2015 Ozone Summary

New Jersey Department of Environmental Protection

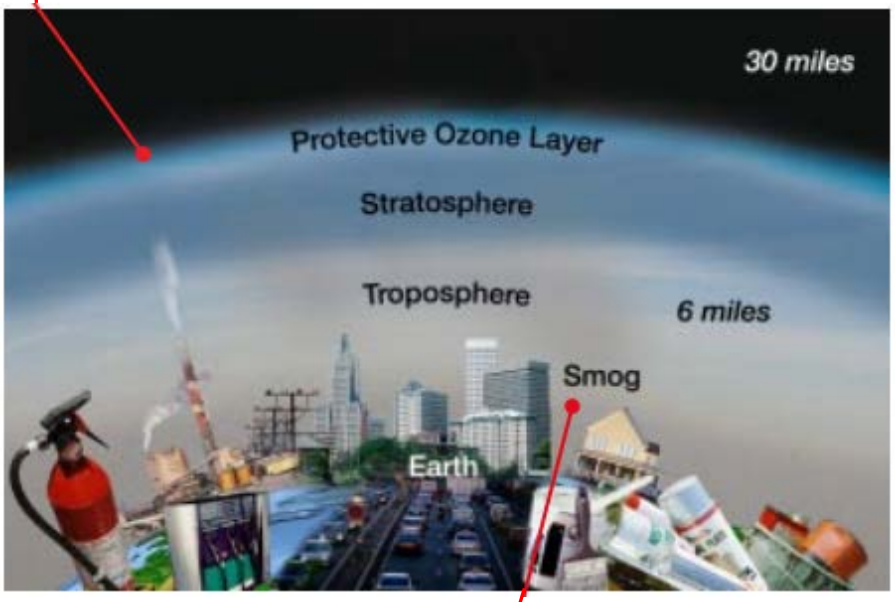
SOURCES

Ozone (O_3) is a gas consisting of three oxygen atoms. It occurs naturally in the upper atmosphere (stratospheric ozone) where it protects us from harmful ultraviolet rays (see Figure 1). However, at ground-level (tropospheric ozone), it is considered an air pollutant and can have serious adverse health effects. Ground-level ozone is created when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight (see Figure 2). NO_x is primarily emitted by motor vehicles, power plants, and other sources of combustion. VOCs are emitted from sources such as motor vehicles, chemical plants, factories, consumer and commercial products, and even natural sources such as trees. The pollutants that form ozone, referred to as "precursor" pollutants, and ozone itself can also be transported into an area from sources hundreds of miles upwind.

Since ground-level ozone needs sunlight to form, it is mainly a daytime problem during the summer months. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone monitoring season runs from April 1st to October 31st. For a more complete explanation of the difference between ozone in the upper and lower atmosphere, see the U.S. Environmental Protection Agency (USEPA) publication, "Ozone: Good Up High, Bad Nearby."

