LOUDOUN COUNTY
PROJECT NUMBER: R000-053-032, P101; UPC NO. 103929
FEDERAL PROJECT NUMBER: STP-5A01(454)

VDOT

TECHNICAL REPORT

AIR QUALITY ANALYSIS

SUBMITTED PURSUANT TO 42 U.S.C. 4332(2)(C)

DULLES AIR CARGO, PASSENGER & METRO ACCESS HIGHWAY

PREPARED BY
Harris Miller Miller & Hanson, Inc.
77 South Bedford •Street Burlington, MA 01803
161 Fort Evans Road, NE •Leesburg, VA 20176

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION &
VIRGINIA DEPARTMENT OF TRANSPORTATION

AIR QUALITY ANALYSIS TECHNICAL REPORT

Dulles Air-Cargo, Passenger and Metro Access Highway

Loudoun County, Virginia

HMMH Report No. 304800.4
May 24, 2013

Prepared for:

Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219

VDOT Project No. R000-053-032, P101
UPC No. 103929

Prepared by:

Harris Miller Miller & Hanson Inc.
77 South Bedford Street
Burlington, MA 01803
T 781.229.0707
F 781.229.7939

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1 Executive Summary

The Virginia Department of Transportation (VDOT) is conducting a study of the proposed Dulles Air Cargo, Passenger, and Metro Access Highway ("Project"). The purpose of the Project is to enhance the movement of passenger and air cargo traffic to the planned western development at the Washington Dulles International Airport (IAD) as well as facilitate intermodal connectivity in conjunction with the planned extension of the Metrorail Silver Line. The Project is intended to reduce congestion and improve capacity on the existing roadway network in the Dulles South area. The study is being conducted to support the Environmental Assessment (EA) of the retained alternatives.

Federal funding is involved with the Project, therefore, compliance with the National Environmental Policy Act (NEPA) and the Clean Air Act (CAA) is required. NEPA requires a discussion of the transportation-related air quality concerns in the project area and a summary of any carbon monoxide analysis performed, and the CAA requires a transportation conformity demonstration with any State Implementation Plan (SIP) for any U.S. Environmental Protection Agency (EPA) criteria pollutant in non-attainment or maintenance areas.

Loudoun County is located in an EPA designated non-attainment area for the 8-hour ozone standard (1997 and 2008 standards) and the 1997 annual fine particulate matter standard ($PM_{2.5}$). The area is designated as attainment for all other National Ambient Air Quality Standards (NAAQS). As such, all reasonable precautions should be taken to limit the emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x). In addition, the following VDEQ air pollution regulations will be adhered to during the construction: 9 VAC 5-130 et seq., Open Burning restrictions, 9 VAC 5-45, Article 7 et seq., Cutback Asphalt restrictions, 9 VAC 5-50-60 et seq. and Fugitive Dust precautions.

On February 20, 2013 the National Capital Region Transportation Planning Board (TPB) agreed to include the Dulles Air Cargo, Passenger, and Metro Access Highway (DACPMAH) Build and No Build Alternatives for regional air quality conformity testing. In July 2013, VDOT will formally request the TPB to select one of the alternatives for inclusion in the 2013 Constrained Long Range Plan (CLRP).

An air quality impact assessment of carbon monoxide (CO) traffic emissions was conducted since the average daily traffic (ADT) is estimated to be above the applicable thresholds in the 2009 VDOT and Federal Highway Administration (FHWA) Project-Level Carbon Monoxide Air Quality Studies Agreement. The worst-case CO ground level impacts were estimated at receptor locations in close proximity to the four worst-case intersections/interchanges in the project corridor based on Level of Service (LOS), traffic volumes, public access, and reasonableness. The worst-case ground level CO impacts were found to remain well below the CO NAAQS at all modeled receptor locations.

The study area is located in an EPA designated non-attainment area for the 1997 annual $PM_{2.5}$ standard; therefore, EPA's Transportation Conformity Rule applies and an analysis was required to determine whether the project is considered to be one of "air quality concern" for fine particulate matter. Based on the EPA criteria specified in the Transportation Conformity Rule and associated EPA guidance, the Study Alternatives are not considered to be of "air quality concern" for fine particulate matter. Therefore, the Clean Air Act and 40 CFR 93.116 requirements for $PM_{2.5}$ were met without the need of performing a hot-spot analysis, since projects such as this have been found to not be ones of air quality concern under 40 CFR 3.123(b)(1).

The analysis also evaluated potential impacts from mobile source air toxics (MSATs) in the Study area. Since the Build Alternatives will not add significant capacity to any of the existing and proposed roadway networks where design year traffic is projected to be 140,000 to 150,000 AADT

or greater, the Alternatives are best characterized as a project with "Low Potential MSAT Effects" under the 2012 FHWA interim guidance update document. For all Build Alternatives in the design year, there could be slightly higher MSAT emissions in the Study area relative to the No Build Alternative due to increased VMT, and there could also be increases in MSAT levels in a few localized areas where VMT is projected to increase. However, in all areas of the project corridor, EPA's vehicle and fuel regulations will bring about significantly lower MSAT levels in the future than exist today.

Emissions produced during the construction of the Study Alternatives will be short-term or temporary in nature. In order to mitigate these emissions, construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications conform to the SIP and require compliance with all applicable local, state, and federal regulations.

2 Introduction

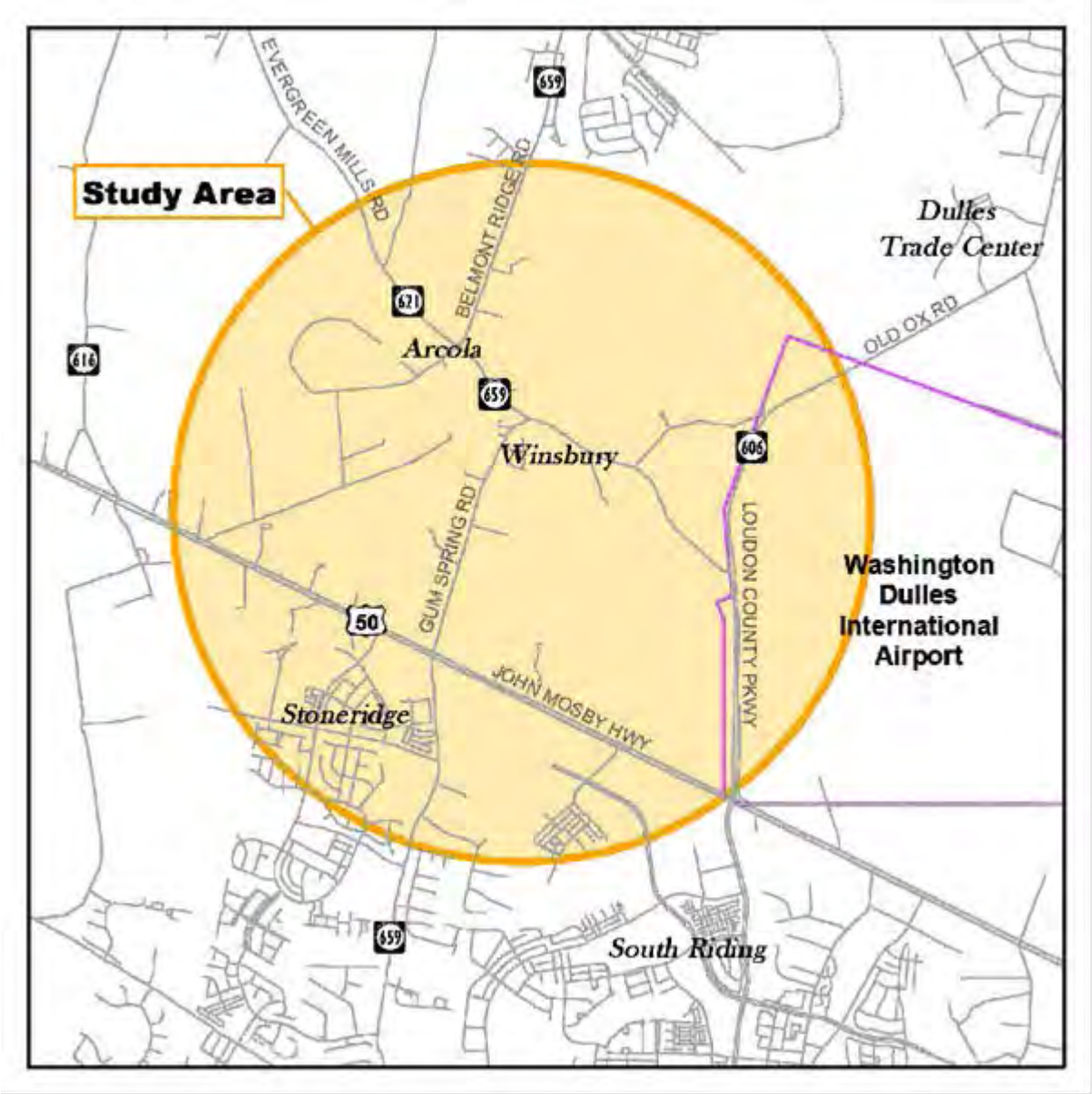
Potential air quality impacts associated with the proposed Dulles Air-Cargo, Passenger and Metro Access Highway (DACPMAH) Alternatives located in Loudoun County were assessed by Harris Miller Miller & Hanson Inc. (HMMH). The purpose of the Project is to enhance the movement of passenger and air cargo traffic to the planned western development at the Washington Dulles International Airport (IAD) as well as facilitate intermodal connectivity in conjunction with the planned extension of the Metrorail Silver Line. The Study Alternatives are intended to reduce congestion and improve capacity on the existing roadway network in the Dulles South area.

