



Seasonal Report

2022 Ozone

OVERVIEW

2022 tied for the cleanest year on record for ozone pollution across the state of Maryland. Improvements in air quality continue to be seen as the number of ozone exceedance days across the state decrease (Figure 1). Surface ozone is a secondary pollutant formed when nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight. The ozone season typically runs April through September when more direct sunlight provides an environment favorable for ozone formation. Unlike upper atmospheric ozone, which protects us from harmful UV radiation emitted by the Sun, surface ozone can be detrimental to the human health. It can cause lung irritation, coughing, and shortness of breath. In addition, long-term exposure to high levels of ozone can also lead to decreased lung function and chronic respiratory problems. It is important to measure ground-level ozone concentrations in order to monitor air quality and take steps to reduce pollution. The Environmental Protection Agency (EPA) sets the National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, including ozone. When the maximum daily 8-hour average ozone concentration exceeds 70 parts per billion (ppb), or 100 on the Air Quality Index (AQI) (see bottom of page), it is deemed unhealthy for sensitive groups (USG). Days that fit this criteria are deemed “exceedance days” and can be an important indicator of an ozone season’s severity. The 2022 ozone season saw just three exceedance days (see Figure 1), tied for the fewest total in Maryland’s recorded history.

Maryland Ozone Exceedance Days

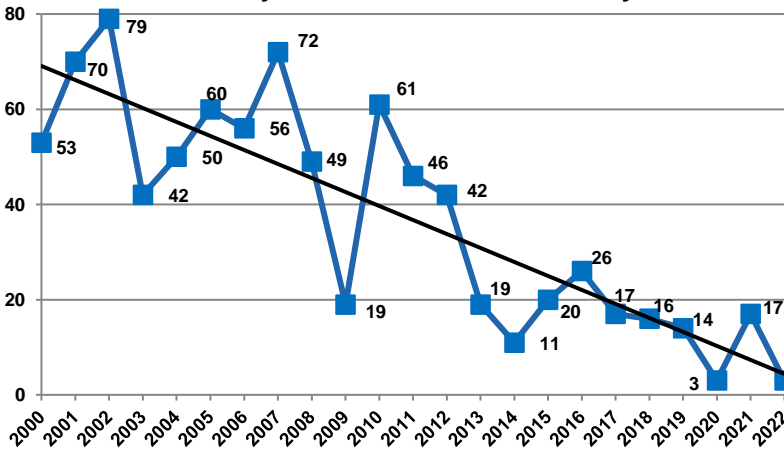


Figure 1: Total number of Maryland ozone exceedance days using the EPA 2015 70 ppb standard, 2000 – 2022. Black trend line is included.

SEASONAL HIGHLIGHTS & STATISTICS

Meteorological conditions were favorable for frequent high ozone formation across the state during the 2022 season. Maximum temperatures across Maryland between April and September of 2022 ranked in the top 80th percentile of recorded history (106th out of 128 years) (see Figure 2). The number of days reaching or exceeding 90°F was also well above normal as well with BWI airport recording 48 days during the 2022 season. The average number of days reaching this threshold being just 33.

Precipitation was average across the Mid-Atlantic region during the 2022 ozone season (Figure 2). Given a near average precipitation distribution across the entire ozone season, it did not put any hinderance on ozone formation over the course of the year. Despite all this, the number of ozone exceedance days was tied for the lowest on record with just 3 days (June 21, June 30 and July 23). In fact, two of the three ozone exceedance days for Maryland in 2022 were triggered by just one monitor squeaking over the standard (see Table 1).

In years past, particularly in the early 2000s and years prior, there was a close relationship between the number of days reaching or exceeding 90°F and the number of ozone exceedances. As a rule of thumb forecasting ozone 20 years ago, if the maximum temperature in Maryland was expected to reach 90°F, there was a good chance that there was to be an ozone exceedance somewhere in the state. In the present day, the disparity between the number of 90° days and the number of ozone exceedances continues to grow. With 2022 seeing only 3 ozone exceedance days and 48 days at or above 90°, a 6.25% ratio (3/48) marks the smallest ratio between these two values in Maryland’s recorded

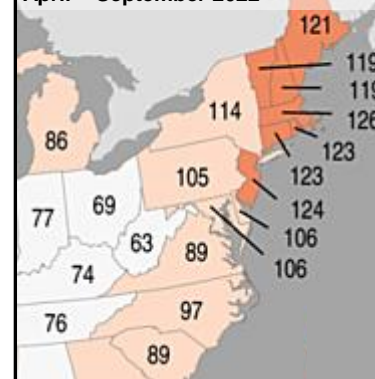
decreased lung function and chronic respiratory problems. It is important to measure ground-level ozone concentrations in order to monitor air quality and take steps to reduce pollution. The Environmental Protection Agency (EPA) sets the National Ambient Air Quality Standards (NAAQS) for six criteria pollutants, including ozone. When the maximum daily 8-hour average ozone concentration exceeds 70 parts per billion (ppb), or 100 on the Air Quality Index (AQI) (see bottom of page), it is deemed unhealthy for sensitive groups (USG). Days that fit this criteria are deemed “exceedance days” and can be an important indicator of an ozone season’s severity. The 2022 ozone season saw just three exceedance days (see Figure 1), tied for the fewest total in Maryland’s recorded history.

