State of New Jersey
Department of Environmental Protection (DEP)
Bureau of Mobile Sources (BMS)
Quality Assurance & Auditing Section (QAAS)

OBD Simulator Fraud:
Environmental Impact Analysis on the Motor Vehicle Inspection & Maintenance Program

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Executive Summary

The purpose of this paper is to quantify the impact of OBD simulator fraud on air quality and explain the quantification methodology. The USEPA MOVES model was used as the basis of the impact assessment and the methodology contained herein is intended to be used by persons familiar with the model's terminology and usage. The inspection facilities that perpetuated the fraud were located in Passaic County, New Jersey. Therefore, Passaic County MOVES inputs were tailored to reflect the vehicles that were fraudulently passed, and county level inventory runs were conducted. There were 3,142 unique vehicles fraudulently tested in 2013 in Passaic County using OBD simulators. These 3,142 vehicles represent less than 1% of the county vehicle population, yet resulted in losing 22.5% of the environmental benefit (NOx and VOC) obtained from inspecting all of the vehicles in Passaic County. This analysis has shown that OBD simulator fraud has a serious environmental impact and a strong enforcement program is a key factor in ensuring that the State's Inspection and Maintenance (I/M) program obtains the air quality benefits it was designed to provide.

OBDII Simulator Impact Analysis Methodology

The use of OBD simulators to defraud the motor vehicle inspection program is an ongoing concern, and the environmental impacts of this issue were previously unquantified. NJDEP uncovered OBD simulators being used during official inspections in order to fraudulently pass OBD equipped vehicles that would have failed if tested properly. The OBD simulator fraud was investigated by a task force composed of staff from the NJ Department of Environmental Protection, the NJ Motor Vehicle Commission, and the NJ Division of Criminal Justice. The fraud spanned five calendar years from April of 2010 to January of 2014, during which time NJDEP identified 6,078 OBD simulated inspections. A majority of the vehicles identified show a repeated history of failure prior to receiving a fraudulent inspection.

This analysis was performed using the MOtor Vehicle Emission Simulator (MOVES) 2010b model, which was developed by the EPA's Office of Transportation and Air Quality, to calculate emission outputs and reductions. The MOVES model is required by EPA for mobile source emissions inventory and reduction calculations which are used as part of the State Implementation Plan (SIP). The SIP is a plan that identifies how the State will attain or maintain the primary and secondary National Ambient Air Quality Standards. The model uses vehicle groupings by weight, fuel type, usage and age to calculate the emissions outputs of the vehicles. County specific data is used to help determine the driving patterns of the vehicle population which has an impact on the emissions output for each county. MOVES can also model the impact of Inspection and Maintenance on emissions. To quantify the environmental impact of OBD simulator fraud, NJDEP has developed the following methodology to use in the MOVES model.

To assess the impact of the OBD simulator fraud perpetrated, the 2013 State Implementation Plan (SIP) inputs for Passaic County were used as a baseline. Passaic County MOVES inputs were selected because the fraud detected derived out of shops all located within the Passaic County area. The analysis was limited to only those inspections performed in the 2013 calendar year to match NJ specific MOVES inputs that were used for baseline SIP inventory runs. The 2013 OBD simulator inspections were extracted from NJ program inspection data. The data showed 3,142 unique fraudulently passed vehicles. A vehicle profile consisting of source type and vehicle age for the OBD Simulator Fleet (**OSF**) was established using the 3,142 fraudulently passed vehicles.

The following MOVES input files were adjusted to reflect the OSF profiles:

- Source Type – Break down of population by vehicle type and usage
- Age Distribution – Based on source type and age of vehicle at inspection
- Vehicle Miles Traveled (**VMT**) – Annual Vehicle Miles Traveled by source type (HPMSVtypeYear is the MOVES input file for annual VMT)

The MOVES model runs are normally representative of a mix of both passing and failing vehicles. The **OSF** is comprised of only failing vehicles. In order to be able to assess the impact of the fraudulently passed vehicles within the MOVES model, an adjustment to the source type populations had to be made. The **OSF** profile populations were adjusted based on the current NJ OBD initial inspection failure rate (10%) in order to obtain a representative sample of vehicles that could be used as inputs into the MOVES model. This adjustment is expressed by:

$$\boldsymbol{OSFpop = \frac{OSF}{NJ\ OBD\ failure\ rate}}$$

The MOVES inputs for age distribution of the source types in the **OSF** were adjusted based upon the ages of each source type within the **OSF** using the model year as the basis for the age of the vehicle. The source types in the **OSF** were passenger cars, passenger trucks, and light duty trucks. The model years ranged from 1996 to 2009 giving an age bracket as follows:

Description	Source Type	Model Year Range	Vehicle Age Range
Passenger Cars	21	1996 to 2009	17 to 4
Passenger Trucks	31	1996 to 2008	17 to 5
Light Duty Trucks	32	1996 to 2009	17 to 4

Within these source types all vehicle ages not found in the **OSF** were zeroed out. The calculated value for age fraction by source type is a reflection of the percent of each model year within the entire **OSF**. All other source type age distributions use the standard NJ SIP inputs.