Figure 1: Good and Bad Ozone

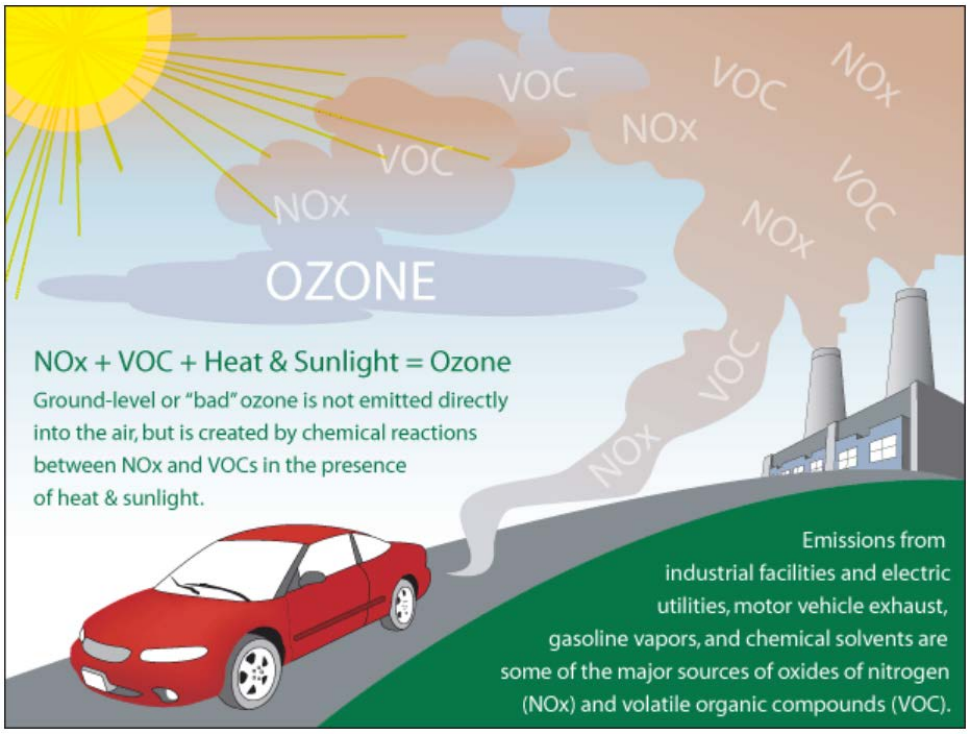
OZONE IS GOOD UP HERE…MANY POPULAR CONSUMER PRODUCTS LIKE AIR CONDITIONERS AND REFRIGERATORS INVOLVE CFCS OR HALONS DURING EITHER MANUFACTURING OR USE. OVER TIME, THESE CHEMICALS DAMAGE THE EARTH'S PROTECTIVE OZONE LAYER.



OZONE IS BAD DOWN HERE… CARS, TRUCKS, POWER PLANTS AND FACTORIES ALL EMIT AIR POLLUTION THAT FORMS GROUND-LEVEL OZONE, A PRIMARY COMPONENT OF SMOG.

Source:USEPA

Figure 2
Ozone Formation



Source: USEPA. https://airnow.gov/index.cfm?action=aqibasics.ozone

Environmental Effects

Ground-level ozone damages plant life and is responsible for 500 million dollars in reduced crop production in the United States each year. It interferes with the ability of plants to produce and store food, making them more susceptible to disease, insects, other pollutants, and harsh weather. "Bad" ozone damages the foliage of trees and other plants, sometimes marring the landscape of cities, national parks and forests, and recreation areas. The black areas on the leaves of the watermelon plant, shown in Figure 3, are damage caused by exposure to ground-level ozone.

Figure 3
Leaf Damage Caused by Ozone

Photos: Gerald Holmes, NCSU Dept. of Horticulture

HEALTH EFFECTS

Ozone can irritate the entire respiratory tract. Repeated exposure to ozone pollution may cause permanent damage to the lungs. Even when ozone is present at low levels, inhaling it can trigger a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. Ozone also can aggravate other medical conditions such as bronchitis, heart disease, emphysema, and asthma, and can reduce lung capacity. People with pre-existing respiratory ailments are especially prone to the effects of ozone. For example, asthmatics affected by ozone may have more frequent or severe attacks during periods when ozone levels are high. Children are also at special risk for ozone-related problems. Their respiratory systems are still developing and they breathe more air per pound of body weight than adults. They are also active outdoors during the summer when ozone levels are at their highest. Anyone who spends time outdoors in the summer can be affected, and studies have shown that even healthy adults can experience difficulty in breathing when exposed to ozone. Anyone engaged in strenuous outdoor activities, such as jogging, should limit activity to the early morning or late evening hours on days when ozone levels are expected to be high.

AMBIENT AIR QUALITY STANDARDS FOR OZONE

National and state air quality standards for ground-level ozone were first promulgated in 1971. There are both primary standards, which are based on health effects, and secondary standards, which are based on welfare effects (such as damage to trees, crops and materials). For ground-level ozone, the primary and secondary National Ambient Air Quality Standards (NAAQS) are the same (see Table 1). In 2008 the ozone NAAQS were revised by USEPA because it was determined that the old standard of 0.08 parts per million (ppm) maximum daily eight-hour average was not sufficiently protective of public health. The 8-hour average daily maximum was changed to 0.075 ppm. The primary 1-hour NAAQS was revoked, but is still used for comparison purposes, although not to determine compliance. In October 2015, the 8-hour ozone NAAQS was lowered once again, to 0.070 ppm. The new standard goes into effect in 2016.