Maryland 2022 Ozone Exceedance Days

Date	Day	No. of Monitors	Highest AQI Monitor	8-Hr Average Ozone AQI
21 June	Tue	1	Fair Hill	101
30 June	Thu	7	Padonia	122
23 July	Sat	1	Lake Montebello	108

Table 1: Maryland 2022 ozone exceedance days. Day of week is noted along with highest reading monitor and its color coded 8-hr AQI value.

Statewide Max Temperature Ranks April – September 2022



Statewide Precipitation Ranks April – September 2022

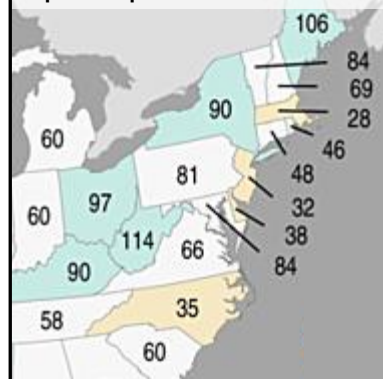


Figure 2: April – September 2022 statewide temperature ranks (left) and precipitation ranks (right). Numerical values represent the ranking warmest (left) or wettest (right) over the past 128 years of record. Source: NOAA/NCDC Climate Division.

AQI 0-50 Good	51-100 Moderate	101-150 USG*	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous
------------------	--------------------	-----------------	----------------------	---------------------------	----------------------

*Unhealthy for Sensitive Groups
Based on 2015 8-hour ozone NAAQS.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

1800 Washington Boulevard | Baltimore, MD 21230

410-537-3000 | 1-800-633-6101

Wes Moore, Governor | Aruna Miller, Lt. Governor | Serena McIlwain, Secretary





Seasonal Report

2022 Ozone

SEASONAL HIGHLIGHTS & STATISTICS (cont.)

history. The ratio surpasses the 2020 ozone season which was an extreme outlier due to reduced emissions during the COVID-19 lockdown. Both 2020 and 2022 saw only 3 ozone exceedance days with 2022 having just a couple more 90° days (46 in 2020 vs 48 in 2022). This brings up the all-important question as to why has there been such a drastic improvement in ozone pollution across Maryland over the past decade?

NO_x REDUCTIONS OVER THE PAST 10 YEARS

Interannual variability of sunlight due to storm systems and cloud coverage exists but cannot explain the drastic drop in the number of ozone exceedance days in Maryland in recent years. The reason lies with one of the other two pieces of the ozone formation puzzle, VOCs and NO_x. As previously noted, ground level ozone is created through the interaction nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. With zero or very little VOCs and or NO_x in the atmosphere, the ingredients to make ozone are not sufficient despite favorable meteorology.

Over the past 10+ years, there have been drastic reductions in the amount of NO_x from several different source sectors. One large contributor to NO_x in our atmosphere is passenger vehicles, with the transportation sector making up 55% of the total NO_x emissions in the US in 2022 according to the EPA. As vehicle technologies continue to advance, the amount of NO_x emitted by the vehicle tailpipe continues to decline. Maryland and the entire US saw a huge step forward in the reduction of vehicle emissions in 2017 when the EPA implemented the [Tier 3 Motor Vehicle Emission and Fuel Standards program](#). The Tier 3 Program is a set of regulations implemented by the EPA to reduce emissions from passenger cars and light-duty trucks. The program requires automakers to meet stricter emissions standards for NO_x, particulate matter (PM), and other harmful pollutants. It also sets new limits on the amount of sulfur in gasoline, which is known to interfere with the effectiveness of vehicle emission control systems.

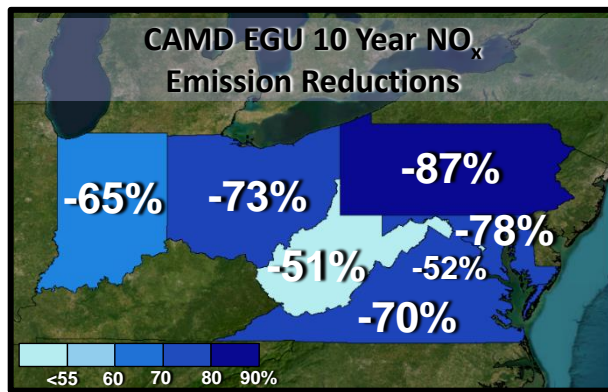


Figure 3: Clean Air Markets Database (CAMD) EGU NO_x emissions comparing ozone season April – Sept 2013 vs 2022. NO_x emissions from each state between 2013 and 2022 are summed and expressed as a percent difference.