The HPMS file was then adjusted from the standard NJ SIP Passaic County input file to reflect the **OSF**. This was necessary because the HPMS file contains the annual **VMT** for the entire Passaic County fleet and the **OSF** was only a small fraction of the vehicles the annual **VMT** was prorated from the baseline as follows:

Determine the NJ SIP Passaic County vehicle population (**PCpop**) broken down by age and source type by taking the overall source type population (**SIPpop**) and multiplying it against the age distribution (**NJad**). The NJ SIP Passaic County Source Type population by age (**PCpop**) is expressed by:

$$\boldsymbol{PCpop = SIPpop * NJad}$$

Using a 2013 summer day NJ SIP Passaic County full county level run output, extract the daily mileage by source type and vehicle age (**PCDailyVMT**). Divide the **PCDailyVMT** by the **PCpop** to get individual daily mileage (**IndvVMT**) for each source type and the corresponding age. Multiply **IndvVMT** by **OSFpop** to derive the Adjusted VMT(**AdjVMT**) for each source type to be used in the adjusted HPMS input file. Note that source types 31 and 32 must be combined for entry into the HPMS input file for type 30. For each adjusted source type perform the following:

$$\boldsymbol{IndvVMT = \frac{PCDailyVMT}{PCpop}}$$

$$\boldsymbol{AdjVMT = \sum IndvVMT \times OSFpop}$$

Once the adjusted Source Type, Age Distribution and VMT files are created, two MOVES runs where then performed with the adjusted inputs discussed above. All other standard inputs from the Passaic County SIP files were used. The first MOVES run was with the standard NJ Inspection & Maintenance (I/M) program to represent the standard compliant vehicles emission output. The second run used no I/M program to represent the fraudulent unrepaired vehicles since these vehicles in essence were not subject to the program. The difference between the two runs equals the amount of benefit loss due to OBD simulator fraud in this one county.

$$\boldsymbol{OBD\ Fraud\ Impact = Adjusted\ Standard\ I/M\ run - Adjusted\ No\ I/M\ run}$$

The **OSF** runs for Passaic County 2013 show a loss of I/M benefit totaling 103.5 TPY out of an emission inventory of 651.5 TPY combined NOx + VOC. The results for the entire 355,166 vehicle Passaic County fleet used in NJ SIP for MOVES runs for in 2013 shows a total I/M benefit of 442.1 TPY out of an inventory of 4,381.1 TPY of NOx + VOC. The 103.5 tons from these 3,142 vehicles represents a 22.5% (103.5/442.1) loss of I/M benefit even though these vehicles account for less than 1% of the entire Passaic County fleet population (3,142 of 355,166).

The results of the MOVES runs are shown in table below (the input and output files are available upon request). The first six rows for each set of runs show the inventory for the fraudulent fleet that is used to calculate the last three rows, which show the I/M emissions benefit loss.

OBD Sim Fleet (OSF) Runs:			
Program Run	**Pollutant**	**Tons /Day**	**Tons /Year (TPY)**
OBD Sim Fleet (OSF) No IM Inventory	NOx	1.32	481.5
	VOC	0.75	273.5
	VOC + NOx	2.07	755.0
OBD Sim Fleet (OSF) Std IM Inventory	NOx	1.15	418.0
	VOC	0.64	233.5
	VOC + NOx	1.79	651.5
(OSF) Fraud Benefit Loss	NOx	0.17	63.5
	VOC	0.11	40.0
	VOC + NOx	**0.28**	**103.5**

Passaic County SIP Full Fleet Runs:			
Program Run	**Pollutant**	**Tons /Day**	**Tons /Year (TPY)**
Passaic County Full Fleet No IM Inventory	NOx	8.3	3028.3
	VOC	4.9	1794.9
	VOC + NOx	13.2	4823.2
Passaic County Full Fleet Std IM Inventory	NOx	7.6	2786.2
	VOC	4.4	1594.9
	VOC + NOx	12.0	4381.1
Passaic County Full Fleet I/M Benefit	NOx	0.7	242.1
	VOC	0.5	200.0
	VOC + NOx	**1.2**	**442.1**