State of Maryland Clean Air Act Section 110(l) Non-Interference Demonstration for Modifications to the Vehicle Emissions Inspection/Maintenance Program in Maryland

SIP #23-04
Part III

Prepared for:
U.S. Environmental Protection Agency

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Additional Items

Additional information related to the two modeling scenarios performed for this demonstration (the 2002 SIP approved program evaluated for 2023 and the current 2023 program) will be submitted separately and includes:

- MOVES Run Specification (RunSpec) files – these files define the scope of the MOVES run by defining elements such as time period(s), geographical area, source types, etc. included in the modeling.

- MOVES Input MariaDB Databases – input databases provide vehicle characteristics, vehicle activity, and other local conditions.

- MOVES Output MariaDB Databases – output databases contain the results of the MOVES analysis.

- MOVES Output MS-Excel Spreadsheet: MOVES output tables processed into Excel.

- Post-processed MS-Excel Spreadsheet containing emissions by scenario, by jurisdiction, by pollutant and by I/M Area.

1. PURPOSE AND BACKGROUND

The purpose of this report is to demonstrate that modifications within the Maryland Vehicle Emissions Inspection Program (VEIP) comply with Section 110(l) of the Clean Air Act (CAA or the Act). This section of the CAA states –

> *The Administrator shall not approve a revision of a plan if the revision would interfere with any applicable requirement concerning attainment and reasonable further progress (as defined in section 171), or any other applicable requirement of this Act.*

CAA Section 110(l) applies to all areas of the country, whether attainment, nonattainment, unclassifiable or maintenance, for one or more of the six criteria pollutants: ozone, particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and lead (Pb).

However, the VEIP program in Maryland is not statewide; it is limited to the counties of: Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, Prince George's, Queen Anne's, and Washington Counties, as well as the City of Baltimore.

The report and supporting analyses demonstrate that the modifications to the VEIP program do not interfere with attainment or maintenance of all current criteria pollutant National Ambient Air Quality Standards (NAAQS), including the 2008 and 2015 Ozone NAAQS, the 2012 $PM_{2.5}$ NAAQS, the 2010 NO_2 NAAQS, the 2010 SO_2 NAAQS, the 1971 CO NAAQS, and the 2008 lead NAAQS.

Table 1: Status of Maryland Jurisdictions per National Ambient Air Quality Standard (NAAQS)

Pollutant	Year Adopted by EPA	Primary/Secondary NAAQS	Averaging Time	Level*	Area/Designation Status
Ozone	2015	Primary and Secondary	8-hour	70 ppb	Washington DC/MD/VA – Moderate with a Clean Data Determination
					Baltimore, MD – Moderate
					Philadelphia PA/NJ/DE/MD – Moderate
CO	2011	Primary	1-hour 8-hour	35 ppm 9 ppm	Attainment Statewide
Lead	2008	Primary and Secondary	Rolling 3-month average	0.15 $\mu g/m^3$	Attainment Statewide
NO2	2010	Primary	1-hour	100 ppb	Attainment Statewide
		Primary and Secondary	Annual	53 ppb	

Pollutant	Year Adopted by EPA	Primary/Secondary NAAQS	Averaging Time	Level*	Area/Designation Status
PM2.5	2012	Primary and Secondary	Annual	12 µg/m^3	Attainment Statewide
		Primary and Secondary	24-hour	15 µg/m3	
PM10	2012	Primary and Secondary	24-hour	150 µg/m3	Attainment Statewide
SO2	2010	Primary	1-hour	75 ppb	Anne Arundel-Baltimore Counties Nonattainment with a Clean Data Determination
		Secondary	3-hour	0.5 ppm	

Where:
The Maryland portion of the Washington DC/MD/VA ozone nonattainment area consists of Calvert, Charles, Frederick, Montgomery, and Prince George's Counties.
The Maryland portion of the Baltimore MD ozone nonattainment area consists of Anne Arundel, Baltimore, Carroll, Harford and Howard Counties and the City of Baltimore.
The Maryland portion of the Philadelphia PA/NJ/DE/MD ozone nonattainment area consists of Cecil County.

2. OVERVIEW

Following adoption of the CAA Amendments of 1990, Maryland's ozone air quality was re-evaluated, and it was determined that portions of the state did not meet the 1-hour ozone NAAQS and were therefore designated by the United States Environmental Protection Agency (USEPA or EPA) as "nonattainment." Maryland was required to implement a Vehicle Emission Inspection and Maintenance (I/M) program that met the "Enhanced" performance standard.

The Maryland Department of the Environment (MDE or the Department) has submitted (and EPA has approved) various SIP revisions concerning the state's VEIP over the years.

In July of 1995, MDE) submitted an Enhanced I/M Program, which was ultimately approved by EPA. The approval of the I/M program SIP was subject to 15 conditions which were discussed in detail in EPA's July 31, 1997, conditional approval.

On July 31, 1997, EPA granted conditional approval of Maryland's enhanced I/M SIP submitted on July 10, 1995, as supplemented on March 27, 1996, with SIP Revision 96-02.

https://www.govinfo.gov/content/pkg/FR-1997-07-31/pdf/97-20219.pdf#page=1

Maryland submitted a subsequent supplemental SIP Revision 98-13 on September 25, 1998. EPA found that all conditions of the 1997 conditional approval were satisfied and granted full approval of Maryland's I/M SIP on October 29, 1999. (Approval and Promulgation of Air Quality Implementation Plans; State of Maryland; Enhanced Inspection and Maintenance Program – A Rule by the Environmental Protection Agency on 10/29/1999).

https://www.govinfo.gov/content/pkg/FR-1999-10-29/pdf/99-27197.pdf#page=1

In order to comply with evolving federal requirements and guidance for integrating On Board Diagnostics testing into state I/M programs, including a new EPA rule published April 5, 2001, Maryland submitted SIP Revision 02-01 on July 9, 2002. On January 16, 2003, EPA published a direct final rule approving the State of Maryland's State Implementation Plan (SIP) revision for an enhanced vehicle inspection and maintenance (I/M) program, with an effective date of March 17, 2003.

https://www.govinfo.gov/content/pkg/FR-2001-04-05/pdf/01-8276.pdf

https://www.epa.gov/sites/default/files/2017-07/documents/md_2208_4pgs_l.pdf

Maryland has made several modifications to the VEIP testing process over the years as both vehicle emissions control technology and I/M testing technology have progressed.

2.1. TESTING PROCESS CHANGES TO ACCOMMODATE TECHNOLOGY PROGRESS

- In July 2002, Maryland initiated mandatory pass/fail On Board Diagnostics (OBD) testing for model year 1996 and newer light duty vehicles and light duty trucks, up to 8,500 pounds Gross Vehicle Weight Rating (GVWR), replacing the IM240 dynamometer test for these vehicles. The OBD test had previously been conducted on an advisory basis to gain experience and identify potential issues with the new OBD test method.

- In July 2005, Maryland changed the official testing procedure for model year 1984 and newer vehicles with a GVWR between 8,501 and 10,000 pounds from the IM240 dynamometer testing to idle testing, due to issues related to dynamometer testing of the heavier vehicles. A small number of vehicles were affected.

- In August 2009, IM240 dynamometer testing ceased due to the rapid improvements in vehicle technology brought about by introduction of the OBD system and the accompanying decline in number of vehicles subject to the IM240 test method. IM240-tested vehicles comprised approximately 10% of the vehicle population at the time, and the existing equipment was aged and would have required replacement at significant cost to the State. All non-OBD tested vehicles became subject to an idle test with mandatory pass/fail gas cap pressure test and catalytic converter check. Idle test cut points were tightened for model year 1991 and newer vehicles up to 10,000 pounds and model year 1993 and newer vehicles between 10,001 and 26,000 pounds to offset the test procedure change.

- Maryland also changed the mandatory test procedure for model year 2008 vehicles weighing between 8,501 and 14,000 pounds to the more-thorough OBD test, as the first step toward expansion of the OBD testing requirements to heavier vehicles due to anticipated technology improvements.

- At this same time, the EPA revised its required emissions model that states must use to model motor vehicle emissions to shift “modeled air quality” benefits away from I/M programs. This shift significantly reduced the modeled impact of Maryland’s I/M program even though Maryland was using the federally mandated OBD test for 90% of the vehicle population.

- In January 2018, Maryland delayed initial testing of new, not previously titled vehicles from 2 years to 3 years, due to the very low failure rate of the newest model years of vehicles given the advancements in technology and increasingly more stringent emissions standards for newly manufactured vehicles. Also, testing requirements ceased for model year 1977 through 1995 vehicles of 8,500 GVWR and lower, as these vehicles comprised a rapidly diminishing percentage of the affected vehicle fleet.

- In 2023, Maryland delayed initial testing of new, not previously titled vehicles from 3 years to 6 years due to the very low failure rate of the newest model years of vehicles given the further advancements in technology and increasingly more stringent emissions standards for newly manufactured vehicles.

2.2. OPERATIONAL CHANGES

- In August 2009, Maryland closed a centralized VEIP inspection station located within Montgomery County in accordance with a request from the Federal Aviation Administration (FAA) due to the station's proximity to an airport and stricter FAA restrictions that were instituted after the station was established in 1994. There are two remaining centralized testing stations in Montgomery County, as well as a self-service kiosk near the area of the station closure.

- In 2015 and 2016, ten self-service OBD testing kiosks were introduced. The kiosks provide additional testing outlets for motorists and a decreased test fee, improving motorist convenience.

- The COVID-19 pandemic resulted in the closing of all centralized VEIP stations from March 17, 2020, through October 19, 2020, as well as extension of testing due dates of many vehicles.

- Hand-held tablets were introduced into the program to provide additional testing capabilities at stations. The tablets have been especially useful in enhancing motorist convenience at the stations that experience high test volumes.

3. NONINTERFERENCE DEMONSTRATION FOR MODIFICATIONS TO THE VEIP I/M PROGRAM

In the following sections, the MDE presents the ambient monitoring and emissions data necessary to demonstrate that the modifications to the VEIP I/M program will not interfere with continued maintenance with all of the NAAQS.

- Section 3.1 presents the noninterference demonstration for the current 2015 8-hour ozone NAAQS by nonattainment area.
- Section 3.2 presents the noninterference demonstration for the PM NAAQs.
- Section 3.3 presents the noninterference demonstration for the NO2 NAAQs.
- Section 3.4 presents the noninterference demonstration for the SO2 NAAQs.
- Section 3.5 presents the noninterference demonstration for the Lead NAAQs.
- Section 3.6 presents the noninterference demonstration for the CO NAAQs.

3.1. 2015 OZONE NAAQS

On October 26, 2015, EPA promulgated a revised primary and secondary NAAQS for ozone to provide requisite increased protection of public health and welfare, respectively.[1] In that action, EPA strengthened both standards from 0.075 parts per million (ppm) to 0.070 ppm, while retaining the indicator (O3), averaging time (8-hour), and form (annual fourth-highest daily maximum, averaged over three years) of the existing standards. Effective August 3, 2018, EPA designated 52 areas throughout the country as nonattainment for the 2015 ozone NAAQS, including the Washington Area, Baltimore Area, and Philadelphia Area[2], which were classified as Marginal nonattainment areas.[3] This designation was based on certified air quality monitoring data from calendar years 2014 to 2016. In that action, EPA established the attainment date for Marginal nonattainment areas as three years from the effective date of the final designations. Thus, the attainment date for Marginal nonattainment areas for the 2015 ozone NAAQS was August 3, 2021.[4]

On April 13, 2022, EPA proposed to determine that 24 Marginal areas, including the Washington Area, Baltimore Area, and Philadelphia Area, failed to attain the 2015 ozone NAAQS by their applicable attainment date and the areas were therefore going to be reclassified by operation of law as Moderate nonattainment upon the effective date of the final

[1] *National Ambient Air Quality Standards for Ozone*, 80 FR 206, October 26, 2015, pp. 65291.

