

# **8-hr and 1-hr Ozone Exceedances in the NESCAUM Region (1993-1997)**

September 1998

## **EXECUTIVE SUMMARY**

On July 18, 1997, the U.S. Environmental Protection Agency (EPA) increased the stringency of the National Ambient Air Quality Standard (NAAQS) for ozone. Previously, the standard was exceeded when ozone concentrations were measured at levels greater than 0.12 parts per million (ppm) over a one-hour period. Under the new standard, exceedances occur when ozone concentrations are measured at levels greater 0.08 ppm over an eight-hour period. Generally speaking, this represents an increase in stringency of approximately 20 percent.

The revised NAAQS will cause the NESCAUM region to experience an increase in the frequency and geographic extent of ozone exceedances. The purpose of this report is to characterize the temporal and spatial pattern of 8-hr and 1-hr ozone exceedances in the NESCAUM region and to examine related meteorological and ozone precursor data to determine how factors contributing to 8-hr exceedances are similar to or different from those contributing to 1-hr exceedances.

Spatial and temporal patterns of 8-hr exceedances during the five-year time period from 1993 to 1997 are evaluated and compared to those of 1-hr exceedances. Results are derived for the entire NESCAUM region and for six subregions, as defined by airshed boundaries. Case studies provide examples of how 8-hr exceedances can occur in the absence of 1-hr exceedances, and vice versa. Synoptic weather patterns and upper-air meteorological conditions are analyzed for their bearing on the types of exceedances (8-hr versus 1-hr) that tend to occur. Radar wind profiler data provide transport statistics for 8-hr and 1-hr exceedance days, and ambient hydrocarbon data from three PAMS (Photochemical Assessment Monitoring Stations) sites are also considered. The major conclusions drawn in this report are summarized below:

### **Spatial and Temporal Patterns**

- In the NESCAUM region, there were over twice as many 8-hr exceedance days (245) as 1-hr exceedance days (95) during the five-year study period (1993-1997).
- There were about six times as many 8-hr site exceedances (2421) as 1-hr site exceedances (399) over the five-year period.
- Most of the additional site exceedances in 1997 resulting from the revised standard occurred on days already containing at least one 1-hr exceedance.

- The greatest increase in site exceedances occurred in areas that were already experiencing significant amounts of 1-hr site exceedances. However, large areas previously unaffected by the 1-hr standard (such as the upper Hudson River Valley, upstate New York, and large inland portions of Maine and New Hampshire) can be expected to exceed the revised standard, thereby expanding the area of concern for air quality officials. This larger area of concern underscores the increasing importance of regional emission control programs, although more analysis is needed to quantify the benefits.
- The impact of the revised standard appears even greater when considering exposure hours in lieu of exceedances. (Exposure hours are the number of 1-hr or 8-hr averages measured above the standard and may be considered a better indicator of exposure than exceedances.)
- Certain sites in the NESCAUM region rank dramatically different in terms of their number of exceedances under the revised standard. For example, only four of the top 10 ranking sites under the 1-hr standard remained in the top 10 under the revised standard.
- Between 1993 and 1997 there appears to be little if any trend in the number of 1-hr exceedance days, but there appears to be a noticeable decrease in the number of 8-hr exceedance days. However, there is no discernable trend in the number of 8-hr site exceedances or 8-hr peak concentrations. This calls for a closer examination of trends, especially one that adjusts for changes in meteorology.
- The disjunct in trends between 8-hr exceedance days, 8-hr site exceedances, and peak concentrations suggests that the frequency of 8-hr ozone episodes may be decreasing although the geographic extent and severity of 8-hr episodes, when they do occur, may not be changing much over time.
- There is a significant seasonal impact of the revised standard. Whereas nearly all 1-hr exceedance days occur in June, July, and August, a significant portion of 8-hr exceedance days occur in May and September. Furthermore, during the June-August period, 8-hr exceedance days occur much more regularly than 1-hr exceedance days, which peak substantially in July.
- There was no obvious day-of-week pattern for 1-hr and 8-hr exceedances in the NESCAUM region as a whole, but modest patterns in several subregions deserve further attention.
- The majority (70 percent) of the 8-hr exceedance days without any 1-hr exceedances were at least one day removed from 1-hr exceedance days. This suggests that the adoption of the 8-hr standard results in new episodes, not simply the extension of existing 1-hr episodes.
- The length of ozone episodes (in terms of the number of consecutive exceedance days) tends to be longer under the revised standard than under the 1-hr standard.

## **Pollution Transport**

- Winds aloft (those located hundreds to a few thousand meters above the surface and containing the bulk of air pollutants in the atmosphere) were stronger on days with both 8-hr and 1-hr exceedances than on days with predominantly 8-hr exceedances only. The 24-hour transport distances for these day-types were 500 km and 400 km, respectively.
- The stronger winds aloft during days with both 8-hr and 1-hr exceedances suggest that these days (the most severe type of exceedance days) are not the result of calm wind conditions but of other weather and air quality factors, such as carryover (pollutants remaining from the prior day), development of the mixing layer, and long-range transport.
- A key component of the strong winds aloft is a low-level jet occurring at depths of 300-600 meters and lasting for most of the evening and early-morning hours. The jet occurs regularly on days with both 8-hr and 1-hr exceedances, and to a lesser extent on days with predominantly 8-hr exceedances only. It is not clear to what extent the jet is contributing to peak ozone concentrations (by transporting pollutants, influencing other important meteorological factors, etc.) or simply associated with them.