Federal funding is involved with the Study Alternatives; therefore, compliance with the National Environmental Policy Act (NEPA) and the Clean Air Act (CAA) is required. NEPA requires a discussion of the transportation-related air quality concerns in the project area and a summary of any carbon monoxide analysis performed, and the CAA requires a transportation conformity demonstration with any State Implementation Plan (SIP) for any EPA criteria pollutant in non-attainment or maintenance areas. Loudoun County is located in an EPA designated non-attainment area for the 8-hour ozone standard (1997 and 2008 standards) and the 1997 annual fine particulate matter ($PM_{2.5}$) standard. The area is designated as attainment for all other NAAQS.

3 Project Description

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA), is proposing to construct a limited-access roadway to the west of the Washington Dulles International Airport in Loudoun County, VA. The project team is evaluating various proposed study Alternatives that would extend from the interchange of the planned Bi-County Parkway and Lee-Jackson Memorial Highway (US Route 50) to the existing intersection of Old Cox Road (VA Route 606) and Arcola Road (VA Route 842) where future airport connector roads and an extension of the Loudon County Parkway are anticipated to converge. **Figure 1** depicts the project study area.

Figure 1 Study Area



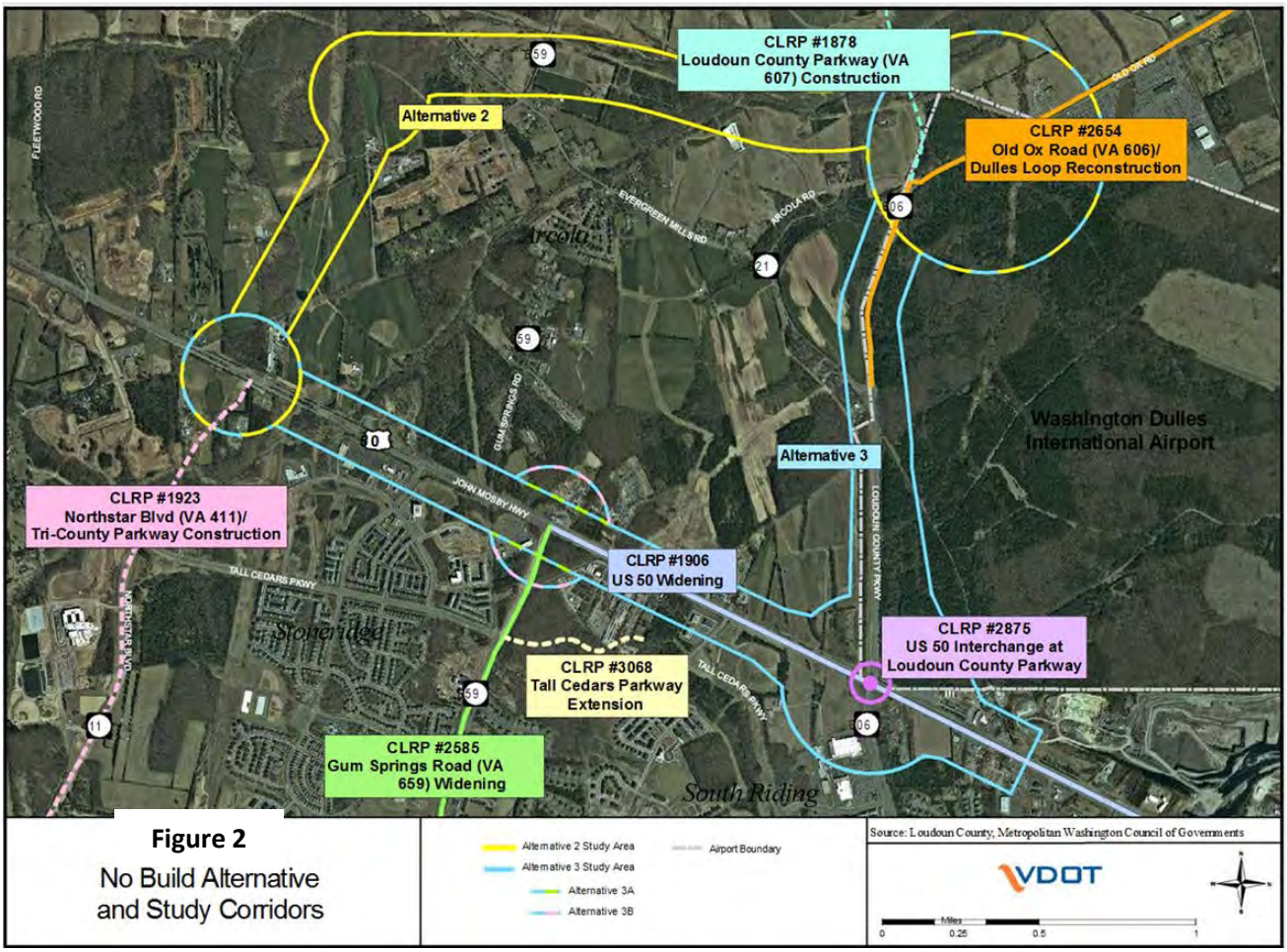
3.1 Alternative 1; No Build Alternative

Consistent with the requirements of the NEPA and related FHWA guidelines, full consideration is given to the environmental consequences of taking no action to meet future travel demand (hereinafter referred to as the "No Build Alternative"). The No Build Alternative serves as a benchmark for comparison to the proposed project alternatives by providing a baseline condition with which to compare the improvements and consequences associated with each of the Build Alternatives. The No Build Alternative would include all planned and programmed transportation improvements in the study area that have been approved and adopted for implementation by 2040, as identified in the most recent *National Capital Region's Financially Constrained Long-Range Plan* (CLRP). Under the No Build Alternative, no additional roadway infrastructure above and beyond the CLRP projects would be realized to the west of the airport. The No Build Alternative would not satisfy the identified needs of the project.

3.2 Alternative 2

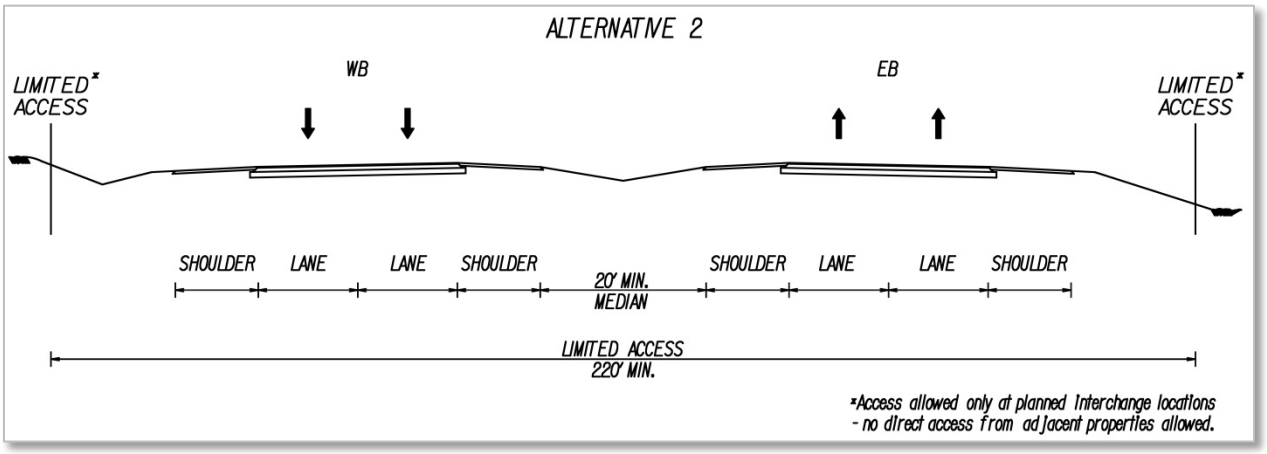
Alternative 2 would originate at US Route 50, approximately 2.2 miles west of its existing intersection with the Loudoun County Parkway (Route 607), in the location where the Bi-County Parkway (VA Route 411) interchange is planned, as depicted in **Figure 2**. Alternative 2 would connect to the proposed interchange allowing for all movements to and from US Route 50 and the proposed Bi-County Parkway (VA Route 411). From US Route 50, the proposed alternative would extend approximately one-mile northeast before turning due east south of Evergreen Mills Road (VA Route 621). The alignment would continue east for approximately 1.7 miles, with an overpass at Belmont Ridge Road (VA Route 659) and Evergreen Mills Road (VA Route 621) until intersecting with existing Old Ox Road (VA Route 606) / Loudoun County Parkway. Proposed Alternative 2 would be a limited access highway, specifically, with no direct access to adjoining properties. Connections with arterial roadways would be provided via US Route 50, Bi-County Parkway, Old Ox Road (VA Route 606), planned extension of Loudoun County Parkway (VA Route 607) and the future airport connector roads.

Figure 2 No Build Alternatives and Study Corridor



As shown in the typical section (See Figure 3) for Alternative 2, the proposed build option would consist of a four-lane divided principal arterial with a design speed of 60 miles per hour.