[2] The Washington Area consists of the following counties/cities: Calvert County, Charles County, Frederick County, Montgomery County, and Prince George's County in Maryland; Alexandria city, Arlington County, Fairfax County, Fairfax city, Falls Church city, Loudoun County, Manassas Park city, Manassas city, Prince William County in Virginia; and all of the District of Columbia. See40 CFR 81.309, 81.321, and 81.347.

[3] *Additional Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards*, 80 FR 107, June 4, 2018, pp. 25776

[4] *Additional Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards*, 80 FR 107, June 4, 2018, pp. 25776

reclassification notice.[5] On October 7, 2022, EPA published the final action in the Federal Register stating that 22 Marginal areas or portions of areas failed to attain the standard by the applicable attainment date. This designation was based on quality-assured, quality-controlled, and certified ozone air quality monitoring data from calendar years 2018 to 2020.[6]

3.1.1. Washington DC-MD-VA 2015 8-Hour Ozone Nonattainment Area

The Maryland portion of the Washington DC-MD-VA 2015 8-hour ozone nonattainment area consists of Calvert, Charles, Frederick, Montgomery, and Prince George's Counties.

3.1.1.1. Monitoring

Attainment of the ozone NAAQS is demonstrated by monitoring ambient air ozone concentrations in areas required to be monitored by EPA (typically in and near large metropolitan areas). A monitoring location is considered in attainment if its design value (DV) is less than 71 parts per billion (ppb).[7]

A Clean Data Determination (CDD) can be issued by EPA under the Clean Data Policy when a nonattainment area is attaining the 2015 ozone NAAQS based on the most recent certified available data. Recent air quality data from 2019 to 2021 indicates that the Washington Area is now attaining the 2015 ozone standard, which EPA used as the basis for the CDD.

Under EPA regulations, the 2015 ozone NAAQS is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations at an ozone monitor is less than or equal to 0.070 ppm.[8] This 3-year average is referred to as the design value (DV). When calculating the DV, digits to the right of the third decimal place are truncated.[9] When the DV is less than or equal to 0.070 ppm at each monitor within the area, then the area is meeting the NAAQS.

Monitoring data demonstrates that the area has continued to maintain compliance with the 2015 ozone standard through the 2022 ozone season. EPA is proposing to determine that the Washington Moderate ozone nonattainment area has attained the 2015 NAAQS for ozone.[10] The monitoring data EPA used for the determination is shown in Table 2 below.

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[5] *Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Marginal for the 2015 Ozone National Ambient Air Quality Standards*, 87 FR 71, April 13, 2022, pp. 21842.

[6] *Determinations of Attainment by the Attainment Date, Extensions of the Attainment Date, and Reclassification of Areas Classified as Serious for the 2008 Ozone National Ambient Air Quality Standards*, 87 FR 194, October 7, 2022, pp. 60926.

[7] An ozone design value is the average of the 4th highest ozone measurement per monitor for each year of a three consecutive year period.

[8] See40 CFR 50.19(b).

[9] See 40 CFR part 50, appendix P.

[10] *Clean Data Determination; District of Columbia, Maryland, and Virginia; Washington, DC-MD-VA Nonattainment Area for the 2015 Ozone National Ambient Air Quality Standard Clean Data Determination*, 88 FR 21, February 1, 2023, pp. 6688

Table 2 – Fourth-Highest 8-Hour Ozone Average Concentrations (ppm) in the Washington Area

Location	AQS Site ID	2018	2019	2020	2021	2022	2020 DV	2021 DV
District of Columbia	110010041	0.050	0.062	0.054	0.064	0.059	0.055	0.060
District of Columbia	110010043	0.073	0.071	0.063	0.072	0.066	0.069	0.068
District of Columbia	110010050	0.073	0.067	0.063	0.069	0.051	0.067	0.066
Calvert, MD	240090011	0.067	0.058	0.054	0.062	0.058	0059	0.058
Charles, MD	240170010	0.068	0.061	0.052	0.066	0.061	0.060	0059
Frederick, MD	240210037	0.067	0.065	0.063	0.067	0.061	0.065	0.065
Montgomery, MD	240313001	0.069	0.062	0.059	0.068	0.063	0.063	0.063
Prince George's, MD	240330030	0.070	0.071	0.064	0.066	0.061	0.068	0.067
Prince George's, MD	240338003	0.070	0.065	0.060	0.070	0.064	0.065	0.065
Prince George's, MD	240339991	0.073	0.075	0.065	0.071	0.065	0.071	0.070
Arlington, VA	510130020	0.070	0.068	0.062	0.070	0.061	0.066	0.066
Fairfax, VA	510590030	0.066	0.070	0.057	0.068	0.062	0.064	0.065
Fauquier, VA	510610002	0.060	0.055	0.049	0.060	0.056	0.054	0.054
Loudoun, VA	511071005	0.065	0.060	0.060	0.066	0.061	0061	0.062
Prince William, VA	511530009	0.065	0.060	0.057	0.062	0.058	0.060	0.059
Stafford, VA	511790001	0.064	0.059	0.056	0.062	0.058	0.059	0.059

3.1.1.2. Emissions Inventory

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). For each of the five Maryland counties in the Washington DC-MD-VA nonattainment area, NOx and VOC ozone season day emissions were estimated for major stationary point sources, quasi-point sources, nonpoint/area sources, on-road mobile sources, non-road mobile sources, and biogenic sources. Emissions were estimated for all sectors to understand each sector's contribution to total emissions, as well as the relative increase in total county-level emissions associated with modifying the VEIP I/M program. The MDE utilized available emission datasets submitted to EPA as part of the state's requirements for marginal ozone nonattainment area as a basis for analysis.

A summary emissions table for the Maryland portion of the Washington DC-MD-VA nonattainment area is presented in Table 3 below. Additional information on the development of the inventory and emission estimates is available in the SIP emissions inventory document submission, dated May 26, 2020, for the Washington DC-MD-VA marginal ozone nonattainment area and is located at the following URL:
https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/SIPDocuments/Inventories/Washington/OzoneMWCOGBaseYrInventory.pdf

Table 3 – 2017 Marginal Area SIP Emissions for the MD Portion of the Washington DC-MD-VA Ozone Nonattainment Area

Maryland Portion of the Washington DC-MD-VA Ozone Nonattainment Area[11]

Source Category	Ozone Season Daily VOC (tpd)	Ozone Season Daily NO_X (tpd)
Point	2.51	49.41
Quasi-Point	0.39	0.19
Area / Nonpoint	57.90	10.00
Nonroad	19.90	11.23
On road	23.85	45.27
M-A-R	0.33	2.96
Anthropogenic MWCOG Subtotal	**104.88**	**119.06**
Biogenic	81.14	2.41
Total	**186.02**	**121.48**

The modifications to the VEIP I/M program only affect the on-road mobile source category. Mobile source emissions modeling was conducted using the latest version of the Motor Vehicle Emission Simulator (MOVES3) to estimate the relative increase in total emissions associated with modifying the VEIP I/M program.

Table 4 provides the projected NOx and VOC emissions in tons/ozone season day from these five counties under two scenarios for 2023. Scenario 1 assumes that the VEIP I/M program remained unchanged from 2002, and scenario 2 assumes the current modifications to the VEIP I/M program for these counties. The difference between the two scenarios is also displayed.

Table 4 – 2023 On-road Mobile Source NOx and VOC Emissions for Maryland Counties in the Washington DC-MD-VA Nonattainment Area

County		Non-Attainment Area	Scenario 1: I/M Program Prior to Modifications		Scenario 2: Current I/M Program Including 6 MY Delay in Initial Testing		Emission Increase: Scenario 2 minus Scenario 1 for 2023	
			NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)
24009	Calvert	MWCOG	0.857	0.715	0.860	0.720	0.003	0.005

[11] *2017 Base Year Emissions Inventory for the Washington DC-MD-VA 2015 Ozone NAAQS Nonattainment Area* https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/SIPDocuments/Inventories/Washington/OzoneMWCOGBaseYrInventory.pdf

24017	Charles	MWCOG	1.492	1.180	1.497	1.190	0.005	0.009
24021	Frederick	MWCOG	3.953	2.123	3.962	2.138	0.010	0.015
24031	Montgomery	MWCOG	7.940	5.103	7.966	5.153	0.026	0.050
24033	Prince George's	MWCOG	10.373	5.659	10.400	5.705	0.027	0.046
MWCOG Total			Total NOx/VOC increase (with rounding)				**0.070**	**0.126**

As shown in Table 4, the MOVES3 emissions modeling results for 2023 show slight increases in anthropogenic NOx emissions for each Maryland county in the nonattainment area, ranging from 0.003 to 0.027 tons/day. The slight increase in VOC emissions for each county ranges from 0.005 to 0.050 tons/day. The total increase in NOx emissions associated with modifying the VEIP I/M program in 2023 is about 0.070 tons/day and the total increase in VOC is 0.126 tons/day of total man-made emissions.

Combining the two tables (Tables 3 & 4) allows for an emissions analysis showing the change in emissions mass, as well as a percent change due to the modifications in the VEIP I/M program.

Table 5 – Analysis of Increase in On-road Mobile Source NOx and VOC Emissions for Maryland Counties in the Washington DC-MD-VA Nonattainment Area

	Table 3		Table 4		Table 4	
	Ozone Season Daily					
Source Category	**VOC (tpd)**	**NO_X (tpd)**	**VOC**	**% VOC**	**NOx**	**% NOx**
Point	2.51	49.41				
Quasi-Point	0.39	0.19				
Area	57.90	10.00				
Nonroad Model	19.90	11.23				
On road	23.85	45.27				
M-A-R	0.33	2.96				
Anthropogenic BNAA Subtotal	104.88	119.06	**0.126**	**0.120%**	**0.070**	**0.059%**
Biogenic Emissions	81.14	2.41				
Total Emissions	186.02	121.47	**0.126**	**0.068%**	**0.070**	**0.058%**

As shown in Table 5, MOVES3 emissions modeling results also show only a slight increase in anthropogenic VOC emissions of 0.126 tons/day for the nonattainment area. The percentage increase in total VOC emissions for the nonattainment area is 0.120 percent. When biogenic VOC emissions from natural sources (81.14 tons/day) are added to the man-made emissions (104.88 tons/day), the actual VOC emissions increase is only about 0.068 percent (0.126/186.2 tons/day x 100).

As shown in Table 5, MOVES3 emissions modeling results also show a slight increase in anthropogenic NOx emissions of 0.070 tons/day for the nonattainment area. The percentage increase in total NOx emissions for the nonattainment area is 0.059 percent. When biogenic NO2 emissions from natural sources (2.41) are added to the man-made emissions (119.06 tons/day), the actual NOx emissions increase is 0.058 percent (0.070/121.47 tons/day x 100).

3.1.1.3. Conclusions

EPA is proposing to determine that the Washington Moderate ozone nonattainment area has attained the 2015 NAAQS for ozone by issuing a Clean Data Determination for the area based on 2019 to 2021 monitoring data.[12]

The MDE does not believe that the very small changes to VOC and NOx emissions will translate into measurable ground-level ozone concentrations changes in the Washington DC-MD-VA 2015 ozone nonattainment area. Consequently, maintenance of the NAAQS is expected to be preserved.

3.1.2. Baltimore Maryland 2015 8-Hour Ozone Nonattainment Area

The Baltimore 8-hour ozone nonattainment area is located entirely within the state boundaries and consists of Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties along with the City of Baltimore.

