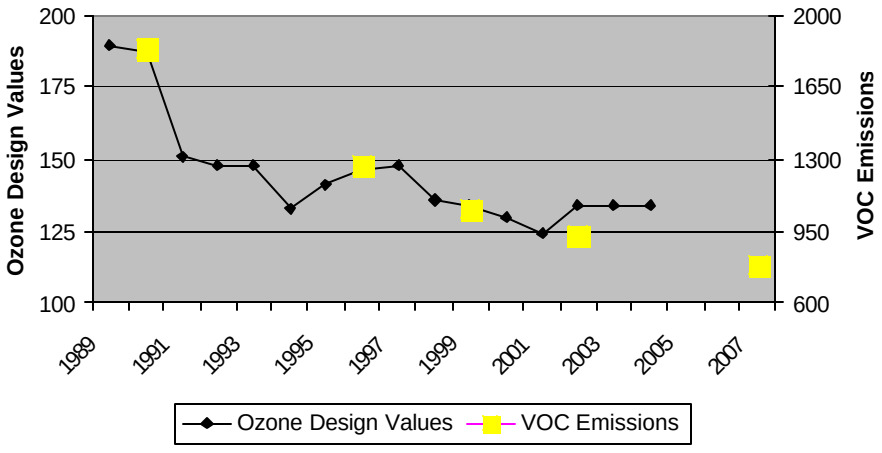
NOx emissions are expected to decline over the next several years, as seen in the figure below. These emission reductions, along with those from on-road and nonroad sources, are expected to reduce transported ozone levels coming into the Lake Michigan area, and reduce local ozone levels.




**Summary**

Ozone air quality has improved considerably over the past 15 years in the Lake Michigan area. In particular, (1) 1-hour ozone design values have declined from 190 ppb to 134 ppb, (2) the number of monitoring sites in violation of the 1-hour standard have declined from 30 to 4, and (3) the number of days above the standard have declined from more than 30 to just a few.

The figure below shows that the improvement in ozone air quality is consistent with the reduction in local VOC. Further progress is expected to come from reductions in regional NOx emissions (e.g., USEPA's NOx SIP Call and Wisconsin's NOx rule).




Based on the air quality improvements which have occurred (in response to mostly VOC emission reductions) and are expected (in response to mostly NOx emission reductions), it can be concluded that the States are "on track" toward attaining the 1-hour ozone standard by the attainment date of 2007.