Figure 3 Alternative 2 Typical Roadway Section



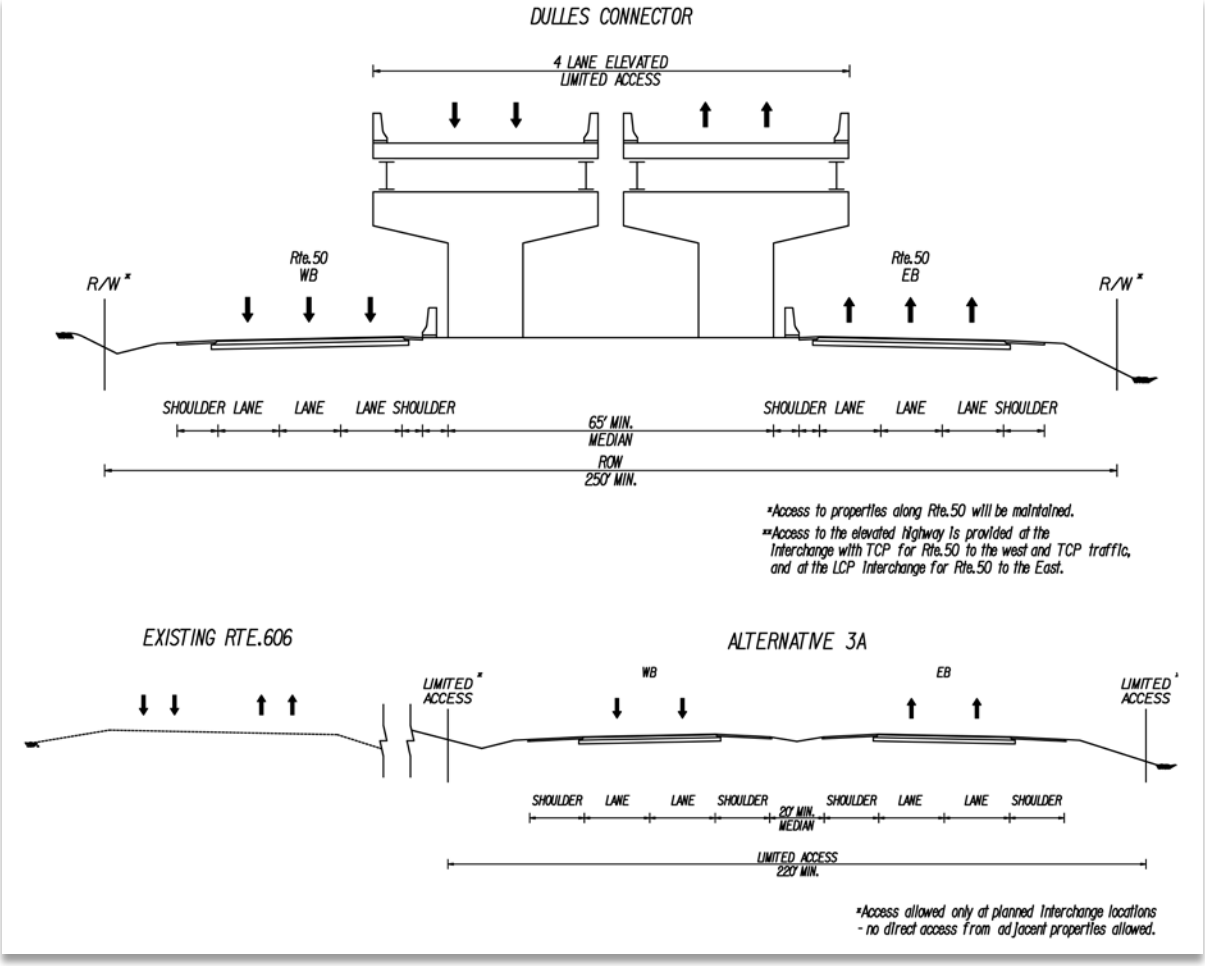
3.3 Alternative 3

Alternative 3 consists of making improvements along existing US Route 50 and Old Ox Road (VA Route 606) from the future US Route 50 interchange at Bi-County Parkway to a proposed full-access interchange with Old Ox Road (VA Route 606), the planned Loudoun County Parkway (VA Route 607) extension, and future IAD connector roads. Within the Location Study Corridor for Alternative 3, two potential improvements, described below, were studied independently for traffic and air quality impacts.

3.3.1 Alternative 3A – US Route 50 Elevated

Alternative 3A (**Figure 4**) would be a 4-lane divided limited access principal arterial, on an aerial structure within the median of US Route 50. Upon returning to grade parallel to Loudoun County Parkway, Alternative 3A would run parallel to Loudoun County Parkway as a separated 4-lane divided principal arterial but at-grade instead of elevated. Alternative 3A would originate at US Route 50 and the planned Bi-County Parkway interchange and provide full connections to Bi-County Parkway (VA Route 411). Proposed Alternative 3A would provide access to US Route 50 westbound and from US Route 50 eastbound only. From the interchange at Bi-County Parkway (VA Route 411), Alternative 3A would follow along the US Route 50 alignment in an elevated section, within the roadway median. At the future interchange with Loudoun County Parkway, the roadway would travel north over the Loudoun County Parkway and return to grade on the east side of Old Ox Road (VA 606) / Loudoun County Parkway, on Dulles Airport property. Alternative 3A would provide a connection to US Route 50 eastbound and from US Route 50 westbound at this future interchange. From there, the facility would extend parallel to Old Ox Road (VA Route 606) / Loudoun County Parkway approximately 1.7 miles to the future airport connector roads.

Figure 4 Alternative 3A Typical Roadway Section



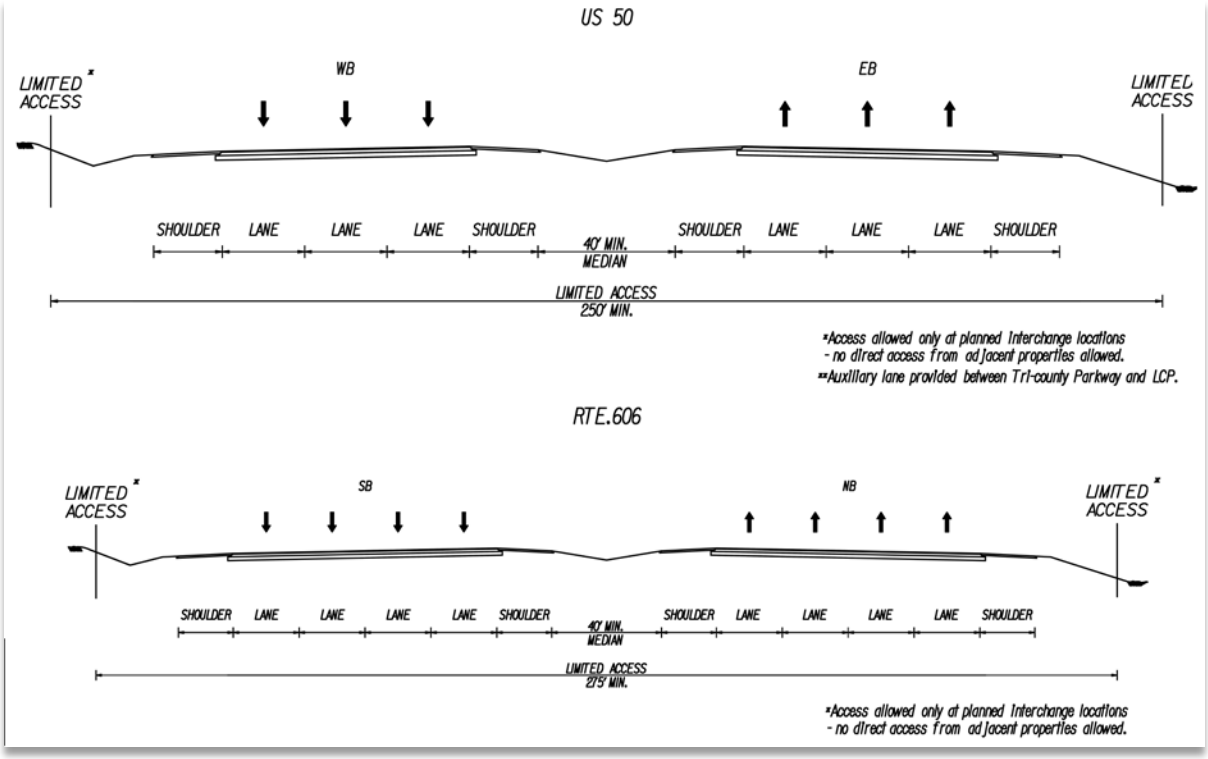
3.3.2 Alternative 3B

Alternative 3B (**Figure 5)** would originate at the planned full-access interchange of US Route 50 and the Bi-County Parkway (VA Route 411). To meet Loudoun County's *Countywide Transportation Plan* (CTP) (Loudoun County, 2012a), US Route 50 is proposed to be widened from four (4) lanes to six (6) lanes from the planned interchange of US Route 50 and Bi-County Parkway (VA Route 411) to Gum Springs Road (VA Route 659). At-grade access to all properties would be closed along US Route 50 from Bi-County Parkway to Loudoun County Parkway to meet the limited access requirements. Access to properties to the south would be provided from Tall Cedars Parkway. Access to properties to the north would be provided from a parallel frontage road accessed from Gum Springs Road (VA Route 659). A full access interchange at Gum Springs Road (VA Route 659) and US Route 50 would also be provided, in order to conform to Loudoun County's adopted CTP.

A full access interchange would be provided at Old Ox Road (VA 606) / Loudoun County Parkway and US Route 50 where Alternative 3B would follow Old Ox Road (VA Route 606) / Loudoun County Parkway to the north. Under Alternative 3B, Old Ox Road (VA Route 606) / Loudoun County Parkway would be upgraded to an eight (8) lane limited access facility to match the Loudoun County CTP designation of the facility as a freeway. The Loudoun County CTP shows at-grade intersections at proposed Glascock Boulevard, Evergreen Mills Rd (VA Route 621) and Arcola Boulevard (VA Route 842) with the proposed freeway facility. Alternative 3B assumes a frontage road will be provided within the proposed corridor along Old Ox Road (VA Route 606) / Loudoun County Parkway in the southbound direction to provide limited access to and from Evergreen Mills

Road (VA Route 621). The frontage road is anticipated to be for the southbound direction only. Alternative 3B would terminate as full-access interchange with Old Ox Road (VA Route 606), the planned Loudoun County Parkway (VA Route 607) extension, and future airport connector roads. This proposed alternative would be a six (6) lane limited access facility along US Route 50 and an eight (8) lane limited access highway along Old Ox Road (VA Route 606) / Loudoun County Parkway.