The 8-hour NAAQS for ozone is set so that determining compliance is based a two-step process using data from the most recent three years. The first step involves determining the fourth-highest daily maximum 8-hour average concentration for each monitoring site for each of the three years. The values for each site are then used to calculate a three-year average. If this value exceeds the NAAQS at any site in the state, the state is determined to be in nonattainment. This is the “design value” for the NAAQS, the actual statistic that determines whether an area meets the standard.

Table 1
National and New Jersey Ambient Air Quality Standards for Ozone
Parts per Million (ppm)

Averaging Period	Type	New Jersey	National
1-Hour	Primary	0.12 ppm	---
8-Hour	Primary	---	0.075 ppm
8-Hour	Secondary	---	0.075 ppm

OZONE MONITORING NETWORK

Ozone was measured at 16 monitoring stations in New Jersey during 2015 (see Figure 5). Of those 16 sites, ten operated year-round and six operated only during the ozone season, which is April 1st through October 31st. Bayonne, Brigantine, Camden Spruce Street, Chester, Columbia WMA, Flemington, Millville, Newark Firehouse, Rider University and Rutgers University operate year-round. Ancora, Clarksboro, Colliers Mills, Leonia, Monmouth University, and Ramapo sites operate only during the ozone season.

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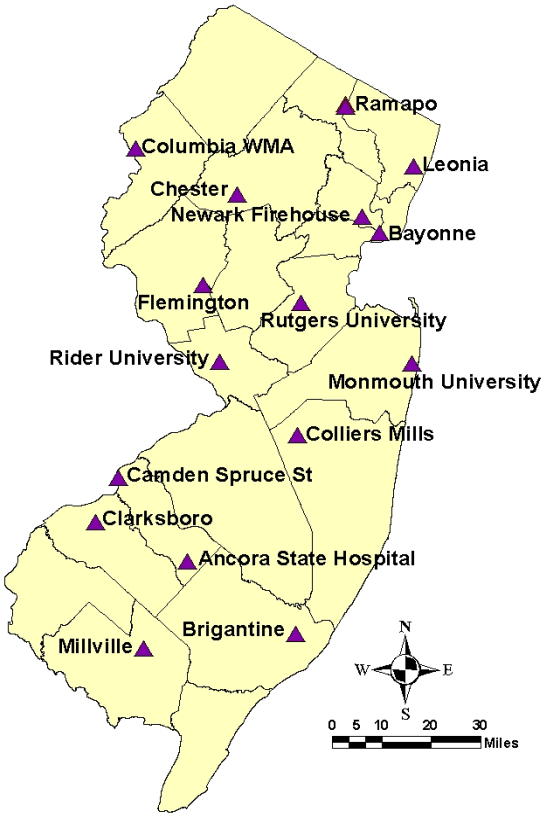
Figure 5
2015 Ozone Monitoring Network



OZONE LEVELS IN 2015

Table 2 shows ozone concentrations in New Jersey for 2015. Of the 16 monitoring sites that were operating during the 2015 ozone season, none recorded levels above the old 1-hour standard of 0.12 ppm. The highest 1-hour concentration was 0.105 ppm, recorded at Bayonne on July 28th.

Eleven of the sixteen ozone monitoring sites recorded levels above the 8-hour NAAQS of 0.075 ppm. The highest daily maximum 8-hour concentration was 0.092 at Bayonne on September 17th. The fourth-highest daily maximum 8-hour values were above the NAAQS at Bayonne, Camden Spruce Street, Clarksboro, Leonia, Monmouth University, and Rutgers University. However, the design value for each of the sites was below the 8-hour standard of 0.075 ppm for the none of the sites in New Jersey were above the design value for the 8-hour standard, based on data from 2013 through 2015. Figure 7 on the following page charts the 8-hour design values for the 2013-2015 period.