3.1.2.1. Monitoring

Attainment of the ozone NAAQS is demonstrated by monitoring ambient air ozone concentrations in areas required to be monitored by EPA (typically in and near large metropolitan areas). A monitoring location is considered in attainment if its design value (DV) is less than 71 parts per billion (ppb).[13]

A Clean Data Determination (CDD) can be issued by EPA under the Clean Data Policy when a nonattainment area is attaining the 2015 ozone NAAQS based on the most recent certified available data. Recent air quality data from 2020 to 2022 indicates that the Baltimore Area is now attaining the 2015 ozone standard.

Under EPA regulations, the 2015 ozone NAAQS is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations at an ozone monitor is less than or equal to 0.070 ppm.[14] This 3-year average is referred to as the design value (DV). When calculating the DV, digits to the right of the third decimal place are truncated.[15] When the DV is less than or equal to 0.070 ppm at each monitor within the area, then the area is meeting the NAAQS.

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[12] *Clean Data Determination; District of Columbia, Maryland, and Virginia; Washington, DC-MD-VA Nonattainment Area for the 2015 Ozone National Ambient Air Quality Standard Clean Data Determination*, 88 FR 21, February 1, 2023, pp. 6688

[13] An ozone design value is the average of the 4th highest ozone measurement per monitor for each year of a three consecutive year period.

[14] See40 CFR 50.19(b).

[15] See 40 CFR part 50, appendix P.

While EPA has not issued a CDD for the Baltimore, MD ozone nonattainment area, the monitoring data indicates that the area is attaining the 2015 Ozone NAAQS when examining the 2022 design values. The monitoring data for the Baltimore nonattainment area is shown in Table 6 below.

Table 6 – Fourth-Highest 8-Hour Ozone Average Concentrations (ppm) in the Baltimore Area

Nonattainment Area	Monitor Name	AQS Site ID	4th Highest					Design Value		
			2018	2019	2020	2021	2022	2020	2021	2022
Baltimore, MD	Glen Burnie	240031003	0.075	0.076	0.066	0.070	0.062	0.072	0.070	0.066
Baltimore, MD	Padonia	240051007	0.069	0.068	0.069	0.070	0.065	0.068	0.069	0.068
Baltimore, MD	Essex	240053001	0.071	0.074	0.062	0.075	0.069	0.069	0.070	0.068
Baltimore, MD	South Carroll	240130001	0.068	0.064	0.061	0.067	0.064	0.064	0.064	0.064
Baltimore, MD	Edgewood	240251001	0.074	0.077	0.067	0.073	0.066	0.072	0.072	0.068
Baltimore, MD	Aldino	240259001	0.071	0.069	0.063	0.072	0.068	0.067	0.068	0.067
Baltimore, MD	Furley**	245100054	0.074	0.076	0.061	0.067	0	0.070	0.068	**
Baltimore, MD	Lake Montebello	245105253	0	0	0	0	0.068			

** The Furley monitor 2020 and 2021 DV are invalid due to data completeness issues. (Monitor forced to relocate).

3.1.2.2. Emissions Inventory

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between NOx and VOC. For each of the six Maryland jurisdictions in the Baltimore MD nonattainment area, NOx and VOC ozone season day emissions were estimated for major stationary point sources, quasi-point sources, nonpoint/area sources, on-road mobile sources, non-road mobile sources and biogenic sources. Emissions were estimated for all sectors to understand each sector's contribution to total emissions as well as the relative increase in total county-level emissions associated with modifying the VEIP I/M program. The MDE utilized available emission datasets submitted to EPA as part of the state's requirements for marginal ozone nonattainment area as a basis for analysis.

A summary emissions table for the Baltimore Maryland nonattainment area is presented in Table 7 below. Additional information on the development of the inventory and emission estimates is available in the SIP emissions inventory document submission, dated June 29, 2020, for the Baltimore Maryland marginal ozone nonattainment area and is located at the following URL:
https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/Current%20SIP/Ozone/2015_NAAQS/Baltimore/BaltNAA.pdf

Table 7 – 2017 Marginal Area SIP Emissions Inventory for the Baltimore, Maryland Ozone Nonattainment Area

Baltimore Maryland Ozone Nonattainment Area[16]

Source Category	Ozone Season Daily	
	VOC (tpd)	NO_X (tpd)
Point	5.73	47.53
Quasi-Point	1.31	7.27
Area / Nonpoint	72.23	10.93
Nonroad	21.31	13.16
On road	25.86	53.72
M-A-R	0.93	7.44
Anthropogenic MWCOG Subtotal	127.38	140.06
Biogenic	64.33	2.84
Total	191.70	142.90

The modifications to the VEIP I/M program only affect the on-road mobile source category. Mobile source emissions modeling was conducted using the latest version of the MOVES3 model to estimate the relative increase in total emissions associated with modifying the VEIP I/M program.

Table 8 provides the projected NOx and VOC emissions in tons/ozone season day from these five counties under two scenarios for 2023. Scenario 1 assumes that the VEIP I/M program remained unchanged from 2002, and scenario 2 assumes the current modifications to the VEIP I/M program for these counties. The difference between the two scenarios is also displayed.

Table 8 – 2023 On-road Mobile Source NOx and VOC Emissions for Maryland Counties in the Baltimore Maryland Nonattainment Area

County		Non-Attainment Area	Scenario 1: I/M Program Prior to Modifications		Scenario 2: Current I/M Including 6 MY Delay in Initial Testing		Emission Increase: Scenario 2 minus Scenario 1 for 2023	
			NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)
24003	Anne Arundel	BNAA	6.932	4.180	6.951	4.213	0.019	0.034
24005	Baltimore	BNAA	9.705	5.246	9.732	5.294	0.027	0.048

16 *2015 8-Hour Ozone NAAQS (0.070 ppm) Marginal Area State Implementation Plan for the Baltimore, MD Nonattainment Area*
https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/Current%20SIP/Ozone/2015_NAAQS/Baltimore/BaltNAA.pdf

24013	Carroll	BNAA	1.745	1.407	1.749	1.416	0.005	0.009
24025	Harford	BNAA	3.029	1.809	3.038	1.825	0.009	0.016
24027	Howard	BNAA	4.738	2.038	4.751	2.059	0.013	0.021
24510	Baltimore City	BNAA	3.958	2.021	3.968	2.039	0.010	0.019
BNAA Total			Total NOx/VOC increase (with rounding)				**0.082**	**0.145**

As shown in Table 8, the MOVES3 emissions modeling results for 2023 show slight increases in anthropogenic NOx emissions for each Maryland county in the nonattainment area, ranging from of 0.005 tons/day to 0.027 tons/day. The slight increase in VOC emissions for each county ranges from 0.009 to 0.048 tons/day. The total increase in area-wide NOx and VOC emissions associated with modifying the VEIP I/M program in 2023 is about 0.082 and 0.145 tons/day of total man-made emissions, respectively.

Combining the two tables (Tables 7 & 8) allows for an emissions analysis showing the change in emissions mass, as well as a percent change due to the modifications in the VEIP I/M program.

Table 9 – Analysis of Increase in On-road Mobile Source NOx and VOC Emissions for Maryland Counties in the Baltimore Maryland Nonattainment Area

	Table 7		**Table 8**		**Table 8**	
	Ozone Season Daily					
Source Category	**VOC (tpd)**	**NO_x (tpd)**	**VOC**	**% VOC**	**NOx**	**% NOx**
Point	5.73	47.53				
Quasi-Point	1.31	7.27				
Area	72.23	10.93				
Nonroad Model	21.31	13.16				
On road	25.86	53.72				
M-A-R	0.93	7.44				
Anthropogenic BNAA Subtotal	127.38	140.06	**0.145**	**0.114%**	**0.082**	**0.059%**
Biogenic Emissions	64.33	2.84				
Total Emissions	191.71	142.90	**0.145**	**0.076%**	**0.082**	**0.057%**

As shown in Table 9, MOVES3 emissions modeling results also show only a slight increase in anthropogenic VOC emissions of 0.145 tons/day for the nonattainment area. The percent increase in anthropogenic VOC emissions for the nonattainment area is 0.114 percent. When biogenic VOC emissions from natural sources (64.33 tons/day) are added to the man-made emissions (127.38 tons/day), the actual VOC emissions increase is only about 0.076 percent (0.145/191.71 tons/day x 100).

As shown in Table 9, MOVES3 emissions modeling results also show only a slight increase in anthropogenic NOx emissions of 0.082 tons/day for the nonattainment area. The percent increase in anthropogenic NOx emissions for the nonattainment area is 0.059 percent. When biogenic NO2 emissions from natural sources (2.84 tons/day) are added to the man-made emissions (140.06 tons/day), the actual total NOx emissions increase is only about 0.057 percent (0.082/142.90 tons/day x 100).

3.1.2.3. Conclusions

Monitoring data indicates that the Baltimore Maryland ozone nonattainment area has attained the 2015 NAAQS for ozone based on 2020 to 2022 monitoring data.

The MDE does not believe that the very small changes to VOC and NOx emissions will translate into measurable ground-level ozone concentrations changes in the Baltimore Maryland 2015 ozone nonattainment area. Consequently, the modifications to Maryland's I/M program will not interfere with attainment or maintenance of the 2015 ozone NAAQS.

3.1.3. PHILADELPHIA-CAMDEN-WILMINGTON-NEWARK DE-MD-NJ-PA 2015 8-HOUR OZONE NONATTAINMENT AREA

Cecil County Maryland is part of the Philadelphia-Camden-Wilmington-Newark DE-MD-NJ-PA 8-hour ozone nonattainment area.

3.1.3.1. Monitoring

Attainment of the ozone NAAQS is demonstrated by monitoring ambient air ozone concentrations in areas required to be monitored by EPA (typically in and near large metropolitan areas). A monitoring location is considered in attainment if its design value (DV) is less than 71 parts per billion (ppb).[17]

Under EPA regulations, the 2015 ozone NAAQS is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations at an ozone monitor is less than or equal to 0.070 ppm (70 ppb).[18] This 3-year average is referred to as the design value (DV). When calculating the DV, digits to the right of the third decimal place are truncated.[19] When the DV is less than or equal to 0.070 ppm at each monitor within the area, then the area is meeting the NAAQS.

While the entire Philadelphia-Camden-Wilmington-Newark DE-MD-NJ-PA nonattainment area is close to attaining the 2015 Ozone NAAQS, the Fair Hill monitor in Cecil County has a design value far below the standard and indicates that Cecil County is attaining the 2015 Ozone NAAQS when examining the 2022 design values. The monitoring data for the Cecil County, Maryland monitor (Fair Hill) is shown in Table 10 below.

[17] An ozone design value is the average of the 4th highest ozone measurement per monitor for each year of a three consecutive year period.
[18] See40 CFR 50.19(b).
[19] See 40 CFR part 50, appendix P.

Table 10 – Fourth-Highest 8-Hour Ozone Average Concentrations (ppm) in Cecil County, Maryland

Nonattainment Area	Monitor Name	AQS Site ID	4th Highest					Design Value		
			2018	2019	2020	2021	2022	2020	2021	2022
Cecil County, MD	Fair Hill	240150003	73	68	64	70	63	68	67	65

3.1.3.2. Emissions Inventory

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between NOx and VOC. NOx and VOC ozone season day emissions were estimated for major stationary point sources, quasi-point sources, nonpoint/area sources, on-road mobile sources, non-road mobile sources and biogenic sources for Cecil County, Maryland. Emissions were estimated for all sectors to understand each sector's contribution to total emissions as well as the relative increase in total county-level emissions associated with modifying the VEIP I/M program. The MDE utilized available emission datasets submitted to EPA as part of the state's requirements for marginal ozone nonattainment area as a basis for analysis.