Figure 5 Alternative 3B Typical Roadway Section



4 Traffic Summary

The traffic analysis for the project was conducted by Whitman, Requardt & Associates, LLP (WRA) for the 2012 base year, anticipated opening/interim year 2025 and the 2040 design year. For the air quality analysis, the relevant traffic components utilized from the traffic study were the level of service (LOS), average daily traffic (ADT), peak-hourly ADT, congested speeds, turning movements, roadway grade and signal timing data for each Alternative. The traffic study consisted of evaluating the four Alternatives to alleviate traffic congestion and address roadway deficiencies within the study area. Each of the Alternatives varied in terms of signalized intersections and proposed interchanges. The four alternatives are described in more detail above, in Section 3. In total, a combination of seven intersections/interchanges was studied in the traffic analysis.

5 Existing Conditions

To characterize the existing air quality conditions of the Loudoun County area, HMMH completed a review of the Virginia Air Quality Data Reports prepared by the Virginia Department of Environmental Quality (VDEQ) Office of Air Quality Monitoring and the EPA. The analysis focused on regulated air pollutants contained in the NAAQS; including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter (PM_{10} and $PM_{2.5}$). The results show that the EPA designated Loudoun County as a non-attainment for the 8-hour ozone (1997 and 2008) standard and 1997 annual fine particulate matter ($PM_{2.5}$) standard. The area is designated as attainment for all other standards.

6 Meteorology Climate

The study area within Loudoun County is located in Northern Virginia on the western side of IAD and approximately 25 miles to the west-northwest of Washington, D.C. Winters are mild with limited snowfall and summers are hot and humid. The average annual temperature for the Dulles area is 55°F, with winter temperatures averaging 35°F and summer temperatures averaging 75°F. The area averages 45 inches of rainfall annually and receives up to 22 inches of snow on average.

7 Regulatory Standards

The air quality analysis addressed the EPA NAAQS, Mobile Source Air Toxics (MSAT) under the NEPA, and the Transportation Conformity Rule as required by the Clean Air Act.

7.1 National Ambient Air Quality Standards

Pursuant to the Federal Clean Air Act of 1970 (CAA), the EPA established National Ambient Air Quality Standards (NAAQS) for major pollutants known as "criteria pollutants." Currently, the EPA regulates six criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter, and lead (Pb). Particulate matter (PM) is divided into two particle size categories: particles with a diameter less than 10 micrometers (PM_{10}) and those with a diameter of less than 2.5 micrometers ($PM_{2.5}$). **Table 1** shows the primary and secondary NAAQS for the criteria pollutants. The NAAQS are two-tiered. The first tier (primary) is intended to protect public health; the second tier (secondary) is intended to protect public welfare and prevent further degradation of the environment.

Section 176(c) of the CAA requires Federal agencies to assure that all of their actions conform to applicable implementation plans for achieving and maintaining the NAAQS. Federal actions must not cause or contribute to any new violation of any standard, increase the frequency or severity of any existing violation, or delay timely attainment of any standard.

Table 1 National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standards [1,2]	Secondary Standards [1,3]
CO	8- hour	9 ppm (10 mg/m^3)	None
	1- hour	35 ppm (40 mg/m^3)	None
Lead [4]	Rolling 3-Month Average[5]	0.15 µg/m^3	Same as Primary
NO_2	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	Same as Primary
	1-hour	0.100 ppm[6]	None
PM_{10}	Annual Arithmetic Mean	None	None
	24-hour	150 µg/m^3	Same as Primary
$PM_{2.5}$	Annual Arithmetic Mean	12 µg/m^{3,9}	15 µg/m^3

Pollutant	Averaging Time	Primary Standards [1,2]	Secondary Standards [1,3]
	24-hour	35 µg/m^3	Same as Primary
O_3	8-hour (2008 standard)	0.075 ppm	Same as Primary
	8-hour (1997 standard)	0.08 ppm	Same as Primary
	1-hour	0.12 ppm[7]	Same as Primary
SO_2	1-hour	75 ppb[8]	None
	3-hour	None	0.5 ppm

Notes:
1. National standards (other than ozone, particulate matter, and those based on annual averages) are not to be exceeded more than once per year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over three years, is equal to or is less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m^3 is equal to or is less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or are less than the standard.
2. Primary Standards: Levels necessary to protect public health with an adequate margin of safety.
3. Secondary Standards: Levels necessary to protect the public from any known or anticipated adverse effects.
4. Lead is categorized as a "toxic air contaminant" with no threshold exposure level for adverse health effects determined.
5. National lead standard, rolling three-month average: final rule signed October 15, 2008.
6. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010).
7. EPA revoked the 1-hour ozone standard in all areas; however, some areas have continuing obligations under that standard.
8. Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
9. EPA updated the NAAQS for $PM_{2.5}$ to strengthen the primary annual standard to 12 *u*g/m^3.

The standards in **Table 1** apply to the concentration of a pollutant in outdoor ambient air. If the air quality in a geographic area is equal to or is better than the national standard, it is called an attainment area. Areas where air quality does not meet the national standard are called non-attainment areas. Once the air quality in a non-attainment area improves to the point where it meets the standards and the additional redesignation requirements in the CAA [Section 107(d) (3)(E)], EPA redesignates the area as a "maintenance area."

The Clean Air Act Amendments (CAAA) of 1990 requires states to designate the status of all areas within their borders as being in or out of compliance with the NAAQS. The CAAA further defines non-attainment areas for ozone based on the severity of the violation as marginal, moderate, serious, severe, and extreme. In an effort to further improve the nation's air quality, the EPA has classified additional areas as attainment/non-attainment for the 2008 8-hour ozone standard. The project is located in an area that was designated as being in marginal non-attainment under the 2008 8-hour ozone standard.

Each state is required to prepare a state implementation plan (SIP) that outlines measures the region will implement to attain the applicable air quality standard in non-attainment areas, and to maintain compliance with the applicable air quality standard in maintenance areas.

7.2 Mobile Source Air Toxics

In December of 2012, FHWA issued the Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA. The update reflects the recent implementation of the EPA MOVES emission model for estimating MSAT emissions from mobiles sources along with updating the scientific research in the MSAT arena.

The EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer drivers from their 1999 National Air Toxics Assessment (NATA). The seven compounds identified were acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter (POM). While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

The FHWA guidance developed a tiered approach for assessing MSATs in NEPA documents and identified three levels of analysis. The three levels identified were for projects with no meaningful MSAT effects, low potential MSAT effects, and high potential MSAT effects. The FHWA guidance defines the levels of analysis for each type of MSAT effect:

- No analysis for projects with no potential for meaningful MSAT effects;
- A qualitative analysis for projects with low potential MSAT effects; and
- A quantitative analysis for projects with high potential MSAT effects.

The study Alternatives were evaluated against each threshold criteria in order to determine the type of MSAT analysis required to satisfy NEPA.

7.3 Transportation Conformity

As discussed above, Loudoun County is located in an attainment area for all pollutants as designated by the EPA except for the 1997 and 2008 8-hour ozone standards and the 1997 annual $PM_{2.5}$ standard for which the area is designated as non-attainment. The state of Virginia has prepared a SIP that outlines the control measures that will be implemented to achieve compliance and maintain the ozone and $PM_{2.5}$ NAAQS, respectively.

The EPA promulgated the Transportation Conformity Rule (40 CFR Parts 51 and 93) concerning applicability, procedures, and criteria that transportation agencies must use in analysing and determining conformity of transportation projects. The Transportation Conformity Rule applies to federal funded transportation projects in certain areas that have violated one or more of the NAAQS in EPA designated non-attainment or maintenance areas (40 CFR 93.102(b)).

In March of 2006, EPA and FHWA issued joint guidance[1] for conducting a hot-spot analysis for particulate matter. The guidance applies to projects within a maintenance or non-attainment area for $PM_{2.5}$ and outlines the criteria for determining whether a project is considered to be one of "air quality concern".

In December 2010, EPA issued updated modeling guidance[2] for performing quantitative analyses of $PM_{2.5}$ and PM_{10} emissions for conforming with the $PM_{2.5}$ NAAQS. This guidance pertains to federal-funded or approved transportation projects that are deemed to be projects of air quality concern that are located in $PM_{2.5}$ non-attainment and maintenance areas.

The federal conformity rule requires that a conforming transportation plan and program be in place at the time of the project approval (40 CFR 93.114), and for the project to be included in the conforming plan and program (40 CFR 93.115). On February 20, 2013 the National Capital Region Transportation Planning Board (TPB) agreed to include the Dulles Air Cargo, Passenger, and Metro Access Highway Build and No Build lternatives for regional air quality conformity testing. In July 2013, VDOT will formally request the TPB to select one of the alternatives for inclusion in the 2013 Constrained Long-Range Plan (CLRP) which includes projected transit and traffic, demographics, and air quality conditions through the 2040 horizon year.

[1] *Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (March 2006).
[2] *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*, US EPA, December 2010.