In addition to cleaner vehicle emissions, the entire vehicle fleet has seen a steady turnover to more hybrid and fully electric. According to the [US Energy Information Administration](#), in 2021, the percentage electric and hybrid vehicles sold in the US surpassed 10% of the total market. This is a drastic increase from just 5 years ago where the total number of sales in this sector was only around 3%.

Another large source sector for NO_x in the US is electricity generation units (EGUs). Over the past 10 years there has been drastic reductions in the amount of NO_x emitted by these point sources in large part due to controls and regulations set in place by the EPA. Figure 3 shows the percent reduction in NO_x from EGUs between 2013 and 2022 across Maryland as well as several other upwind states during the ozone season (April – September). These 6 states (and DC) have seen an average decrease of around 73% with Maryland recording a decrease of 78%. In the last year alone, these states have seen a reduction in EGU NO_x of over 20%! With less and less NO_x in the atmosphere, it becomes increasingly difficult for ozone to reach exceedance level thresholds across the state of Maryland despite warmer than normal conditions.

MARYLAND DESIGN VALUES

Another way of measuring the severity of ozone levels for a given location is by determining a monitoring site's design value. An ozone design value is a metric used by the EPA to indicate the severity of ozone pollution in a particular location over a given period. The design value is calculated as the three-year average of the annual fourth-highest daily maximum eight-hour average ozone concentration.

Design values are typically used to designate and classify nonattainment areas, as well as to assess progress towards meeting the NAAQS. Monitoring sites which have an ozone design value greater than 70 ppb are in violation of the NAAQS. When this happens, the EPA may require measures to reduce ozone pollution, such as implementing stricter emissions controls. 2022 marks the first year in Maryland's history where all ozone monitors across the state are below the 70 ppb design value attainment threshold. This is clear evidence of the tremendous strides that Maryland and surrounding states have made towards improving air quality across the region.

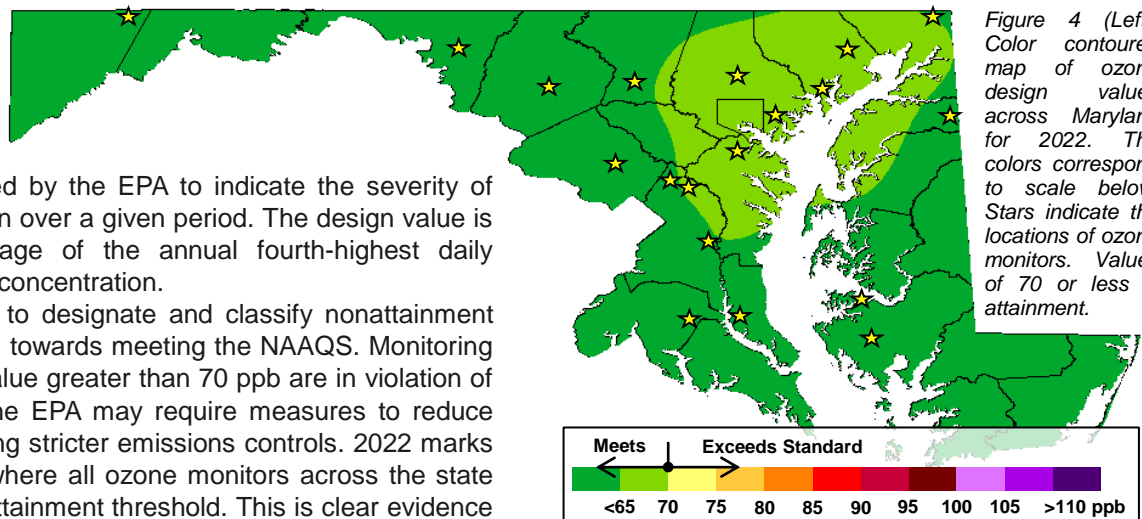


Figure 4 (Left): Color contoured map of ozone design values across Maryland for 2022. The colors correspond to scale below. Stars indicate the locations of ozone monitors. Values of 70 or less is attainment.

2022 Ozone Design Values

0-50 Good	51-100 Moderate	101-150 USG*	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous
--------------	--------------------	-----------------	----------------------	---------------------------	----------------------

Unhealthy for Sensitive Groups based on 2015 8-hr ozone NAAQS denotes the USG

MARYLAND DEPARTMENT OF THE ENVIRONMENT

1800 Washington Boulevard | Baltimore, MD 21230

410-537-3000 | 1-800-633-6101

Wes Moore, Governor | Aruna Miller, Lt. Governor | Serena McIlwain, Secretary