A summary emissions table for Cecil County, Maryland is presented in Table 11 below. Additional information on the development of the inventory and emission estimates is available in the SIP emissions inventory document submission, dated June 29, 2020, for Cecil County, MD and is located at the following URL:
https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/SIPDocuments/Inventories/Cecil/CecilBY2017.pdf

Table 11 – 2017 Marginal Area SIP Emissions Inventory for Cecil County, Maryland

Cecil County, Maryland 2017 Emissions Inventory[20]

Source Category	Ozone Season Daily	
	VOC (tpd)	NO_X (tpd)
Point	0.415	1.604
Quasi-Point	0.000	0.000
Area / Nonpoint	2.729	0.333
Nonroad	2.315	1.019
On road	1.468	4.460
M-A-R	0.063	1.463
Anthropogenic Subtotal	6.990	8.879
Biogenic	10.087	0.593
Total	17.077	9.472

[20] *2015 8-Hour Ozone NAAQS (0.070 ppm) Marginal Area State Implementation Plan for the Cecil County, MD Nonattainment Area SIP*
https://mde.maryland.gov/programs/air/AirQualityPlanning/Documents/SIPDocuments/Inventories/Cecil/CecilBY2017.pdf

The modifications to the VEIP I/M program only affect the on-road mobile source category. Mobile source emissions modeling was conducted using the latest version of the MOVES3 model to estimate the relative increase in total emissions associated with modifying the VEIP I/M program.

Table 12 provides the projected NOx and VOC emissions in tons/ozone season day from the county under two scenarios for 2023. Scenario 1 assumes that the VEIP I/M program remained unchanged from 2002, and scenario 2 assumes the current modifications to the VEIP I/M program for these counties. The difference between the two scenarios is also displayed.

Table 12 – 2023 On-road Mobile Source NOx and VOC Emissions for Cecil County, Maryland

County		Non-Attainment Area	Scenario 1: I/M Program Prior to Modifications		Scenario 2: Current I/M Program Including 6 MY Delay in Initial Testing		Emission Increase: Scenario 2 minus Scenario 1 for 2023	
			NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)
24015	Cecil	Philly	2.605	0.902	2.608	0.907	0.004	0.005
Total NOx/VOC increase (with rounding)							**0.004**	**0.005**

As shown in Table 12, the MOVES3 emissions modeling results for 2023 show a slight increase in anthropogenic NOx emissions Cecil County of 0.004 tons/day and a slight increase in VOC emissions 0.005 tons/day.

Combining the two tables (Tables 11 & 12) allows for an emissions analysis showing the change in emissions mass, as well as a percent change due to the modifications in the VEIP I/M program.

Table 13 – Analysis of Increase in On-road Mobile Source NOx and VOC Emissions for Cecil County, Maryland

	Table 11		Table 12		Table 12	
	Ozone Season Daily					
Source Category	VOC (tpd)	NOx (tpd)	VOC	% VOC	NOx	% NOx
Point	0.415	1.604				
Quasi-Point	0.000	0.000				
Area	2.729	0.333				
Nonroad Model	2.315	1.019				
On road	1.468	4.460				

M-A-R	0.063	1.463				
Anthropogenic Subtotal	6.990	8.879	**0.005**	**0.072%**	**0.004**	**0.045%**
Biogenic Emissions	10.087	0.593				
Total Emissions	17.077	9.472	**0.005**	**0.029%**	**0.004**	**0.042%**

As shown in Table 13, MOVES3 emissions modeling results also show only a slight increase in anthropogenic VOC emissions of 0.005 tons/day for the nonattainment area. The percent increase in anthropogenic VOC emissions for the nonattainment area is 0.072 percent. When biogenic VOC emissions from natural sources (10.087 tons/day) are added to the man-made emissions (6.990 tons/day), the actual VOC emissions increase is only about 0.029 percent (0.005/17.077 tons/day x 100).

As shown in Table 13, MOVES3 emissions modeling results also show a slight increase in anthropogenic NOx emissions of 0.004 tons/day for the nonattainment area. The percent increase in anthropogenic NOx emissions for the nonattainment area is 0.045 percent. When biogenic NO2 emissions from natural sources (0.593 tons/day) are added to the man-made emissions (8.879 tons/day), the actual total NOx emissions increase is only about 0.042 percent (0.004/9.472 tons/day x 100).

3.1.3.3. Conclusions

Monitoring data indicates that the Fair Hill monitor in Cecil County, Maryland has attained the 2015 NAAQS for ozone based on 2020 to 2022 monitoring data.

The MDE does not believe that the very small changes to VOC and NOx emissions will translate into measurable ground-level ozone concentrations changes in Cecil County, Maryland 2015 ozone nonattainment area. Consequently, the modifications to the Maryland's I/M program will not interfere with attainment or maintenance of the 2015 ozone NAAQS.

3.1.4. MARYLAND COUNTIES DESIGNATED ATTAINMENT WITH VEIP

Two additional Maryland counties are required under the CAA to have a VEIP program. They are Queen Anne's County on the eastern shore and Washington County in western Maryland. These two counties are designated attainment/unclassifiable for the 2015 8-hour ozone NAAQS.

3.1.4.1. Monitoring

Attainment of the ozone NAAQS is demonstrated by monitoring ambient air ozone concentrations in areas required to be monitored by EPA (typically in and near large metropolitan areas). A monitoring location is considered in attainment if its design value (DV) is less than 71 parts per billion (ppb).[21]

[21] An ozone design value is the average of the 4th highest ozone measurement per monitor for each year of a three consecutive year period.

On November 6, 2017, EPA designated both Queen Anne's County and Washington County "Attainment/ Unclassifiable" for the 2015 8-hour ozone NAAQS (based on certified monitoring data for 2014-2016).[22] The two Maryland counties have continued to maintain compliance with the 2015 ozone standard through December 31, 2021.

Under EPA regulations, the 2015 ozone NAAQS is attained when the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations at an ozone monitor is less than or equal to 0.070 ppm.[23] This 3-year average is referred to as the design value (DV). When calculating the DV, digits to the right of the third decimal place are truncated.[24] When the DV is less than or equal to 0.070 ppm at each monitor within the area, then the area is meeting the NAAQS.

The monitoring data demonstrated that the area has continued to maintain compliance with the 2015 ozone standard through the 2021 ozone season. Table 14 shows the two counties, the three-year average ozone DV for counties that have monitors.

Table 14 – Fourth-Highest 8-Hour Ozone Average Concentrations (ppm) in the Attainment Counties

Nonattainment Area	Monitor Name	AQS Site ID	4th Highest					Design Value		
			2018	2019	2020	2021	2022	2020	2021	2022
Queen Anne's County, MD	Millington[A]	240290002	70	66	61	67	65	65	64	64
Washington, County, MD	Hagerstown	240430009	66	59	65	57	61	60	60	63

[A]: The Millington monitor is located in nearby Kent County and serves as the main ozone monitor for the area.

3.1.4.2. Emissions Inventory

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between NOx and VOC. NOx and VOC ozone season day emissions were estimated for major stationary point sources, quasi-point sources, nonpoint/area sources, on-road mobile sources, non-road mobile sources and biogenic sources for Queen Anne's and Washington counties. Emissions were estimated for all sectors to understand each sector's contribution to total emissions as well as the relative increase in total county-level emissions associated with modifying the VEIP I/M program. The MDE utilized available emission datasets submitted to EPA as part of the state's requirements for marginal ozone nonattainment area as a basis for analysis.

A summary emissions table for each county is presented in Tables 15 & 16 below.

[22] Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards (NAAQS), 82 FR 54232, November 16, 2017, pp. 54232.
[23] See40 CFR 50.19(b).
[24] See 40 CFR part 50, appendix P.

Table 15 – 2017 SIP Emissions Inventory for Queen Anne's County, Maryland

Queen Anne's County, Maryland 2017 Emissions Inventory

Source Category	Ozone Season Daily VOC (tpd)	Ozone Season Daily NO_X (tpd)
Point	0.028	0.103
Quasi-Point	0.000	0.000
Area / Nonpoint	1.727	0.103
Nonroad	1.899	1.063
On road	0.821	2.45
M-A-R	0.032	0.167
Anthropogenic MWCOG Subtotal	4.508	3.890
Biogenic	7.331	0.741
Total	11.838	4.631

Table 16 – 2017 SIP Emissions Inventory for Washington, Maryland

Washington County, Maryland 2017 Emissions Inventory

Source Category	Ozone Season Daily VOC (tpd)	Ozone Season Daily NO_X (tpd)
Point	0.991	1.906
Quasi-Point	0.000	0.000
Area / Nonpoint	4.606	0.408
Nonroad	1.421	0.936
On road	2.58	8.26
M-A-R	0.213	0.633
Anthropogenic MWCOG Subtotal	9.811	12.139
Biogenic	13.124	0.611
Total	22.935	12.750

The modifications to the VEIP I/M program only affect the on-road mobile source category. Mobile source emissions modeling was conducted using the latest version of the MOVES3 model to estimate the relative increase in total emissions associated with modifying the VEIP I/M program.

Table 17 provides the projected NOx and VOC emissions in tons/ozone season day from the county under two scenarios for 2023. Scenario 1 assumes that the VEIP I/M program remained unchanged from 2002, and scenario 2 assumes the modifications to the VEIP I/M program for these counties. The difference between the two scenarios is also displayed.

Table 17 – 2023 On-road Mobile Source NOx and VOC Emissions for Queen Anne's and Washington Counties

County		Non-Attainment Area	Scenario 1: I/M Program Prior to Modifications		Scenario 2: Current I/M Program Including 6 MY Delay in Initial Testing		Emission Increase: Scenario 2 minus Scenario 1 for 2023	
			NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)
24035	Queen Anne's	Attainment	1.726	0.546	1.728	0.549	0.002	0.003
Total NOx/VOC increase (with rounding)							**0.002**	**0.003**

County		Non-Attainment Area	Scenario 1: I/M Program Prior to Modifications		Scenario 2: Current I/M Program Including 6 MY Delay in Initial Testing		Emission Increase: Scenario 2 minus Scenario 1 for 2023	
			NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)	NOx (tons/O3 day)	VOC (tons/O3 day)
24043	Washington	Attainment	4.545	1.462	4.550	1.469	0.005	0.007
Total NOx/VOC increase (with rounding)							**0.005**	**0.007**

As shown in Table 17, the MOVES3 emissions modeling results for 2023 show only slight increases in anthropogenic NOx emissions in Queen Anne's County of 0.002 tons/day. The difference in VOC emissions for Queen Anne's County is 0.003 tons/day.

As shown in Table 17, the MOVES3 emissions modeling results for 2023 show only slight increases in anthropogenic NOx emissions in Washington County of 0.005 tons/day. The difference in VOC emissions for Washington County is 0.007 tons/day.

Combining the three tables (Tables 15, 16 & 17) allows for an emissions analysis showing the change in emissions mass as well as a percent change due to the modifications in the VEIP I/M program.

Table 18 – Analysis of Increase in On-road Mobile Source NOx and VOC Emissions for Queen Anne's County, Maryland

	Table 15		Table 17		Table 17	
	Ozone Season Daily					
Source Category	VOC (tpd)	NO_X (tpd)	VOC	% VOC	NOx	% NOx
Point	0.028	0.103				
Quasi-Point	0.000	0.000				
Area	1.727	0.103				
Nonroad Model	1.899	1.063				
On road	0.821	2.45				
M-A-R	0.032	0.167				
Anthropogenic QA Subtotal	4.508	3.890	0.003	0.066%	0.002	0.051%
Biogenic Emissions	7.331	0.741				
Total Emissions	11.839	4.631	0.003	0.025%	0.002	0.043%

Table 19 – Analysis of Increase in On-road Mobile Source NOx and VOC Emissions for Washington County, Maryland

	Table 16		Table 17		Table 17	
	Ozone Season Daily					
Source Category	VOC (tpd)	NO_X (tpd)	VOC	% VOC	NOx	% NOx
Point	0.991	1.906				
Quasi-Point	0.000	0.000				
Area	4.606	0.408				
Nonroad Model	1.421	0.936				
On road	2.58	8.26				
M-A-R	0.213	0.633				
Anthropogenic Wash Subtotal	9.811	12.139	0.007	0.071%	0.005	0.041%
Biogenic Emissions	13.124	0.611				
Total Emissions	22.935	12.750	0.007	0.030%	0.005	0.039%

As shown in Tables 18 & 19, MOVES3 emissions modeling results also show only a slight increase in anthropogenic VOC emissions of 0.003 and 0.007 tons/day for Queen Anne's and Washington counties, respectively. The percent increase in anthropogenic VOC emissions for the counties are 0.066 percent and 0.071 percent. When biogenic VOC emissions from natural sources (7.331 tons/day and 13.124 tons/day, respectively) are added to the man-made emissions (4.508 tons/day and 9.811 tons/day, respectively), the actual VOC emissions increase is only about 0.025 percent (0.003/11.839 tons/day x 100) for Queen Anne's County and 0.030 percent (0.007/22.935 tons/day x 100) for Washington County.