8 Project Assessment

An air quality project level analysis was conducted for carbon monoxide (CO), particulate matter (PM) and Mobile Source Air Toxics (MSATs). The methodologies and assumptions for addressing the type of analysis for each pollutant is discussed below and is consistent with all FHWA and EPA regulations and guidance, as well as the VDOT Consultant Guide on Air Quality Project-Level Analysis (May 2009)[3].

8.1 Carbon Monoxide (CO) Analysis

On February 27, 2009, the FHWA and VDOT finalized an updated memorandum of understanding (MOU) addressing NEPA requirements for project-level CO air quality analyses. Under this agreement, project-level air quality (hot-spot) analyses are conducted for CO for projects that meet traffic and related criteria as specified in the agreement. A hot-spot analysis for CO is required for this analysis as the expected traffic volumes will exceed the qualitative analysis threshold criteria specified in the MOU.

The air quality study utilizes the traffic assessment conducted by the design team for the 2012 base year, 2025 interim year and the 2040 design year conditions. Emissions of CO were estimated using the EPA Motor Vehicle Emissions Simulator (MOVES) model. Ambient concentrations at sensitive receptor locations were estimated using the EPA CAL3QHC dispersion model, and the results were added to appropriate background concentrations for comparison to the CO NAAQS to determine compliance.

8.1.1 Methodology

The microscale analysis typically examines worst-case ground-level CO impacts due to traffic flow in the immediate vicinity of a project intersection/interchange. CO is used in microscale studies to indicate roadway pollutant levels as it is the most abundant pollutant emitted by motor vehicles and can result in so-called "hot-spot" (i.e., high concentration) locations around congested intersections. The NAAQS were developed by the EPA to protect human health against adverse health effects with a margin of safety. These standards do not allow ambient CO concentrations to exceed 35 parts per million ("ppm") for a 1-hour averaging period and 9 ppm for an 8-hour averaging period, more than once per year at any location. The widespread use of advanced catalytic technologies on late-model vehicles has significantly reduced the occurrences of CO hotspots in recent years. Air quality models (computer simulation programs) are typically used to predict worst-case CO levels for both existing and future conditions to evaluate compliance of proposed roadways with the CO NAAQS.

The microscale analysis was conducted using the latest versions of the EPA MOVES (MOVES2010b) and CAL3QHC models to estimate worst-case CO concentrations at individual receptor (i.e. receiver) locations. CAL3QHC modeling results for each condition were then added to the appropriate background CO concentrations to determine worst-case air quality impacts for each Study Alternative. These values were then compared to the 1-hour and 8-hour CO NAAQS to determine compliance.

[3] *Consultant Guide Air Quality Project-Level Analysis, Revision 18*: VDOT Environmental Division, Air Section, May 2009.

8.1.2 Intersections Studied

As discussed above, a peak-hour volume and LOS analysis was completed for the existing, interim and design year for each Alternative. Based on the traffic analysis, a quantitative hot-spot air quality analysis was required for CO since traffic volumes are predicted to exceed the threshold criteria specified in the 2009 VDOT-FHWA Project-Level Carbon Monoxide Air Quality Studies Agreement. An analysis of the peak-hour Build Alternative volumes, LOS, and delay times were evaluated to establish the worst-case intersection/interchanges and Alternative conditions for inclusion in the CO hot-spot modeling analysis. **Table 2** provides the total AM and PM peak-hour traffic volumes along with the LOS for each signalized intersection and/or interchange within the project corridor while **Table 3** provides the projected delay times. The tables summarize the traffic results for the existing (2012), No Build, and Build Alternatives for 2025 and 2040.

Table 2 Estimated LOS and Peak-Hourly Traffic Volumes at the Intersections/Interchanges for the 2025 and 2040 Alternative Conditions

Site #	Intersection	Peak	Existing Volumes	Existing LOS	2025 No Build Volumes	2025 NB LOS	2025 Build Alt-2 Volumes	2025 Build Alt-2 LOS	2025 Build Alt-3A Volumes	2025 Build Alt-3A LOS	2025 Build Alt-3B Volumes	2025 Build Alt-3B LOS	2040 No Build Volumes	2040 NB LOS	2040 Build Alt-2 Volumes	2040 Build Alt-2 LOS	2040 Build Alt-3A Volumes	2040 Build Alt-3A LOS	2040 Build Alt-3B Volumes	2040 Build Alt-3B LOS
1	Loudon County Parkway @ Old Ox Road at Dulles Connector Road[1]	AM	This intersection only exists in future Alternatives		3584	C	3656	C	Intersection becomes an Interchange, All Ramps operate at C or Better (See Note 1)		Intersection becomes an Interchange, All Ramps operate at C or Better (See Note 1)		4552	F	4100	D	Intersection becomes an Interchange, All Ramps operate at C or Better (See Note 1)		Intersection becomes an Interchange, All Ramps operate at C or Better (See Note 1)	
		PM			4480	D	4570	D					5690	F	5000	D				
					8064		8226						10242		9100					
1A	Loudoun County Parkway at EB Dulles Connector Ramps	AM	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		3117	C	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		3500	D	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2	
		PM					3263	B							3600	C				
		Total					6380								7100					
1B	Loudoun County Parkway at WB Dulles Connector Ramps	AM	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		3117	B	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		3500	C	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2	
		PM					3263	B							3600	C				
		Total					6380								7100					
3	US 50 @ Northstar Boulevard	AM	Interchange Does not exist under the Existing Conditon		Interchange All Ramps operate at C or Better		This an Interchange, all ramps operate at LOS C or better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		This is an Interchange, all ramps operate at LOS C or better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better	
		PM																		
3A	US 50 @ SB Northstar Boulevard	AM	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		1765	A	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		2345	A	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2	
		PM					2185	A							2400	A				
		Total					3950								4745					
3B	US 50 @ NB Northstar Boulevard	AM	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		2135	**B**	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2		2345	B	Signalized Ramps Only Exist Under Alternative -2		Signalized Ramps Only Exist Under Alternative -2	
		PM					1958	A							2150	A				
		Total					4093								4495					
2	US 50 @ Loudoun County Parkway	AM	4485	D	Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better		Interchange All Ramps operate at C or Better	
		PM	5025	D																
4	US 50 @ Gum Spring Road	AM	2445	F	3955	E	3709	E	3767	D	Intersection becomes an Interchange All Ramps operate at C or Better		4460	E	3900	E	4139	D	Intersection becomes an Interchange All Ramps operate at C or Better	
		PM	3160	F	5691	D	4641	D	5374	D			6382	E	4950	E	5996	E		
		Total	5605		9646		8350		9141				10842		8850		10135			
4A	Gum Spring Road @ EB Route 50 Ramps	AM	Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		2474	A	Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		3217	A
		PM									1603	A							3076	A
		Total									4077								6293	
4B	Road @ WB Route 50 Ramps	AM	Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		1572	B	Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		Signalized Ramps Only Exist Under Alternative -3B		1840	B
		PM									3092	C							2457	C
		Total									4664								4297	
5	Evergreen Mills Road @ Belmont Ridge Road/Briarfield Lane	AM	1840	F	2645	F	2185	F	2505	F	1980	F	2965	F	2245	F	2810	F	2063	F
		PM	1912	F	2745	F	2255	F	2560	F	2253	F	2970	F	2295	F	2910	F	2289	F
		Total	3752		5390		4440		5065		4233		5935		4540		5720		4352	
6	Loudon County Parkway @ Evergreen Mills Road	AM	2520	D	4278	B	4135	B	4598	D	Intersection is removed, access provided via a frontage road		5159	D	4170	B	5043	D	Intersection is removed, access provided via a frontage road	
		PM	2910	C	5385	F	4760	E	5803	F			6495	F	4790	E	6366	F		
		Total	5430		9663		8895		10401				11654		8960		11409			

Note 1: Site # 1 is an intersection that does not exist currently. With the extension of Loudoun County Parkway in the future this intersection will exist. The Dulles Connector road joins this intersection in Alternative 2 to form a 4th leg, and in Alternatives 3A and 3B this intersection becomes part of the interchange.

Table 3 Estimated LOS and Projected Delay Times at the Intersections for the 2025 and 2040 Alternative Conditions