Table 2
2015 Ozone Concentrations in New Jersey
Parts per Million (ppm)

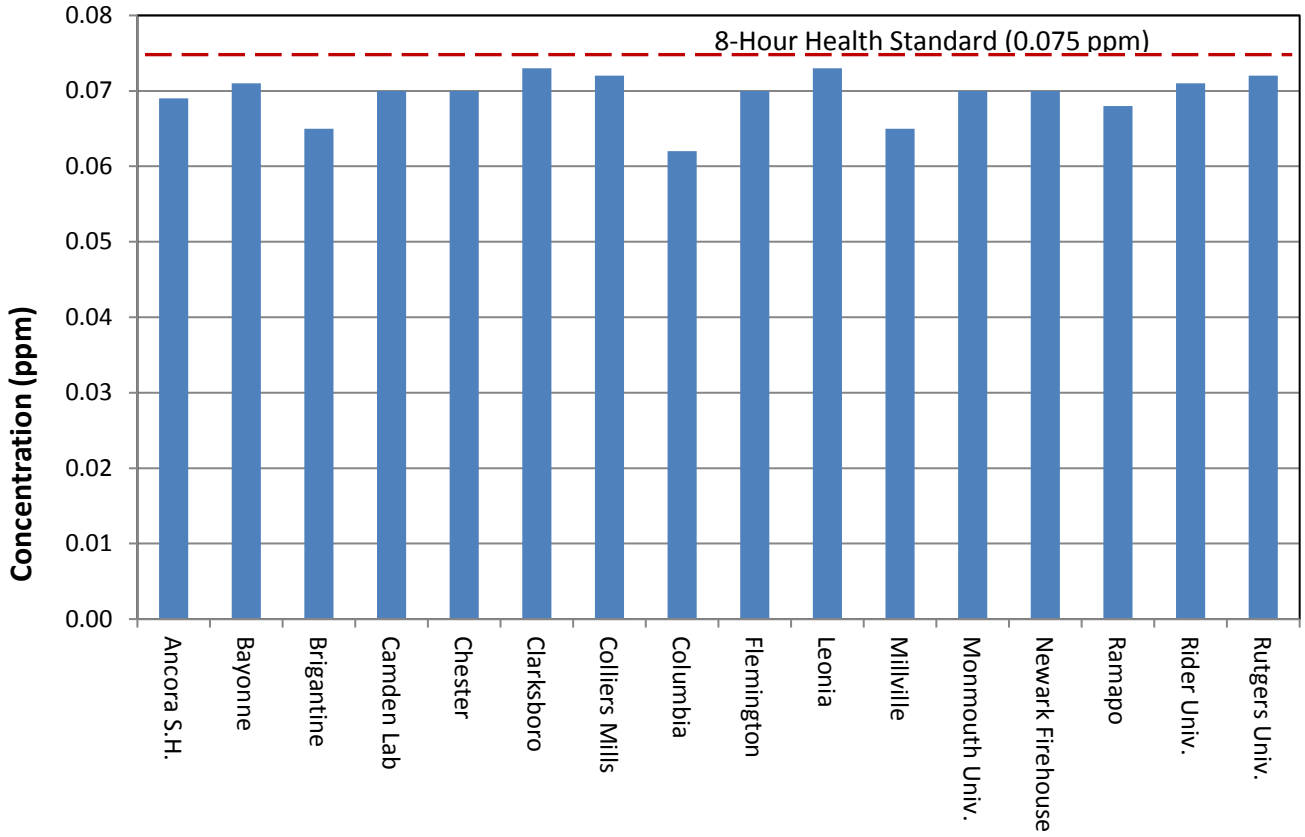
Monitoring Site	1-Hour Average Maximum	8-Hour Averages		
		Highest Daily Maximum	4th-Highest Daily Maximum	2013-2015 Average of 4th-Highest Daily Max.
Ancora	0.086	0.076	0.072	0.069
Bayonne	0.105	0.092	0.077	0.071
Brigantine	0.086	0.077	0.064	0.065
Camden Spruce St.	0.103	0.090	0.079	0.070
Chester	0.084	0.073	0.070	0.070
Clarksboro	0.091	0.080	0.076	0.073
Colliers Mills	0.100	0.090	0.075	0.072
Columbia WMA	0.093	0.075	0.066	0.062
Flemington	0.090	0.075	0.073	0.070
Leonia	0.099	0.080	0.076	0.073
Millville	0.078	0.073	0.068	0.065
Monmouth Univ.	0.100	0.087	0.077	0.070
Newark Firehouse	0.099	0.074	0.072	0.070
Ramapo	0.100	0.084	0.071	0.068
Rider University	0.100	0.084	0.073	0.071
Rutgers University	0.104	0.081	0.077	0.072

