Air Quality 101
A Review of Air Quality Facts & Figures in the Baltimore Region
Air Pollution

• Federal Clean Air Act requires the U.S. EPA to set National Ambient Air Quality Standards (NAAQS)

• Primary NAAQS are designed to protect health
  – Prevent effects such as respiratory and heart disease aggravation, respiratory symptoms, and even death

• Secondary NAAQS protect against welfare effects
  – Protect wildlife, vegetation, agriculture, buildings, and visibility
Air Quality Standards

• NAAQS are set for six common air pollutants (“criteria air pollutants”)
  – Ozone (smog, O\textsubscript{3})
  – Fine particulate matter (PM\textsubscript{2.5})
  – Lead (Pb)
  – Nitrogen dioxide, (NO\textsubscript{2})
  – Sulfur dioxide (SO\textsubscript{2})
  – Carbon monoxide (CO)

• Sources include motor vehicles, electricity production, industries, & even some trees

Pics: https://www.epa.gov/criteria-air-pollutants
Maryland is in attainment of most air quality standards

- **Nitrogen dioxide** – one of the highly reactive gases, nitrogen oxides (NOx)
  - Sources: Primarily from burning fuel in motor vehicles, power plants, & off-road equipment

- **Particulate matter** – fine particles (PM$_{2.5}$) and coarse particles (PM$_{10}$)
  - Sources: motor vehicles, power plants, factories, wood burning, construction, forest fires, and more.

- **Sulfur Oxides** – harmful to the human respiratory system
  - Sources: Burning of fuel (primarily coal)

- **Lead** – released from industry & nature
  - Utilities, incinerators, & previously in gasoline
  - Now found predominantly in AvGas

Fine Particle Air Pollution
Lower Levels Across the State

Annual PM2.5 (µg/m³)

EPA Annual Standard 12 µg/m³
Progress in Cleaning Maryland’s Air

* 2019 data is preliminary
Though Aug 14th
Baltimore area is “nonattainment” but getting close to attainment for these:

- **Ozone (smog)** = nitrogen oxides (NOx) + volatile organic compounds (VOCs) + sunlight
  - Sources of NOx: burning fuel in motor vehicles, power plants/industries
  - Sources of VOCs: motor vehicles, recreational marine vehicles, consumer products
  - Sources of formed ozone: upwind states

- **Sulfur dioxide**
  - Sources: burning of fossil fuels, especially coal & diesel in power plants, paper & steel industries, ships

Sulfur Dioxide – SO2

Anne Arundel County and Baltimore County SO2 Nonattainment Area

• 26.8 km (16.7 miles) of the Wagner Unit 3 stack
Ozone - Smog

OZONE IN THE LOW ZONE

STRATOSPHERE

PROTECTIVE OZONE LAYER

TROPOSPHERE

DANGEROUS GROUND-LEVEL OZONE

POLLUTION + HEAT & SUNLIGHT = OZONE

Source: EPA
2020 Ozone Design Values

8 -HOUR OZONE DESIGN VALUE
Based on the 2015 70 ppb standard

*2020 data is considered preliminary
Maryland Exceedance Days are Decreasing

Number of days annually when any MD monitor exceeds NAAQS

Avg days > 70ppb: 77

NOx SIP Call Implemented

Tier II Vehicle NOx reductions

~80% reduction in bad air days

2014-2018 Avg days > 70ppb: 18

Maryland Exceedance Days are Decreasing
## Understanding Ozone Designations and SIP Process

### Key Dates for 2015 Ozone Nonattainment Areas

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Area Designations</td>
<td>April 2018</td>
</tr>
<tr>
<td>Emission statement rule, emission inventory, and Moderate area/OTR RACT SIPs</td>
<td>August 2020</td>
</tr>
<tr>
<td>Marginal area attainment date</td>
<td>August 2021*</td>
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<tr>
<td>Attainment plans and demonstrations for initial Moderate areas</td>
<td>August 2021</td>
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<tr>
<td>Attainment plans and demonstrations for initial Serious and above areas</td>
<td>August 2022</td>
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<tr>
<td>Moderate area attainment date</td>
<td>August 2024</td>
</tr>
<tr>
<td>Serious area attainment date</td>
<td>August 2027</td>
</tr>
<tr>
<td>Severe area attainment date</td>
<td>August 2033</td>
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</tbody>
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Demonstrating Attainment of the NAAQS

• Short Answer – By Monitoring Actual Pollutant Concentrations in the Nonattainment Area

• Long Answer
  1. Each Monitor in the Nonattainment Area must demonstrate attainment
  2. The monitors are independent of each others
     • If one monitor exceeds the NAAQS then the entire area is in Nonattainment
     • Therefore, calculations for demonstrating attainment must also be conducted by individual monitor.
Demonstrating Attainment of the NAAQS
EPA Design Value Concept

• What is a Design Value?

A design value is a statistic that describes the air quality status of a given location relative to the level of the National Ambient Air Quality Standards (NAAQS).

Developed to deliver a 98% Confidence Level

Very high threshold/hurdle to meet

• The Baltimore NAA monitors did not meet the criteria for Attainment by the end of the 2020 or 2021 Ozone Seasons
Demonstrating Attainment of the NAAQS 
EPA Design Value Concept

• Design Value Calculation (per Monitor)
  1. 3-year average of the 98th percentile 1-hour daily maximum concentrations
  2. Hourly Concentrations are Recorded and Daily Maximum 8-hour Average Concentrations are Calculated
     - 24 possible running 8-hour average ozone concentrations for each calendar day during the ozone season.
     - The daily maximum is the highest of the 24 possible 8-hour averages.
  3. The 4th Highest Annual 8-Hour Average Ozone Concentration is used to Calculate the 3-year Design Value
Summary DV Statistic

• The standard-related summary statistic is the annual fourth-highest daily maximum 8-hour ozone concentration averaged over three years, also known as the design value.

• The three year average is expressed to three decimal places, and any remaining digits to the right are truncated.

• Example 2020 Design Value for Monitor 1

\[2020DV \ (i) = \frac{4^{th \ High \ Value\ for\ 2018+2019+2020}}{3}\]

Truncated at 3 decimal places

0.0709 = 0.070
Implications Not Meeting the NAAQS by the Attainment Date

• If Attainment is NOT demonstrated by assigned Attainment Date
  – The Nonattainment Area is “Bumped Up” to the next highest Ozone Classification
    – i.e: Marginal NAA are “Bumped Up” to Moderate
    – The “Bump Up” can be a voluntary action by the state(s) or mandated by EPA.
    – Higher Classifications are given more time to meet the NAAQS
  – The Baltimore Marginal Ozone Nonattainment Area will be “Bumped Up” to the Moderate Ozone Classification
Moderate SIP Requirements

- All Marginal SIP Requirements

- Attainment demonstration
  - Photochemical Modeling that Demonstrates Attainment
  - Due Date by Statute: August 2024
  - August is NOT the end of an Ozone Season so Attainment must be demonstrated by the end of the 2023 Ozone Season

- 15% reasonable further progress (RFP) over 6 years
  - All source categories

- On-Road Mobile Emissions Conformity Budget

- Contingency measures for failure to attain
Closing Thoughts

• Enormous amount of work to be done in a relatively short period of time.
  – Typically an entire ozone SIP takes 2 -3 years
  – This one needs to be done in less than 1 year.

• Photochemical modeling and Reasonable Further Progress Demonstrations are the most time consuming

• MDE is counting on MDOT/Baker/BMC to provide on-road emissions for the SIP in a timely fashion.