Site	Intersection	2025 Alternative-2				2025 Alternative 3A				2025 Alternative 3B				2040 Alternative-2				2040 Alternative 3A				2040 Alternative 3B			
		AM	Delays (sec)	PM	Delays (sec)	AM	Delays (sec)	PM	Delays (sec)	AM	Delays (sec)	PM	Delays (sec)	AM	Delays (sec)	PM	Delays (sec)	AM	Delays (sec)	PM	Delays (sec)	AM	Delays (sec)	PM	Delays (sec)
1	Loudon County Parkway @ Old Ox Road at Dulles Connector Road[1]	C	33.6	D	35.1	Intersection becomes an interchange, all ramps operate at C or better (See Note 1)				Intersection becomes an interchange, all ramps operate at C or better (See Note 1)				D	46	D	45.2	Intersection becomes an interchange, all ramps operate at C or better (See Note 1)				Intersection becomes an interchange, all ramps operate at C or better (See Note 1)			
1A	Loudoun County Parkway at EB Dulles Connector Ramps	C	25.2	B	18.6	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2				D	36.5	C	32.2	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2			
1B	Loudoun County Parkway at WB Dulles Connector Ramps	B	11.9	B	18.6	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2				C	20.1	C	25.9	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2			
3	US 50 @ Northstar Boulevard	This is an Interchange, all ramps operate at LOS C or better				This is an Interchange, all ramps operate at LOS C or better				This is an Interchange, all ramps operate at LOS C or better				This is an Interchange, all ramps operate at LOS C or better				This is an Interchange, all ramps operate at LOS C or better				This is an Interchange, all ramps operate at LOS C or better			
3A	US 50 @ SB Northstar Boulevard	A	6.3	A	4.9	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2				A	6.4	A	7.5	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2			
3B	US 50 @ NB Northstar Boulevard	B	11.9	A	6.5	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2				B	14.5	A	9.9	Signalized Ramps Only Exist Under Alternative-2				Signalized Ramps Only Exist Under Alternative-2			
2	US 50 @ Loudoun County Parkway	This is an Interchange, all ramps operate at LOS C or				This is an Interchange, all ramps operate at LOS C or				This is an Interchange, all ramps operate at LOS C or				This is an Interchange, all ramps operate at LOS C or				This is an Interchange, all ramps operate at LOS C or				This is an Interchange, all ramps operate at LOS C or			
4	US 50 @ Gum Spring Road	E	56.4	D	40.3	D	47.4	D	38.7	Intersection becomes an Interchange, All ramps operate at C or better				E	73.4	E	55.1	D	54.6	E	57.6	Intersection becomes an Interchange, All ramps operate at C or better			
4A	Gum Spring Road @ EB Route 50 Ramps	Signalized Ramps Only Exist under Alternative 3B				Signalized Ramps Only Exist under Alternative 3B				A	9.3	A	9	Signalized Ramps Only Exist under Alternative 3B				Signalized Ramps Only Exist under Alternative 3B				A	8.8	A	4.9
4B	Gum Spring Road @ WB Route 50 Ramps	Signalized Ramps Only Exist under Alternative 3B				Signalized Ramps Only Exist under Alternative 3B				B	11.4	C	22.4	Signalized Ramps Only Exist under Alternative 3B				Signalized Ramps Only Exist under Alternative 3B				B	12.7	C	23.4
5	Evergreen Mills Road @ Belmont Ridge Road/Briarfield Lane	F	166.9	F	209.1	F	225.8	F	251.9	F	158.7	F	302.4	F	172.6	F	216.4	F	299.9	F	324.1	F	183.7	F	329.8
6	Loudon County Parkway @ Evergreen Mills Road	B	20	E	64.4	D	36.3	F	156.8	Intersection is removed, access provided via a frontage road				B	18.9	E	62.6	D	51.7	F	195.8	Intersection is removed, access provided via a frontage road			

Note 1: Site # 1 is an intersection that does not exist currently. With the extension of Loudoun County Parkway in the future this intersection will exist. The Dulles Connector road joins this intersection in Alternative 2 to form a 4th leg, and in Alternatives 3A and 3B this intersection becomes part of the interchange.

A comparison of the three Build Alternatives for 2025 shows that there are two intersections which are expected to operate at an LOS of F for both the AM and PM peak-hourly periods;

1. Evergreen Mills Road at Belmont Ridge Road at Briarfield Lane, and
2. Loudoun County Parkway at Evergreen Mills Road.

The highest peak-hourly volumes of the three Build Alternatives are expected to occur under Alternative 3A at these intersections. US 50 at Gum Spring Road is also expected to operate at LOS of D. The worst-case peak-hourly volumes (e.g. 9,375) for this intersection are also expected to occur under Alternative 3A. In addition, the predicted delay times are also generally expected to be the highest under Alternative 3A with a maximum delay time ranging from 41 seconds to 255 seconds.

A comparison of the Build Alternatives for 2040 shows that the two highest peak-hour traffic volumes are expected at the following intersections for the Alternative 3A condition:

1. US 50 at Gum Springs Road, and
2. Loudoun County Parkway at Evergreen Mills Road.

These intersections are also expected to operate at LOS of D, E or F. The next highest peak-hour traffic volumes with a LOS of F are expected to occur at the intersection of Evergreen Mills Road and Belmont Ridge Road and Briarfield Lane also for Alternative 3A. The delay times for these intersections are expected to be the highest, generally ranging from 52 seconds to 324 seconds. These three intersections with the highest peak volumes and delay times are representative of where the maximum CO concentrations are expected to occur where the general public may have access. The remaining intersections within the project corridor are projected to have lower peak-hour traffic volumes or operate at a LOS of D or better for all other Alternatives which would generally correlate to lower 1-hour and 8-hour peak CO concentrations.

In summary, a review of the LOS, peak traffic volumes and delay time for each analysis year determined that the three worst-case intersections for inclusion in the CO hot-spot analysis were:

1. US 50 at Gum Springs Road;
2. Evergreen Mills Road at Belmont Ridge Road at Briarfield Lane; and
3. Loudoun County Parkway at Evergreen Mills Road.

The analysis also included evaluations of the worst-case affected interchanges from each Build Alternative for inclusion in the air quality analysis. **Table 4** provides the predicted ADT volumes at each interchange for 2025 and 2040 conditions. The ADT presented in **Table 4** represent the total volumes entering and exiting the interchange from all directions.

A comparison of the ADT at each interchange for each Build Alternative shows the highest traffic volumes are expected to occur at the US 50 at Loudoun County Parkway interchange for both the 2025 and 2040 conditions. For the 2025 and 2040 conditions, Alternative 3A results in the worst-case ADT of 109,100 and 112,250, respectively. Therefore, the interchange at US 50 and Loudoun County Parkway was included in the CO hot-spot analysis along with the three intersections identified above since it was also determined to be representative of where maximum CO concentrations may be expected to occur and where the general public may have access.

Table 4 Estimated ADT Entering and Exiting the Interchanges for the 2025 and 2040 Alternative Conditions

Interchange	Description	2025 Build-Alt-2 Daily Volumes Total	2025 Build-Alt-3A Daily Volumes Total	2025 Build-Alt-3B Daily Volumes Total	2040 Build-Alt2 Daily Volumes Total	2040 Build-Alt-3A Daily Volumes Total	2040 Build-Alt-3B Daily Volumes Total
1	Loudoun County Parkway at Dulles Connector Ramps	47,650	53,600	56,700	56,850	58,900	66,550
2	US 50 at Loudoun County Parkway	87,750	109,100	101,650	87,750	112,250	111,650
3	US 50 at Northstar Boulevard	68,850	49,500	51,150	68,850	69,350	57,200
4	Gum Spring Road at Route 50	57,600	64,650	81,600	57,600	63,200	87,800

Notes: 1. Daily volumes are the sum of ADT entering and exiting the intersections from all directions.

The traffic analysis as summarized above has demonstrated that the four intersections/interchanges selected for evaluation in the CO hot-spot analysis have the worst-case LOS and/or highest traffic volumes within the project corridor, and are representative of the locations where peak CO concentrations would be expected to occur and where the general public may have access. It is assumed that, if these worst-case intersections/interchanges are found to have peak ground level CO concentrations below the CO NAAQS, then all other locations in the study area will also remain below the CO NAAQS.

As per **Appendix A**, the traffic analysis results for each condition used in the air quality analysis can be made available upon request.

8.1.3 MOVES Emissions Estimation

CO vehicle emission rates were estimated using the latest version of the EPA MOVES (MOVES2010b) model which recently replaced the MOBILE6.2 emission model. The methodologies and assumptions used to run the MOVES model in this analysis were consistent with the EPA guidance document "Using MOVES in Project Level Carbon Monoxide Analyses."[4] Vehicle, fuels, and traffic data used as input into the MOVES model was provided by the Metropolitan Washington Council of Governments (MWCOG) and the Virginia Department of Environmental Quality (VDEQ), consistent with inputs used in the most recent regional emissions modeling analysis. Specifically, fuel and I/M input data required as input to the MOVES database were provided by VDEQ for Loudoun County. MOVES was run utilizing the vehicle population and age distribution input data provided by MWCOG since these databases have been augmented with regional survey data and are specific to the area. The vehicle population data from MWCOG was used to develop the "link source type" database for each intersection, as a similar distribution of source types was assumed for the study area as contained in the latest regional conformity analysis for Loudoun County. MOVES input relies on link-specific data, therefore, link files were developed for each studied intersection/interchange for each analysis year. The link files include data such as road type, peak-hourly volumes, link lengths, speed, and roadway grade. The roadway grades for the existing, No Build and Build intersections were derived using GIS contours. For any future new

[4] Environmental Protection Agency, "Using MOVES in Project Level Carbon Monoxide Analyses". Report Number EPA 420-B-10-041. December 2010.

interchange ramps and roadways, maximum allowable roadway grades were estimated using the VDOT Road Design Manual as a worst-case assumption. Worst-case meteorological data consistent with the VDOT Consulting Guide for Northern Virginia was assumed in RunSpec portion of the MOVES input file. A summary of the MOVES inputs are presented in **Table 5**.

Table 5 Summary of MOVES Inputs

Parameter	Assumptions
Scale Menu	Project Domain
Min/Max Temperature	22°F
Season	2
Absolute Humidity	75%
Evaluation Month	January
Time Span	Year=2012, Month=January, AM Hour= 8AM to 9AM, PM Hour = 5PM to 6PM, Days=Weekdays
Geographic Bounds	Virginia, Loudoun County
Vehicles Equipment	All Vehicle Types and Fuel Types
Link Files	Intersection Specific
Roadway Grade/Link Speeds	Provided by WRA
Fuel and I/M Inputs	Provided by VDEQ
Vehicle Population and Age Distribution	Provided by MWCOG
Pollutants and Process Panel	CO Running and CO Crankcase
Output Panel	Grams and Miles Selected as Units, Population and Distance traveled

Mobile source emissions were calculated based on actual congested speeds at which vehicles travel through the intersections, while idle emissions are used to represent vehicles queuing. The MOVES runs were used to generate CO emission rates for input into the CAL3QHC dispersion model for the base year (2012), interim year (2025) and final design year (2040) conditions. A sample MOVES input and output file is provided in **Appendix B**. A complete set of MOVES input/output files can be made available upon request.