As shown in Tables 18 & 19, MOVES3 emissions modeling results also show only a slight increase in anthropogenic NOx emissions of 0.002 and 0.005 tons/day for Queen Anne's and Washington Counties, respectively. The percent increase in anthropogenic NOx emissions for the nonattainment area is 0.051 percent and 0.041 percent. When biogenic NO2 emissions from natural sources (0.741 tons/day and 0.611 tons/day, respectively) are added to the man-made emissions (3.890 tons/day and 12.139 tons/day, respectively), the actual total NOx emissions increase is only about 0.043 percent (0.002/4.631 tons/day x 100) for Queen Anne's County and 0.039 percent (0.005/12.750 tons/day x 100) for Washington County.

3.1.4.3. Conclusions

Queen Anne's and Washington Counties have always been in attainment of the 2015 Ozone NAAQS. Current monitoring data indicates that the areas continue to maintain attainment.

The MDE does not believe that the very small changes to VOC and NOx emissions will translate into measurable ground-level ozone concentrations changes in Queen Anne's or Washington County, Maryland. Consequently, maintenance of the NAAQS is expected to be preserved.

3.2. 2012 PM2.5 NAAQS

On December 14, 2012, EPA promulgated a revised primary annual $PM_{2.5}$ NAAQS .[25] In that action, EPA revised the primary annual $PM_{2.5}$ standard, strengthening it from 15.0 micrograms per cubic meter (μg/m3) to 12.0 μg/m3; retained the existing 24-hour $PM_{2.5}$ standard at 35 μg/m3 ; retained the existing 24-hour PM_{10} (coarse particle) standard at 150 μg/m3; and retained the current suite of secondary PM standards.

EPA considered Maryland's designation recommendations, reviewed relevant technical information including air quality data from 2011-2013, and concluded that the data does not indicate any violation of the 2012 annual PM2.5 NAAQS in Maryland or contribution to any nearby area. Accordingly, EPA designated the entire State of Maryland as "unclassifiable/attainment".

These areas have monitoring data that shows they meet the standard or EPA has reviewed available data and determined they are likely to be meeting the standard and not contributing to a nearby violation.

In years following the EPA designation determination, Maryland has continued to meet the $PM_{2.5}$ NAAQS.

Table 20 – 3-Year PM 2.5 Annual Design Values

Monitor Location County Name	PM2.5 Annual Design Values								
	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020	2019-2021
Anne Arundel	10.0	9.5	9.3	9.0					
Baltimore	10.3	10.0	9.8	9.5	8.9	8.0	7.8	7.7	7.9
Baltimore (City)	10.5	9.8	9.6	9.2	8.7	8.4	8.4	7.9	7.5
Cecil	10.0	9.2	9.4	8.7	8.4	7.8	7.4	6.6	6.7
Dorchester			7.9	8.1	7.8	7.1	6.5	5.4	5.6
Garrett	8.9	7.6	6.6	5.7	5.5	5.7	5.7	5.3	5.3
Harford	10.3	10.3	9.4	8.8	8.1	7.6	7.4	6.6	6.9
Howard					9.1	9.1	8.3	7.8	7.1
Kent	10.2	9.3	8.8	7.9	7.9	7.0	7.0	5.7	5.4
Montgomery	9.7	9.1	8.9	8.4	7.4	7.0	6.9	6.8	6.4
Prince George's	10.1	9.5	9.4	9.1	8.4	7.0	6.7	6.3	6.4
Washington	10.5	9.6	9.4	8.9	8.6	7.7	7.4	7.0	7.2

[25] *National Ambient Air Quality Standards for Particulate Matter*, 78 FR 10, January 15, 2013, pp. 3086

Table 21 – 3-Year PM2.5 24-Hour Design Values

Monitor Location County Name	PM2.5 24-Hour Design Values								
	2011-2013	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020	2019-2021
Anne Arundel	23	23	23	22					
Baltimore	26	24	25	23	23	19	23	20	20
Baltimore (City)	26	24	26	24	22	20	20	19	19
Cecil	25	24	25	23	21	18	18	16	18
Dorchester			19	18	17	16	15	13	12
Garrett	20	17	16	14	14	14	13	12	12
Harford	25	24	23	21	21	19	18	17	18
Howard					20	19	18	17	16
Kent	24	21	21	19	18	16	16	13	13
Montgomery	23	21	21	19	18	17	17	17	17
Prince George's	23	22	21	20	18	16	15	15	14
Washington	27	26	26	23	20	18	20	21	20

Modifications to the VEIP I/M program in the 14 Maryland counties would not increase direct $PM_{2.5}$ or SO_2 emissions. This is because pollution control systems for light-duty gasoline vehicles subject to the VEIP I/M program are not designed to reduce emissions for these pollutants; therefore, modifying the program is not expected to have any impact on ambient concentrations of these pollutants. MOVES3 emissions modeling results show only slight increases in NOx emissions for each county, ranging from 0.002 tons/day to 0.027 tons/day in 2023 and slight increases in VOC emissions for each county ranging from 0.003 tons/day to 0.050 tons/day. Based upon these emissions estimates and the fact that Maryland is well below the annual and 24-hour PM standards statewide, the MDE concludes that the slight increase in NOX and VOC emissions will not interfere with continued attainment of the 24-hour and annual PM standards.

3.3. 2010 NO_2 NAAQS

The 2010 1-hour NO_2 NAAQS is set at 100 ppb, based on the 3-year average of the 98th percentile of the yearly distribution of 1-hour daily maximum concentrations.[26] The annual standard of 53 ppb is based on the annual mean concentration. The table below lists the monitoring requirements for the NO2 standard.

Table 22 – NO2 Monitoring Requirements

Requirement	Appendix D 40 CFR Part 58	Required in Maryland	Number of monitors active in Maryland

[26] *Primary National Ambient Air Quality Standards for Nitrogen Dioxide*, 75 FR 26, February 9, 2010, pp. 6474

Near Road NO2 monitoring in CBSA with a population > 2,500,000	4.3.2(a)	2	2
Area-wide NO2 monitoring in CBSA with a population > 1,000,000	4.3.3	1	2
Regional Administrator required monitoring	4.3.4	Variable	0

Table 23 – NO2 Annual Design Values

County Name	Year							
Monitor Location	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Baltimore	11	11	16	14	14	14	13	14
Baltimore (City)	16	16	15	14	13	12	12	12
Garrett	3	2	2	2	2	2	2	2
Howard	18	18	17	16	16	16	14	16
Prince George's	8	8	8	7	6	6	5	6

Table 24 – NO2 1-Hour Design Values

County Name Monitor Location	Year 2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020	2019-2021
Baltimore	44			47	45	42	41	41
Baltimore (City)	52			53	50	48	48	
Garrett			13	11	10			
Howard				50	47	42	40	41
Prince George's		39				35	34	34

All of the NO_2 monitors in the state are measuring below the annual NO_2 standard, and all near-road monitors are measuring below the 1-hour NO_2 standard. Maryland has always been in compliance with the NO_2 standards, and the fourteen counties in Maryland with VEIP I/M modifications are designated attainment under the 2010 NO_2 NAAQS.

MOVES3 emissions modeling results show only slight increases in NOx emissions for each county, ranging from 0.002 tons/day to 0.027 tons/day in 2023. Based upon these emissions estimates and the fact that Maryland is well below the annual and 1-hour NO2 standards statewide, the MDE concludes that slight increase in NO2 emissions will not interfere with continued attainment of the annual and 1-hour NO2 standards.

3.4. 2010 SO_2 NAAQS

The 2010 1-hour SO_2 NAAQS is set at 75 ppb. EPA designated one area in Maryland, portions of Anne Arundel and Baltimore Counties, as nonattainment for the SO_2 standard. EPA issued a Clean Data Determination (CDD) under the Clean Data Policy for the area based on data from 2019-2020-2021. Recent air quality data and commitments by three coal-fired electric generating units indicate the area is now attaining the 2010 1-hour SO_2 standard. The EPA has determined that the Anne Arundel County and Baltimore County SO_2 nonattainment area has attained the 2010 NAAQS for SO_2.[27]

SO_2 emissions from on-road mobile sources are not impacted by the modifications to the VEIP I/M program. This is because pollution control systems for light-duty gasoline vehicles subject to the VEIP I/M program are not designed to reduce SO_2 emissions; therefore, modifications to the VEIP I/M program is not expected to have any impact on ambient concentrations of these pollutants and VEIP I/M program will not interfere with attainment or any other requirement of the CAA with respect to the 2010 SO_2 standard.

3.5. 2008 LEAD NAAQS

With the introduction of unleaded gasoline, on-road mobile source emissions of lead have become irrelevant. Therefore, the modifications in the VEIP I/M program in these counties will not interfere with attainment or any other requirement of the CAA in these counties with respect to the 2008 lead standard.

3.6. 1971 CO NAAQS

On road mobile source CO emissions have been declining for decades due to the phase in of federal motor vehicle emissions standards; therefore, the modifications in the VEIP I/M program in these counties are not anticipated to affect the areas' continued attainment status for this standard.

4. CONCLUSION

Based on the analyses presented in this report, the modifications to the VEIP I/M program in Maryland did not interfere with attainment or maintenance of the NAAQS for any of the six different criteria pollutants. Therefore, the modifications to Maryland's I/M program in all the mandated I/M counties comply with Section 110(l) of the CAA.

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[27] *Air Plan Approval; Maryland; Clean Data Determination and Approval of Select Attainment Plan Elements for the Anne Arundel County and Baltimore County, Maryland Sulfur Dioxide Nonattainment Area*, Federal Register Vol. 87, No. 211, November 2, 2022, pp. 66086.

5. APPENDIX

MODELING METHODOLGY

Modeling Methodology

This section summarizes Maryland's methodology for estimating emissions from highway vehicles using EPA's Motor Vehicle Emission Simulator (MOVES) model and PPSuite, a custom pre- and post-processing system. This methodology is used for Maryland's official emission inventories and State Implementation Plans (SIP). It includes a summary of the methodology and data assumptions used for the Performance Standard Modeling (PSM) and the accompanying Section 110(l) demonstration. It provides details regarding the MOVES input parameters, vehicle miles traveled (VMT) and emission results for Maryland's 14 VEIP I/M jurisdictions.

Background:

The operation of highway vehicles has proven to be a significant contributor to air pollution, particularly to ground-level ozone, as they emit both volatile organic compounds (VOC) and oxides of nitrogen (NOx) during operation. Ground-level ozone is not created directly rather, it is formed through a chemical reaction between VOCs and NOx in the presence of sunlight. Given that both VOC and NOx are emitted from the operation of highway vehicles, Maryland's ozone-related emission modeling efforts have been focused on these pollutants.

In order to estimate both the rate at which emissions are being generated and to calculate vehicle miles traveled (activity level), Maryland examines its road network and fleet to estimate vehicle activity. For ozone-related modeling and inventories, the analysis is done for a typical summer weekday. For emissions modeling and inventories of other pollutants such as carbon monoxide (CO) or greenhouse gases (GHG), the analyses may be done for a typical winter weekday or annual conditions.