Figure 6

New Jersey Ozone Design Values for 2013-2015

3-Year Average of the 4th Highest Daily Maximum 8-hour Average

Parts per Million (ppm)



OZONE TRENDS

Efforts to reduce concentrations of ground-level ozone in New Jersey have been focused on reducing emissions of VOCs and NOx. Studies have shown that such an approach should lower peak ozone concentrations, and it does appear to have been effective in achieving that goal. The chart in Figure 8 is based on the fourth-highest 8-hour average concentrations recorded each year, which is the basis of the ozone NAAQS. As Figure 8 illustrates, the maximum 8-hour concentrations have decreased fairly steadily since 1988, with the maximum site for 2015 just barely exceeding 0.075 ppm. In 2015, the design value (three-year average of the 4th-highest daily maximum 8-hour concentrations at any site) was actually finally met, as shown in Figure 9. However, the standard will be lowered to 0.070 ppm in 2016, so further improvements will be needed. Ozone levels in New Jersey are greatly impacted by emissions from upwind sources in other states, so reductions in VOCs and NOx emissions will have to be achieved over a region beyond state borders.

Figure 8
Ozone Concentrations in New Jersey, 1986-2015
4th-Highest Daily Maximum 8-Hour Averages
Parts per Million (ppm)

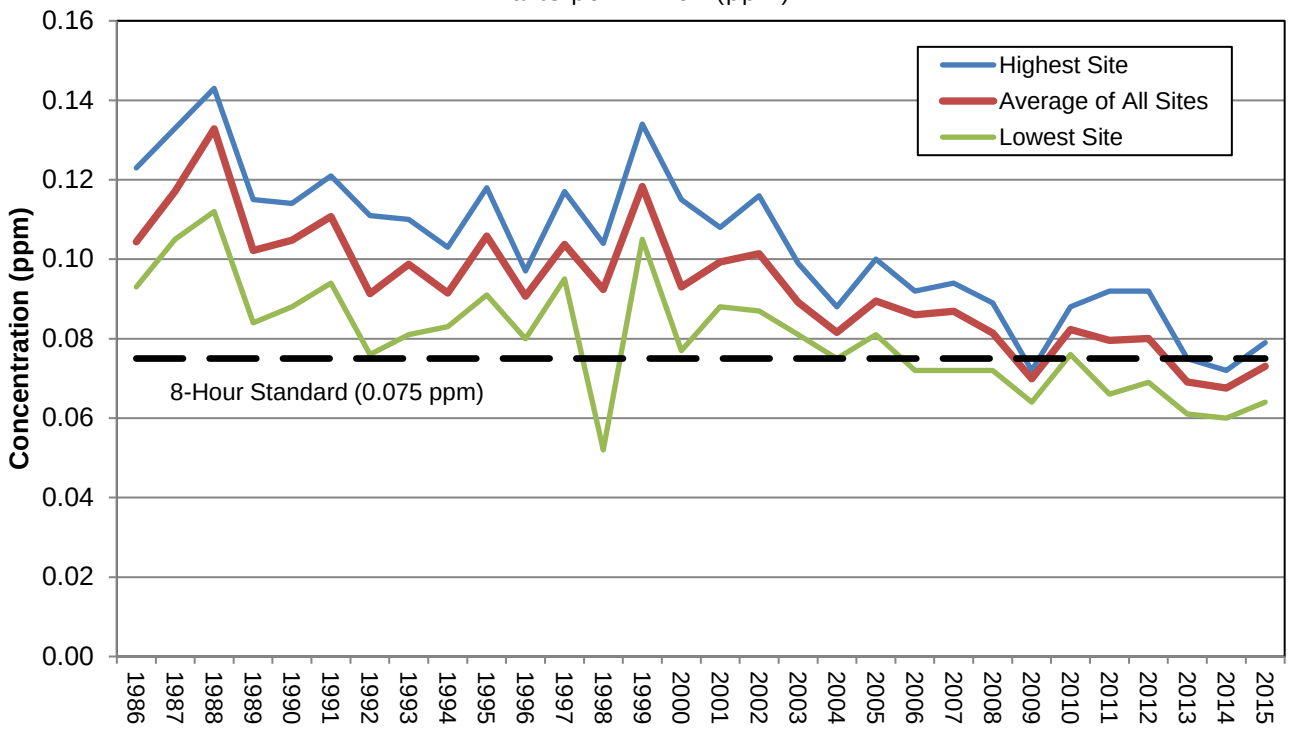
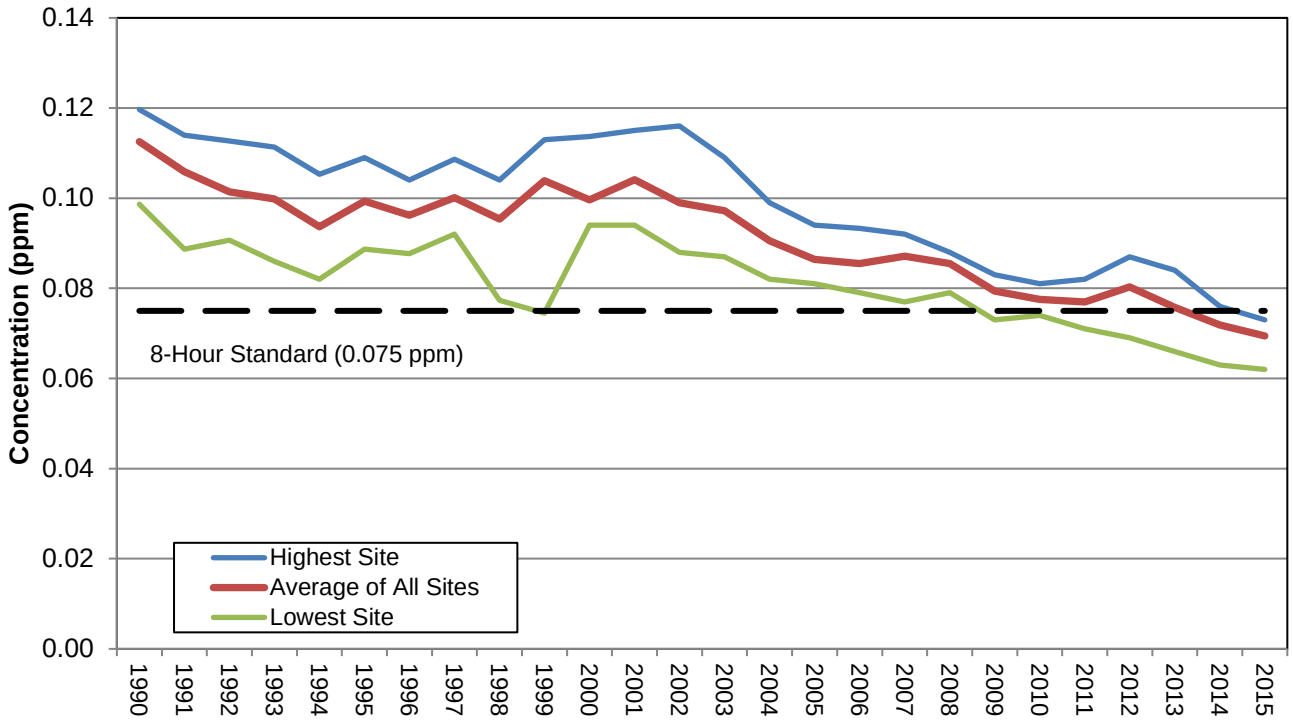


Figure 9
Ozone Design Values in New Jersey, 1990-2015
3-Year Averages of 4th-Highest Daily Maximum 8-Hour Average Concentrations
Parts per Million (ppm)