8.1.4 CAL3QHC Dispersion Model

The latest version of the CAL3QHC model (04244)[5] was used to predict worst-case 1-hour CO concentrations from queue and free-flow links using the FHWA CAL3Interface[6]. The CAL3Interface is a software package that incorporates the EPA CAL3QHC dispersion model. The CAL3QHC model incorporated default parameters per EPA guidance and the VDOT Consultant Guide. The 1-hour

[5] "User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections", EPA-454/R-92-006 (Revised), EPA, September 1995.
[6] See CAL3Interface – A Graphical User Interface for the CALINE3 and CAL3QHC Highway Air Quality Models", Michael Claggett, Ph.D., FHWA Resource Center, 2006.

concentrations from CAL3QHC were scaled by a factor of 0.7[7] to estimate 8-hour concentrations. Appropriate signal timing data from the traffic analysis modeling runs were input into the model for the signalized intersections. Travel speeds were estimated based on field observations, the traffic analysis, and queuing at the intersections. A summary of inputs used in the CAL3Interface model are shown in **Table 6**.

Table 6 Summary of CAL3QHC Inputs

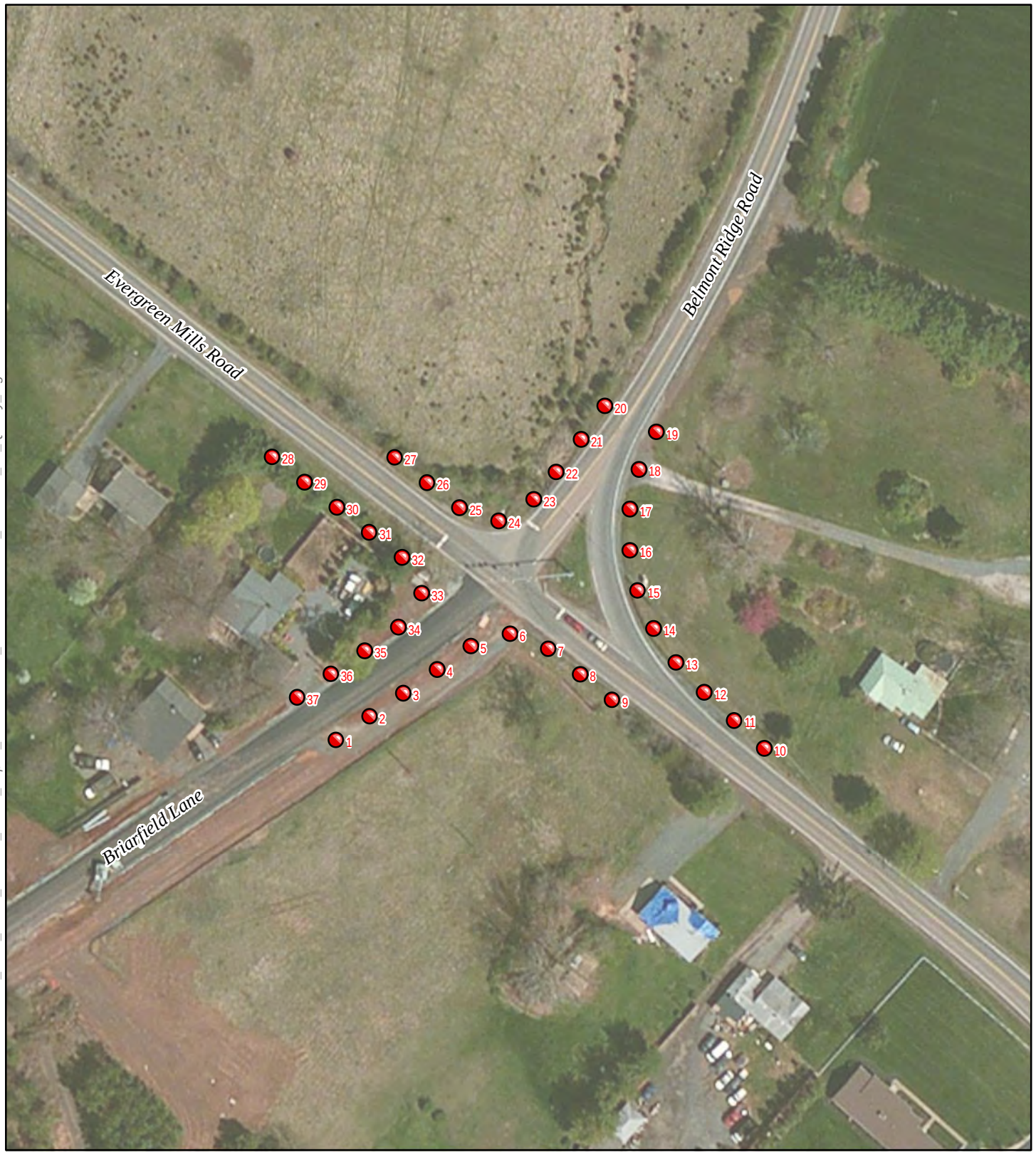
Description	Value
Surface Roughness Coefficient	175 Centimeters
Background CO Concentrations	2.9 ppm 1-hour, 2.3 ppm 8-hour (NOVA)
Wind Speed	1.0 meter per second
Stability Class	Urban D
Mixing Height	1,000 meters
Wind Direction	5 degree increments

A sample CAL3QHC input and output file is provided in **Appendix C**. A complete set of CAL3QHC files can be made available upon request.

8.1.5 Receptors

For the modeling analysis, receptor locations were placed in the vicinity of the four intersections/interchanges at worst-case locations such as sidewalks, property lines, and parking lots where the public generally has access. Consistent with EPA modeling guidelines[8], the receptors were located a minimum of 3 meters from the edge of the roadway and positioned at a height of 1.8 meters above the ground. Figures 6 through 11 show the receptor locations input into CAL3QHC for each intersection/interchange. It should be noted that the modeling for the existing, No Build and Build Alternative conditions at the interchange of US 50 and Loudoun County parkway were conducted using three different sets of roadway geometry (i.e. links) configurations and receptor locations since this intersection/interchange design varies for each condition. The existing condition represents a typical four-way signalized intersection while the future No Build conditions incorporate the anticipated VDOT design as a result of a separate project which changes from an intersection to an interchange. Alternative 3A represents a separate roadway design independent of the existing and No Build conditions. The receptor locations for the US 50 and Loudoun County Parkway intersection/interchange are presented in Figures 9, 10 and 11 for each modeled condition. Where appropriate, receptors from the existing condition were also included in the modeling of the No Build and Build Alternative.

[7] EPA guidance for estimating 8-hour concentrations from 1-hour concentrations.
[8] "Guidelines for Modeling Carbon Monoxide from Roadway Intersections", EPA-454/R-92-005, US EPA, 1992.



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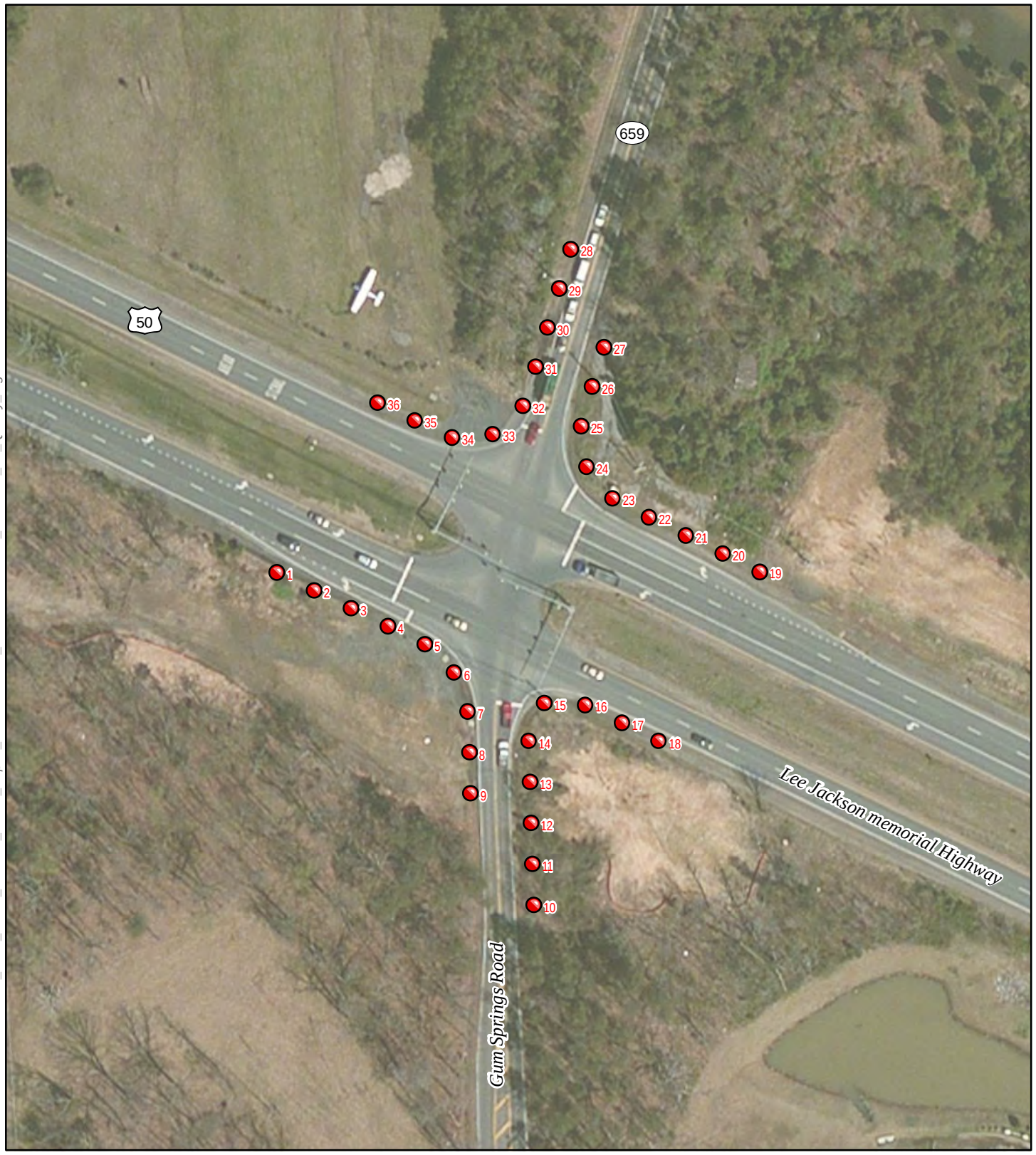
VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 6
CAL3QHC Receptor Locations:
Evergreen Mills Road at Belmont Ridge Road and Briarfield Lane

HARRIS MILLER MILLER & HANSON INC.