This Section 110(l) modeling, as well as the PSM modeling, was performed using the MOVES3.1 model, EPA's latest official version of the MOVES model for estimating emissions from highway vehicles. This MOVES3 model version was released in November 2022 and contains a minor revision incorporating appropriate I/M benefits for some light heavy-duty Class 2b and 3 gasoline trucks. It also encompasses the latest date on vehicle populations, travel activity and emission rates as well as updated fuel data at the county level from the previous MOVES 3 versions.

EPA's Guidance Resources for MOVES3 Modeling:

The following EPA guidance documents were used to develop the modeling methodology used in Maryland's official highway emissions inventory and SIPs, including this Section 110(l) demonstration and PSM modeling:

- *Policy Guidance on the Use of MOVES3 for State Implementation Plan Development, Transportation Conformity, General Conformity, and Other Purposes,* US EPA Office of Transportation and Air Quality, EPA-420-B-20-044, November 2020.

- *MOVES3 Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity,* US EPA Office of Transportation and Air Quality, EPA-420-B-20-052, November 2020.
- *Performance Standard Modeling for New and Existing Vehicle Inspection and Maintenance (I/M) Programs Using the MOVES Mobile Source Emission model;* US EPA Office of Transportation and Air Quality, EPA-420-B-22-034, October 2022.

Analysis Methodology:

The methodologies used to produce the emission results conform to the recommendations provided in EPA's technical guidance documents. A mix of local and national default (internal to MOVES3) data has been used for this work. All the MOVES3 modeling input parameters are summarized in Table 1 below. Local data has been used for the primary data items that have a significant impact on emissions and reflects the latest available planning assumptions developed by the Maryland Department of the Environment (MDE) using data obtained from the Maryland Department of Transportation Motor Vehicle Administration (MDOT MVA), the Maryland Department of Transportation State Highway Administration (MDOT SHA), the local Metropolitan Planning Organizations (MPOs) and other local/national sources as identified in the table.

A detailed explanation of the model, how the inputs in the table below were developed and the emissions methodology used in determining on-road mobile source emissions for MDE's official inventories and SIPs can be found in Appendix E of Maryland's Moderate Nonattainment Area 0.070 ppm 8-Hour Ozone State Implementation Plan Attainment Demonstration for the Baltimore Area. The mobile modeling methodologies in this document are applicable to all of MDE's official modeling efforts.

Table 1
Maryland I/M SIP Modeling Inputs Checklist for 2023

Data Item	2023 Emission Inventory Inputs Assumptions (SHA-PPSuite Process with MOVES3.1)
Traffic Data	
Highway Network	2020 MD-MDOT SHA Universal Highway Database
Seasonal/Daily Adjustments	2020 MD-MDOT SHA Traffic Trends Report
County HPMS VMT Adjustments	2020 MD-HPMS Adjustments

Mapfile	Use MOVES3 national defaults VMT distributions for Maryland to disaggregate light duty vehicles/buses/trucks to the 13 MOVES source types
Hourly Patterns	MPO Modified hourly distributions to be used for MD hourly patterns
Vehicle Mixes	1. 2020 Vehicle Classification by Functional Class 2. 2020 TMS & hourly distribution from SHA traffic count data 3. Truck percentage assumption consistent with MPO travel modeling
VMT Growth Forecast	2000-2019 HPMS growth trend, applied to 2019 HPMS Base Year Applied forecasted VMT growth factor to obtain 2023 VMT
Vehicle Population Growth Forecast	1. Source Type 11, 21, 31, 32, 41, 42, 43, 51 & 54: max of population, household and VMT 2. Trucks (source type 52, 53 ,61 & 62): Estimated by using VMT, MOVES3 national default VMT and population ratios
MOVES Inputs	
Month VMT Fractions	Calculated based on 2020 seasonal adjustment factors
Day VMT Fractions	Calculated based on 2020 seasonal adjustment factors
Hourly VMT Fractions	Calculated by PPSUITE
Average Speed Distribution	Calculated by PPSUITE
Source Type Population	1. Source Type 11, 21, 31, 32, 41, 42, 43, 51 & 54: Applied 2023 VPOP growth to 2020 base year inputs developed using VIN-Decoded data 2. Trucks (source type 52, 53 ,61 & 62): Estimated by using 2023 modeled VMT, MOVES3 national default VMT, and population ratios
Vehicle Age Distribution	Developed in-house using MDOT MVA vehicle registration data as of July 1, 2020. VIN decoding was done by ESP Data Solutions, a commercial VIN decoding service. MOVES3 defaults were used for heavy-duty vehicle types 61 and 62.

Fuel Supply	MOVES3 inputs developed in-house using MD's Fuel Data
Fuel Formulation	MOVES3 inputs developed in-house using MD's Fuel Data
Fuel Usage Fraction	MOVES3 inputs developed from the MOVE3 default database
Temperatures/Humidity	2020 inputs developed in-house using meteorological data for local airports through NOAA
I/M Parameters	Two separate I/M Programs for 2023; 1) SIP approved program in 2023, and 2) the current I/M program
Early NLEV / CALLEV	Early NLEV and CALEV program databases developed with MOVES3
AVFT	Developed in-house by MDE from 2020 MVA data (2020 light-duty electric vehicle Sales%)
Federal Fuel & Emissions Standards	Controlled Measures included in MOVES3

The analysis methodology is consistent with statewide inventory efforts including the 2020 National Emissions Inventory (NEI) submission. This includes the use of statewide traffic roadway data and custom post-processing software (PPSUITE) to calculate hourly speeds and prepare key traffic input files to the MOVES3 emission model. PPSUITE consists of a set of programs that perform the following functions:

- Analyzes highway operating conditions,
- Calculates highway speeds,
- Compiles vehicle miles of travel (VMT) and vehicle type mix data,
- Pre-processes MOVES inputs and MOVES Run Specs,
- Runs MOVES in batch mode, and
- Post-processes MOVES outputs and develops Excel reports and Summaries.

PPSUITE is a widely used and accepted tool for estimating speeds and processing emissions rates. It has been used for past SIP highway inventories in Maryland, Pennsylvania, and New Jersey. The software is based upon accepted transportation engineering methodologies. For example, PPSUITE utilizes speed and delay estimation procedures based on planning methods provided in the Highway Capacity Manual, a report prepared by the Transportation Research Board (TRB) summarizing current knowledge and analysis techniques for capacity and level-of-service analyses of the transportation system.

MOVES Runs:

After calculating speeds and aggregating VMT and VHT, PPSUITE prepares traffic-related inputs needed to run EPA's MOVES3 model. Additional required MOVES inputs are tapped from the folders already prepared/stored external to the processing software such as meteorology, I/M program parameters, fuel characteristics, vehicle fleet age distributions and source type population.

The MOVES County importer is run in batch mode. This program converts all data files into the MariaDB formats used by the MOVES model. At that point a MOVES run specification file (*.mrs) is created which specifies options and key data locations for the run. MOVES is then run in batch mode.

MOVES can be run using either the *inventory* or *rate-based* approach. For this I/M SIP work, MOVES is run using the *inventory-based* approach. Under this method, actual VMT and population are provided as inputs to the model; MOVES is responsible for producing the total emissions for the modeling domain.

MOVES Output Summary:
After all the MOVES individual jurisdiction runs (separate run for each scenario) are completed, quality assurance checks are done to ascertain that there are no data import errors or execution errors. Then PPSuite's Summary module is used to aggregate the 14 individual jurisdiction emissions results into one comprehensive, I/M domain-wide summary of daily VOC and NOx emissions in grams per day (gpd), and VMT by jurisdiction by various modes such by source type, by roadway type, etc.

The emissions in grams per day (gpd), by pollutant, are then converted to tons per day (tpd) for each jurisdiction by applying a conversion factor. The same approach is applicable to the area wide emissions.

Emission factors in grams per mile (gpm) are developed for each jurisdiction by dividing the total emissions (gpd) by the associated total VMT in miles per day. The same approach is applicable to the area wide emission factors used in the PSM.

The MOVES3.1 model is equipped with an SQL script-based function that can be used to obtain the gpm emissions factor. This function can only be used in the stand-alone mode which is a time-consuming process and is counter to the automated PPSuite-based process MDE uses. MDE used the SQL script-based function for one county and found the results matched very well to the MDE approach described above. In consultation with EPA OTAQ, MDE was given approval to use MDE's gpm emissions factor approach for calculating the emissions factors used to demonstrate compliance with the Enhanced Performance Standard.

Quality Assurance:
Quality assurance checks have been applied throughout the development of MOVES inputs, MOVES import operations, and MOVES runs through a review of feedback reports after each county run. The MOVES3 integrated into the PPSuite software, has been validated and produces the same emissions/VMT results when compared to a stand-alone MOVES run.

A sample run for 2023 for Baltimore County (current I/M with 6MY delay scenario) is included in the MOVES3 output folder demonstrating a near perfect match between results of MOVES stand-alone and PPSuite runs.

Modeling Data Description:
Per US EPA Guidance on Performance Standard Modeling for New and Existing Vehicle Inspection and Maintenance (I/M) Programs Using the MOVES Mobile Source Emission model, all required data, and descriptions to support the conclusion that the I/M program meets the applicable performance standard, the following MOVES files and/or databases are being provided with this SIP.

- MOVES Run Specification (RunSpec) files – these files define the scope of the MOVES run by defining elements such as time period(s), geographical area, source types, etc. included in the modeling.

- MOVES Input MariaDB Databases – input databases provide vehicle characteristics, vehicle activity, and other local conditions.

- MOVES Output MariaDB Databases – output databases contain the results of the MOVES analysis.

- MOVES Output MS-Excel Spreadsheets: MOVES output tables processed into Excel with a sample case for quality assurance demonstrating match with MOVES standalone operation.

- Post-processed MS-Excel Spreadsheets: Containing emissions and emission factor tables by scenario, by jurisdictions, by pollutant and by I/M Area demonstrating how the I/M program meets the applicable performance standard in the I/M regulations.

Development of Inspection and Maintenance (I/M) Program Input Table – Current Program Evaluated in 2023

The I/M evaluation consists of many parameters. This section describes MDE's approach to each parameter of the I/M input table in MOVES. Section 4.9 of EPA's MOVES Technical Guidance document explains the appropriate input assumptions and sources of data for using MOVES in State Implementation Plans and Transportation Conformity Determinations[28]. The MOVES I/M input table was developed following the assumptions and methods described in Section 4.9.

[28] https://www.epa.gov/sites/default/files/2020-11/documents/420b20052.pdf

Pollutant Process ID

Maryland's I/M program includes exhaust and evaporative OBD tests as well as an exhaust idle test and evaporative gas cap pressure check. All tests provide emission benefits for hydrocarbons/volatile organic compounds (VOCs) and the OBD tests provide additional emission benefits for nitrogen oxides (NO_x). For exhaust emissions, I/M programs can affect both running and starting emissions. For evaporative emissions, I/M programs affect hydrocarbon emissions from fuel vapor venting and fuel leaks. For the relevant test types, Pollutant Process ID's in this input include 101, 102, 112, 113, 301 and 302.

Source Type ID

Maryland's I/M program includes passenger cars and trucks with a gross vehicle weight rating of 26,000 pounds or less. Therefore, the MOVES source type IDs included in the I/M input table are passenger cars, passenger trucks, and light commercial trucks. (IDs = 21, 31, and 32, respectively). Maryland's I/M program covers heavy duty vehicles, and this would include source type 51, and 52. The benefit from including these in the I/M inputs are negligible and MDE, after discussions with EPA, was advised not to include them.