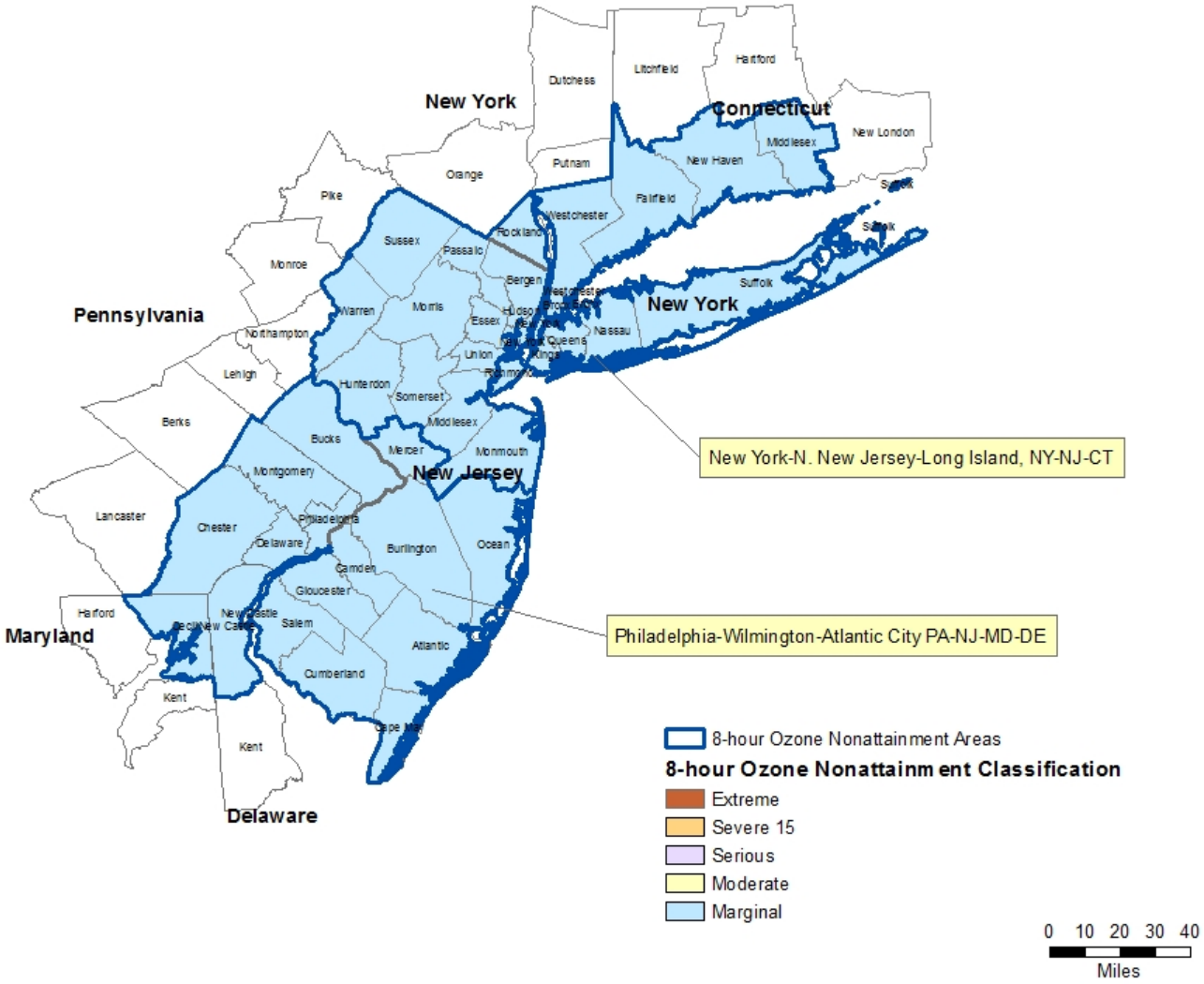


OZONE NONATTAINMENT AREAS IN NEW JERSEY

The Clean Air Act requires that all areas of the country be evaluated for attainment or nonattainment for each of the NAAQS. The 1990 amendments to the Clean Air Act required that areas be further classified based on the severity of nonattainment. The classifications range from "marginal" to "extreme" and are based on the design values that determine whether an area meets the standard.

The entire state of New Jersey has been in nonattainment for the ozone NAAQS, and is classified as being "marginal." A "marginal" area has a design value of 0.076 up to but not including 0.086 ppm. New Jersey's current classification with respect to the 8-hour standard is shown in Figure 9.

Figure 9
New Jersey 8-Hour Ozone Nonattainment Areas



Source: www3.epa.gov/airquality/greenbook/map/nj8_2008.pdf

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