Fuel Type ID

Maryland's I/M program applies to gasoline and flex fuel vehicles. MOVES calculates an I/M emissions benefit for these vehicles. Therefore, two MOVES fuel type IDs were included in the I/M input table (ID = 1 for regular gasoline, and ID = 5 for E85 gasoline).

Inspection Frequency

Maryland's I/M program requires emission tests every two years. Therefore, the MOVES inspection frequency ID that represents biennial tests (ID = 2) was used in the I/M input table.

Test Standards

Maryland's I/M program is a centralized program with OBD tests for exhaust and evaporative systems, as well as an idle test with gas cap pressure check. Therefore, the MOVES test standard IDs for exhaust OBD check, evaporative system OBD check, idle test, and gas cap pressure test (IDs = 43, 51, 11, and 41, respectively), were used.

I/M Program ID

This is an arbitrary number developed by the MOVES user to define a unique test given for vehicles within a range of model years. I/M program IDs were arbitrarily assigned to the various unique tests within the I/M program.

Beginning and Ending Model Years

Maryland's I/M program applies to light duty gasoline vehicles with a model year of 1996 and newer, and to heavy duty (8,501-26,000 GVWR) vehicles 1977 and newer. In the MOVES input, light duty vehicles cover 1996-2017. Heavy duty vehicles cause a split, as OBD was introduced for vehicles under 14,000 lbs in 2008. Heavy duty vehicles from 1977-1995 are pre-OBD and entirely idle-tested, 1996-2007 of the commercial trucks are <8,500 and are modeled as OBD tested, and 2008-2017.

Not included in the model are 1996 and newer idle tested vehicles. Source Types 31 & 32 have minority segments that are heavy duty pre-OBD; since MOVES considers additional rows covering the same Year/Source Type combination as double-counting, these were not included in the I/M inputs to prevent errors.

Compliance Factor

The I/M Compliance Factor was calculated according to the MOVES guidance document using Equation 1.

Equation 1:

$$Compliance\ Factor = compliance\ rate\ \times (1 - waiver\ rate\ \times failure\ rate) \times regulatory\ class\ coverage\ adjustment$$

To calculate the compliance factor for each MOVES source type ID included in Maryland's I/M program (IDs = 21, 31, and 32, respectively), the compliance rate, failure rate, waiver rate, and regulatory class coverage adjustment were determined as follows:

Compliance Rate, Failure Rate, and Waiver Rate

The Compliance Rate is the percentage of vehicles that either pass a test or receive a waiver compared to the total number of vehicles in the program. MDE's Mobile Program keeps track of vehicles that were sent a test notice but did not receive an initial test, Mobile refers to these vehicles as "no shows". "No show" vehicles are included in the denominator of the compliance rate calculation. The Failure Rate is the percentage of vehicles that fail their initial test compared to all vehicles that receive an initial test. The Waiver Rate is the number of vehicles that receive a waiver divided by the number of vehicles that fail their initial test. Because Maryland's I/M program is a biennial program, meaning half the vehicles were tested in 2021 and half in 2022, the combined data from the 2021-2022 was used.

Table 2
I/M Data and MOVES Compliance, Waiver, and Failure Rates

Parameter	Total
Subject Vehicles	2,352,376
No Shows	14,365
Compliance Rate	95.55%
Total Initial Fails	193,799

Failure Rate	8.29%
Total Waivers	21,950
Waiver Rate	11.3%

Regulatory Class Coverage Adjustment

The regulatory class coverage adjustment accounts for the fraction of vehicles within a source type that are included in Maryland's I/M program. Because Maryland's I/M tests non-OBD heavy, duty vehicles, the regulatory class coverage adjustment factor is split up differently depending on what model year range is being modeled. Mobile used Table A.1 in the Appendix of the MOVES technical guidance document to develop the regulatory class coverage adjustment factor, as shown in the table below:

Table 3
Regulatory Class Coverage Adjustment Factors

MOVES Vehicle Classification	MOVES Source Type ID	Model Year Range	Regulatory Class Coverage Adjustment Factor
Passenger Cars	21	1996-2017	100%
Passenger Trucks	31	1977-1995	3.88%
"	"	1996-2007	96.12%
"	"	2008-2017	100%
Light Commercial Trucks	32	1977-1995	24.74%
"	"	1996-2007	75.26%
"	"	2008-2017	100%

Calculating the Compliance Factor

Using these values for the compliance rate, waiver rate, failure rate, and regulatory class coverage adjustment, the compliance factors for the following three MOVES vehicle types were calculated using Equation 1:

$$Passenger\ Cars\ Compliance\ Factor = \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{100\%}{100\%} = 94.65\%$$

Passenger Trucks Compliance Factor

1977-1995

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{3.88\%}{100\%} = 3.67\%$$

1996-2007

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{96.12\%}{100\%} = 90.98\%$$

2008-2017

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{100\%}{100\%} = 94.65\%$$

$Light\ Commercial\ Trucks\ Compliance\ Factor$

1977-1995

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{24.74\%}{100\%} = 23.42\%$$

1996-2007

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{75.26\%}{100\%} = 71.24\%$$

2008-2017

$$= \left(\frac{95.55\%}{100\%}\right) \times \left(1 - \frac{8.29\%}{100\%} \times \frac{11.33\%}{100\%}\right) \times \frac{100\%}{100\%} = 94.65\%$$

Combining these values provides the MOVES I/M input table as shown in Table 4 for one Maryland I/M county.

Table 4: I/M Input Table for One Maryland County

Pol Process ID	State ID	County ID	Year ID	Source type ID	Fuel Type ID	IM Program ID	Inspect Freq	Test Standards ID	Begin Model Year ID	End Model Year ID	Use IM (y/n)	Compliance Factor
101	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
102	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
201	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
202	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
301	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
302	24	24003	2023	21	1	21511	2	51	1996	2017	Y	94.65
112	24	24003	2023	21	1	21431	2	43	1996	2017	Y	94.65
113	24	24003	2023	21	1	21431	2	43	1996	2017	Y	94.65
101	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98
102	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98
201	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98
202	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98
301	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98
302	24	24003	2023	31	1	31511	2	51	1996	2007	Y	90.98

112	24	24003	2023	31	1	31431	2	43	1996	2007	Y	90.98
113	24	24003	2023	31	1	31431	2	43	1996	2007	Y	90.98
101	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
102	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
201	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
202	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
301	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
302	24	24003	2023	31	1	31512	2	51	2008	2017	Y	94.65
112	24	24003	2023	31	1	31432	2	43	2008	2017	Y	94.65
113	24	24003	2023	31	1	31432	2	43	2008	2017	Y	94.65
101	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
102	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
201	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
202	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
301	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
302	24	24003	2023	32	1	32511	2	51	1996	2007	Y	71.24
112	24	24003	2023	32	1	32431	2	43	1996	2007	Y	71.24
113	24	24003	2023	32	1	32431	2	43	1996	2007	Y	71.24
101	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
102	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
201	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
202	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
301	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
302	24	24003	2023	32	1	32512	2	51	2008	2017	Y	94.65
112	24	24003	2023	32	1	32432	2	43	2008	2017	Y	94.65
113	24	24003	2023	32	1	32432	2	43	2008	2017	Y	94.65
101	24	24003	2023	31	1	31111	2	11	1977	1995	Y	3.67
102	24	24003	2023	31	1	31111	2	11	1977	1995	Y	3.67
201	24	24003	2023	31	1	31111	2	11	1977	1995	Y	3.67
202	24	24003	2023	31	1	31111	2	11	1977	1995	Y	3.67
112	24	24003	2023	31	1	31411	2	41	1977	1995	Y	3.67
101	24	24003	2023	32	1	32111	2	11	1977	1995	Y	23.42
102	24	24003	2023	32	1	32111	2	11	1977	1995	Y	23.42
201	24	24003	2023	32	1	32111	2	11	1977	1995	Y	23.42
202	24	24003	2023	32	1	32111	2	11	1977	1995	Y	23.42
112	24	24003	2023	32	1	32411	2	41	1977	1995	Y	23.42
101	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
102	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
201	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
202	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
301	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
302	24	24003	2023	21	5	1	2	51	1996	2017	Y	94.65
112	24	24003	2023	21	5	2	2	43	1996	2017	Y	94.65
113	24	24003	2023	21	5	2	2	43	1996	2017	Y	94.65
101	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98
102	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98
201	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98
202	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98
301	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98
302	24	24003	2023	31	5	3	2	51	1996	2007	Y	90.98

112	24	24003	2023	31	5	4	2	43	1996	2007	Y	90.98
113	24	24003	2023	31	5	4	2	43	1996	2007	Y	90.98
101	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
102	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
201	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
202	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
301	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
302	24	24003	2023	31	5	5	2	51	2008	2017	Y	94.65
112	24	24003	2023	31	5	6	2	43	2008	2017	Y	94.65
113	24	24003	2023	31	5	6	2	43	2008	2017	Y	94.65
101	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
102	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
201	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
202	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
301	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
302	24	24003	2023	32	5	7	2	51	1996	2007	Y	71.24
112	24	24003	2023	32	5	8	2	43	1996	2007	Y	71.24
113	24	24003	2023	32	5	8	2	43	1996	2007	Y	71.24
101	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
102	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
201	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
202	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
301	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
302	24	24003	2023	32	5	9	2	51	2008	2017	Y	94.65
112	24	24003	2023	32	5	10	2	43	2008	2017	Y	94.65
113	24	24003	2023	32	5	10	2	43	2008	2017	Y	94.65
101	24	24003	2023	31	5	15	2	11	1977	1995	Y	3.67
102	24	24003	2023	31	5	15	2	11	1977	1995	Y	3.67
201	24	24003	2023	31	5	15	2	11	1977	1995	Y	3.67
202	24	24003	2023	31	5	15	2	11	1977	1995	Y	3.67
112	24	24003	2023	31	5	16	2	41	1977	1995	Y	3.67
101	24	24003	2023	32	5	17	2	11	1977	1995	Y	23.42
102	24	24003	2023	32	5	17	2	11	1977	1995	Y	23.42
201	24	24003	2023	32	5	17	2	11	1977	1995	Y	23.42
202	24	24003	2023	32	5	17	2	11	1977	1995	Y	23.42
112	24	24003	2023	32	5	18	2	41	1977	1995	Y	23.42

Development of Inspection and Maintenance (I/M) Program Input Table for Maryland's Program Prior to Modification Evaluated in 2023

The Inspection and Maintenance (I/M) Program evaluation consists of many parameters. This section describes MDE's approach for each parameter of the I/M input table in MOVES for modeling Maryland's I/M program prior to modification (i.e., the 2002 Approved SIP program).

Pollutant Process ID

The 2002 Approved SIP includes OBD testing, IM240 testing, idle testing, and gas cap pressure checks. The idle testing and gas cap pressure checks provide emission benefits for hydrocarbons/volatile organic compounds (VOCs). The OBD and IM240 tests, in addition to VOC reductions, provide additional emission benefits for nitrogen oxides (NO_x). For the relevant test types, Pollutant Process ID's in this input include 101, 102, 112, 113, 301 and 302.

Source Type ID

The 2002 SIP I/M program includes passenger cars and trucks with a gross vehicle weight rating of 26,000 pounds or less. Therefore, the MOVES source type IDs included in the I/M input table are passenger cars, passenger trucks, light commercial trucks, single unit short haul, and single unit long haul vehicles. (IDs = 21, 31, 32, 51, and 52 respectively).

Fuel Type ID

The 2002 SIP I/M program applies to gasoline and flex fuel vehicles. MOVES calculates an I/M emissions benefit for these vehicles. Therefore, MDE included two MOVES fuel type IDs in the I/M input table (ID = 1 for regular gasoline, and ID = 5 for E85 gasoline).

Inspection Frequency

The 2002 SIP I/M program requires emission tests every two years. Therefore, the MOVES inspection frequency ID that represents biennial tests (ID = 2) is used in the I/M input table.

Test Standards

The 2002 SIP I/M program is a centralized program with OBD tests for exhaust and evaporative systems, as well as an idle test with gas cap pressure check. Therefore, the MOVES test standard IDs for exhaust OBD check, evaporative system OBD check, idle test, and gas cap pressure test, and IM240 (IDs = 43, 51, 11, 41, and 31, respectively), were used.

I/M Program ID

This is an arbitrary number developed by the MOVES user to define a unique test given for vehicles within a range of model years. I/M program IDs were arbitrarily assigned to the various unique tests within the I/M program.

Beginning and Ending Model Years

The 2002 SIP I/M program applies to gasoline vehicles with a model year of 1977 and newer, including heavy duty vehicles up to 26,000lb GVWR. Light duty vehicles receive an idle test w/gas cap check from 1977-1983, an IM240 test from 1984-1995, and an OBD test from 1996-2021. Heavy duty vehicles receive an idle test and gas cap check from 1977-2021. The heavy duty portion of Source Type 31 & 32 1984-1995 vehicles get idle tested in Maryland, but are not in the model to avoid double counting.

Compliance Factor

The I/M Compliance Factor was calculated according to the MOVES guidance document using Equation 1.

Equation 1:

$$Compliance\ Factor = compliance\ rate\ \times (1 - waiver\ rate\ \times failure\ rate) \times regulatory\ class\ coverage\ adjustment$$

To calculate the compliance factor for each MOVES source type ID included in Maryland's I/M program (IDs = 21, 31, and 32, respectively), Mobile determined the compliance rate, failure rate, waiver rate, and regulatory class coverage adjustment as follows:

Compliance Rate, Failure Rate, and Waiver Rate

For the 2002 Approved SIP I/M Program, various assumptions had to be made due to the lack of current IM240 testing, as well as the ending of Light Duty idle testing (pre-1996) in Maryland. The compliance rate was assumed to remain similar to previous years and the program-wide rate of 96% was used. For idle tested vehicles, Mobile combined 2016 & 2017 data to make one test cycle. This test cycle was the final year that pre-1996 light duty vehicles were included. This gave us a Fail rate of 26.9%. For IM240 tested vehicles, we looked at older databases and made a linear approximation for fail rate for 1984-1995 IM240 vehicles. This trend indicated about 36-37% fail rate by 2023 and we took a conservative estimate of 35%. The waiver rate chosen was the same as the older idle tests. OBD tests used current data and had a Fail Rate and Waiver rate of 7.5% and 4.9% respectively.

Regulatory Class Coverage Adjustment

The regulatory class coverage adjustment accounts for the fraction of vehicles within a source type that are included in Maryland's I/M program. Because Maryland's I/M tests non-OBD heavy, duty vehicles, the regulatory class coverage adjustment factor is split up differently depending on what model year range is being modeled. For Source Types 52 and 53, Maryland includes vehicles up to 26,000lbs, so Mobile approximated the RCCA by halving the "19,501-33,000lb" portion of the RCCA when adding them together. Mobile used Table A.1 in the Appendix of the MOVES technical guidance document to develop the regulatory class coverage adjustment factor, as shown in Table 5:

Table 5: Regulatory Class Coverage Adjustment Factors

MOVES Vehicle Classification	MOVES Source Type ID	Model Year Range	Regulatory Class Coverage Adjustment Factor
Passenger Cars	21	1977-2021	100%
Passenger Trucks	31	1977-1983	100%
"	"	1984-2021	96.12%
Light Commercial Trucks	32	1977-1983	100%

“	“	1984-2021	75.26%
Single Unit Short Haul	52	1977-2021	94.98%
Single Unit Long Haul	53	1977-2021	94.22%

<u>Calculating the Compliance Factor</u>

Using these values for the compliance rate, waiver rate, failure rate, and regulatory class coverage adjustment, Mobile calculated the compliance factors for the following three MOVES vehicle types using Equation 1.

Equation 1:

Passenger Cars Compliance Factor

$$(Idle) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{26.9\%}{100\%}\right) \times \frac{100\%}{100\%} = 92.72\%$$

$$(IM240) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{35\%}{100\%}\right) \times \frac{100\%}{100\%} = 91.73\%$$

$$(OBD) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{4.9\%}{100\%} \times \frac{7.5\%}{100\%}\right) \times \frac{100\%}{100\%} = 95.65\%$$

Passenger Trucks Compliance Factor

$$(Idle) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{26.9\%}{100\%}\right) \times \frac{100\%}{100\%} = 92.72\%$$

$$(IM240) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{35\%}{100\%}\right) \times \frac{96.12\%}{100\%} = 88.17\%$$

$$(OBD) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{4.9\%}{100\%} \times \frac{7.5\%}{100\%}\right) \times \frac{96.12\%}{100\%} = 91.94\%$$

Light Commercial Trucks Compliance Factor

$$(Idle) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{26.9\%}{100\%}\right) \times \frac{100\%}{100\%} = 92.72\%$$

$$(IM240) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{35\%}{100\%}\right) \times \frac{75.26\%}{100\%} = 69.04\%$$

$$(OBD) = \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{4.9\%}{100\%} \times \frac{7.5\%}{100\%}\right) \times \frac{75.26\%}{100\%} = 71.98\%$$

Single Unit Short Haul Compliance Factor

$$= \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{26.9\%}{100\%}\right) \times \frac{94.98\%}{100\%} = 88.07\%$$

Single Unit Long Haul Compliance Factor

$$= \left(\frac{96\%}{100\%}\right) \times \left(1 - \frac{12.7\%}{100\%} \times \frac{26.9\%}{100\%}\right) \times \frac{94.22\%}{100\%} = 87.36\%$$

Combining these values provides the MOVES I/M input table as shown in Table 6 for one Maryland County.

Table 6: I/M Input Table for One County

Pol Process ID	State ID	County ID	Year ID	Source Type ID	Fuel Type ID	IM Program ID	Inspect Freq	Test Standards ID	Beg Model Year ID	End Model Year ID	Use IM (y/n)	Compliance Factor
101	24	24003	2023	21	1	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	21	1	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	21	1	1	2	11	1977	1983	Y	92.72
202	24	24003	2023	21	1	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	21	1	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	31	1	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	31	1	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	31	1	1	2	11	1977	1983	Y	92.72
202	24	24003	2023	31	1	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	31	1	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	32	1	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	32	1	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	32	1	1	2	11	1977	1983	Y	92.72
202	24	24003	2023	32	1	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	32	1	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	52	1	1	2	11	1977	2021	Y	88.07
102	24	24003	2023	52	1	1	2	11	1977	2021	Y	88.07
201	24	24003	2023	52	1	1	2	11	1977	2021	Y	88.07
202	24	24003	2023	52	1	1	2	11	1977	2021	Y	88.07
112	24	24003	2023	52	1	2	2	41	1977	2021	Y	88.07
101	24	24003	2023	53	1	1	2	11	1977	2021	Y	87.36
102	24	24003	2023	53	1	1	2	11	1977	2021	Y	87.36
201	24	24003	2023	53	1	1	2	11	1977	2021	Y	87.36
202	24	24003	2023	53	1	1	2	11	1977	2021	Y	87.36
112	24	24003	2023	53	1	2	2	41	1977	2021	Y	87.36
101	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
102	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
201	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
202	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
301	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
302	24	24003	2023	21	1	1	2	31	1984	1995	Y	91.73
112	24	24003	2023	21	1	2	2	41	1984	1995	Y	91.73
101	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17
102	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17
201	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17
202	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17
301	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17

302	24	24003	2023	31	1	1	2	31	1984	1995	Y	88.17
112	24	24003	2023	31	1	2	2	41	1984	1995	Y	88.17
101	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
102	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
201	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
202	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
301	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
302	24	24003	2023	32	1	1	2	31	1984	1995	Y	69.04
112	24	24003	2023	32	1	2	2	41	1984	1995	Y	69.04
101	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
102	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
201	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
202	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
301	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
302	24	24003	2023	21	1	1	2	51	1996	2021	Y	95.65
112	24	24003	2023	21	1	2	2	43	1996	2021	Y	95.65
113	24	24003	2023	21	1	2	2	43	1996	2021	Y	95.65
101	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
102	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
201	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
202	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
301	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
302	24	24003	2023	31	1	1	2	51	1996	2021	Y	91.94
112	24	24003	2023	31	1	2	2	43	1996	2021	Y	91.94
113	24	24003	2023	31	1	2	2	43	1996	2021	Y	91.94
101	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
102	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
201	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
202	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
301	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
302	24	24003	2023	32	1	1	2	51	1996	2021	Y	71.99
112	24	24003	2023	32	1	2	2	43	1996	2021	Y	71.99
113	24	24003	2023	32	1	2	2	43	1996	2021	Y	71.99
101	24	24003	2023	21	5	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	21	5	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	21	5	1	2	11	1977	1983	Y	92.72
202	24	24003	2023	21	5	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	21	5	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	31	5	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	31	5	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	31	5	1	2	11	1977	1983	Y	92.72

202	24	24003	2023	31	5	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	31	5	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	32	5	1	2	11	1977	1983	Y	92.72
102	24	24003	2023	32	5	1	2	11	1977	1983	Y	92.72
201	24	24003	2023	32	5	1	2	11	1977	1983	Y	92.72
202	24	24003	2023	32	5	1	2	11	1977	1983	Y	92.72
112	24	24003	2023	32	5	2	2	41	1977	1983	Y	92.72
101	24	24003	2023	52	5	1	2	11	1977	2021	Y	88.07
102	24	24003	2023	52	5	1	2	11	1977	2021	Y	88.07
201	24	24003	2023	52	5	1	2	11	1977	2021	Y	88.07
202	24	24003	2023	52	5	1	2	11	1977	2021	Y	88.07
112	24	24003	2023	52	5	2	2	41	1977	2021	Y	88.07
101	24	24003	2023	53	5	1	2	11	1977	2021	Y	87.36
102	24	24003	2023	53	5	1	2	11	1977	2021	Y	87.36
201	24	24003	2023	53	5	1	2	11	1977	2021	Y	87.36
202	24	24003	2023	53	5	1	2	11	1977	2021	Y	87.36
112	24	24003	2023	53	5	2	2	41	1977	2021	Y	87.36
101	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
102	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
201	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
202	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
301	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
302	24	24003	2023	21	5	1	2	31	1984	1995	Y	91.73
112	24	24003	2023	21	5	2	2	41	1984	1995	Y	91.73
101	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
102	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
201	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
202	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
301	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
302	24	24003	2023	31	5	1	2	31	1984	1995	Y	88.17
112	24	24003	2023	31	5	2	2	41	1984	1995	Y	88.17
101	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
102	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
201	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
202	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
301	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
302	24	24003	2023	32	5	1	2	31	1984	1995	Y	69.04
112	24	24003	2023	32	5	2	2	41	1984	1995	Y	69.04
101	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65
102	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65
201	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65

202	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65
301	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65
302	24	24003	2023	21	5	1	2	51	1996	2021	Y	95.65
112	24	24003	2023	21	5	2	2	43	1996	2021	Y	95.65
113	24	24003	2023	21	5	2	2	43	1996	2021	Y	95.65
101	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
102	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
201	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
202	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
301	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
302	24	24003	2023	31	5	1	2	51	1996	2021	Y	91.94
112	24	24003	2023	31	5	2	2	43	1996	2021	Y	91.94
113	24	24003	2023	31	5	2	2	43	1996	2021	Y	91.94
101	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
102	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
201	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
202	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
301	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
302	24	24003	2023	32	5	1	2	51	1996	2021	Y	71.99
112	24	24003	2023	32	5	2	2	43	1996	2021	Y	71.99
113	24	24003	2023	32	5	2	2	43	1996	2021	Y	71.99