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VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 7
CAL3QHC Receptor Locations:
US 50 at Gum Springs Road

HARRIS MILLER MILLER & HANSON INC.

Path: G:\PROJECTS\304800_WRA_VDOT_Env\004_Dulles_Airport_Connector\001_Noise\GIS\305080_DullesAC_Air_Quality_Figure8.mxd

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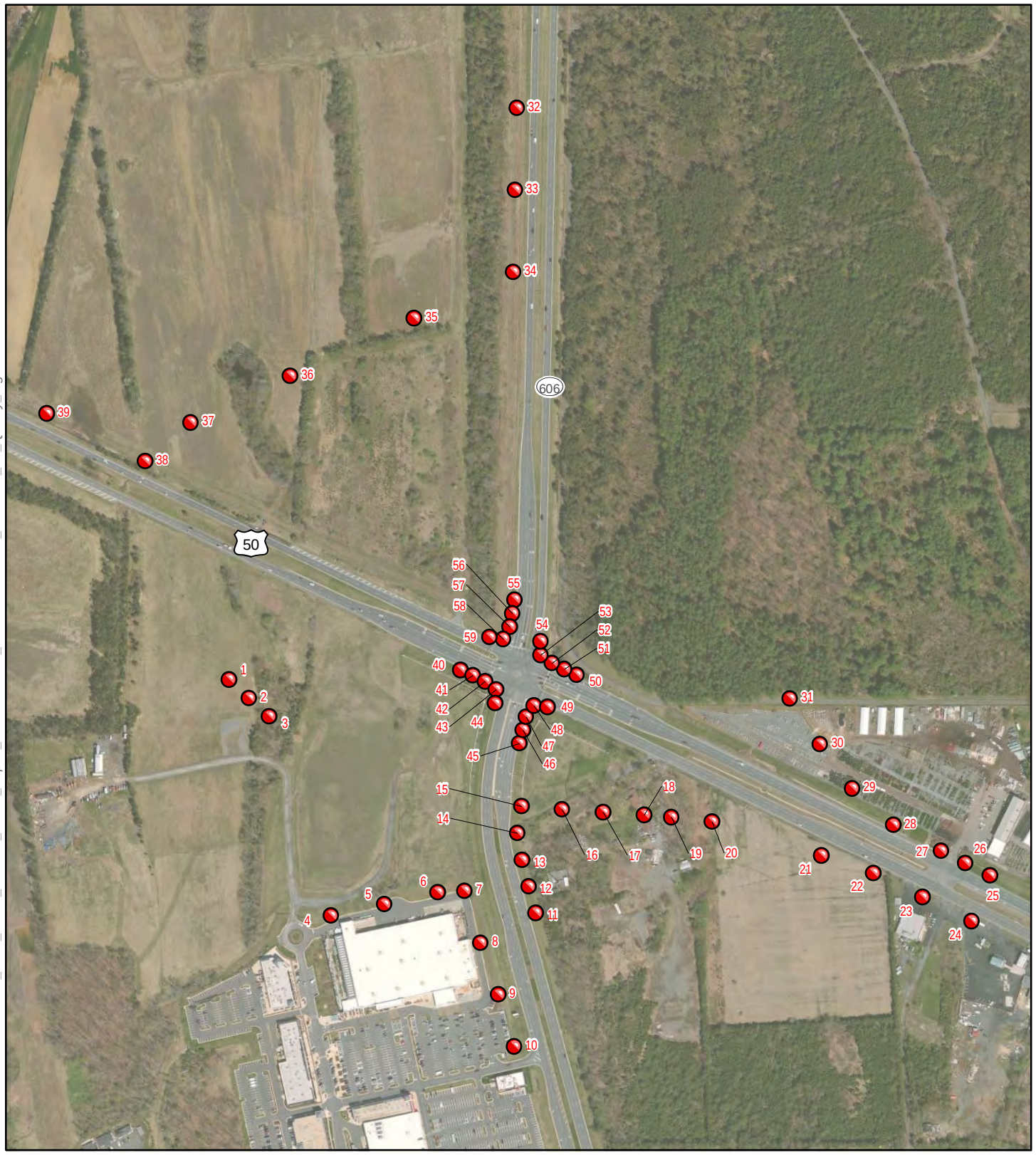
VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 8
CAL3QHC Receptor Locations:
Loudoun County Parkway at Old Ox Road

HARRIS MILLER MILLER & HANSON INC.



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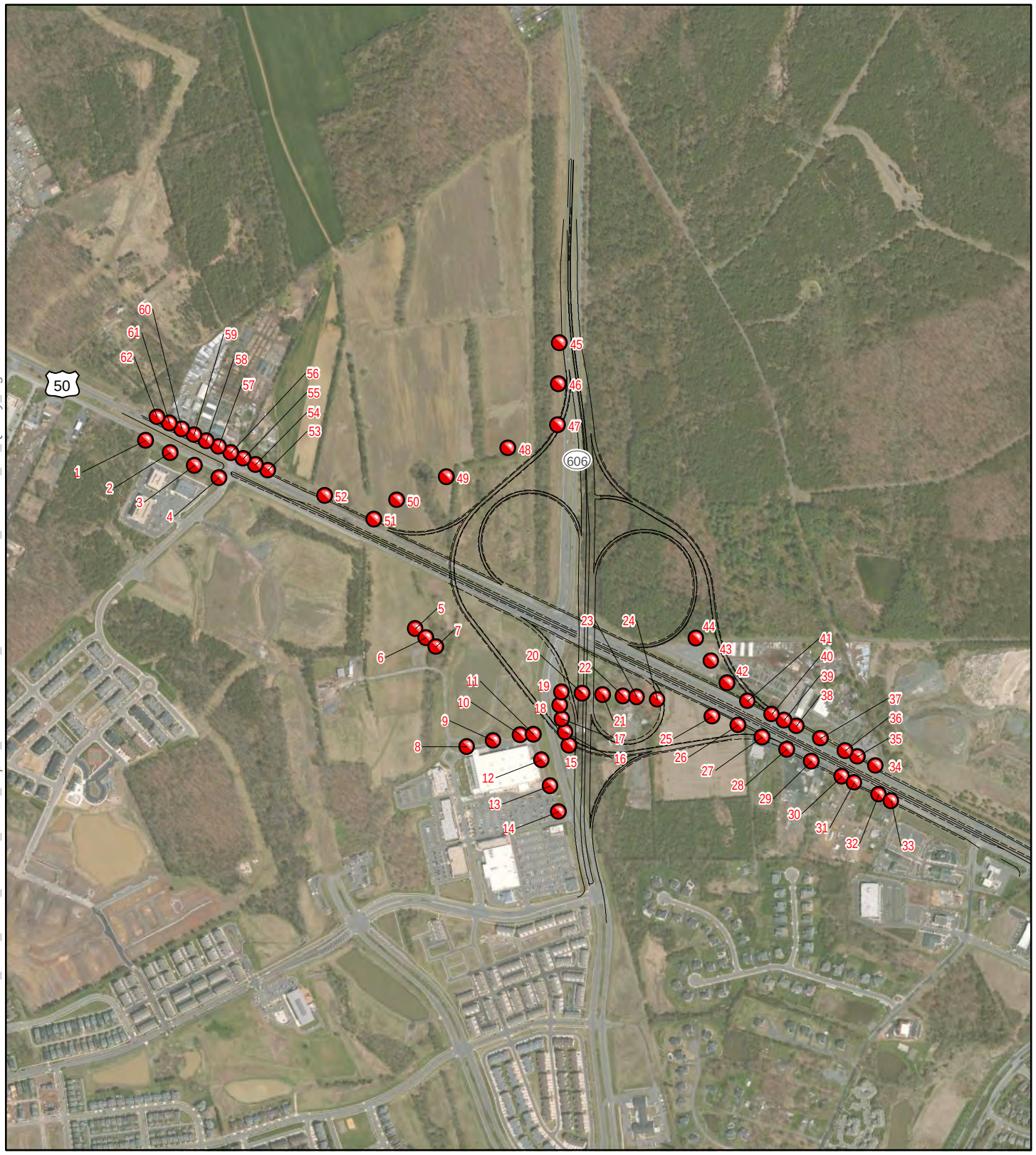
VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 9
CAL3QHC Receptor Locations:
US 50 at Loudoun County Parkway
Existing Conditions

HARRIS MILLER MILLER & HANSON INC.



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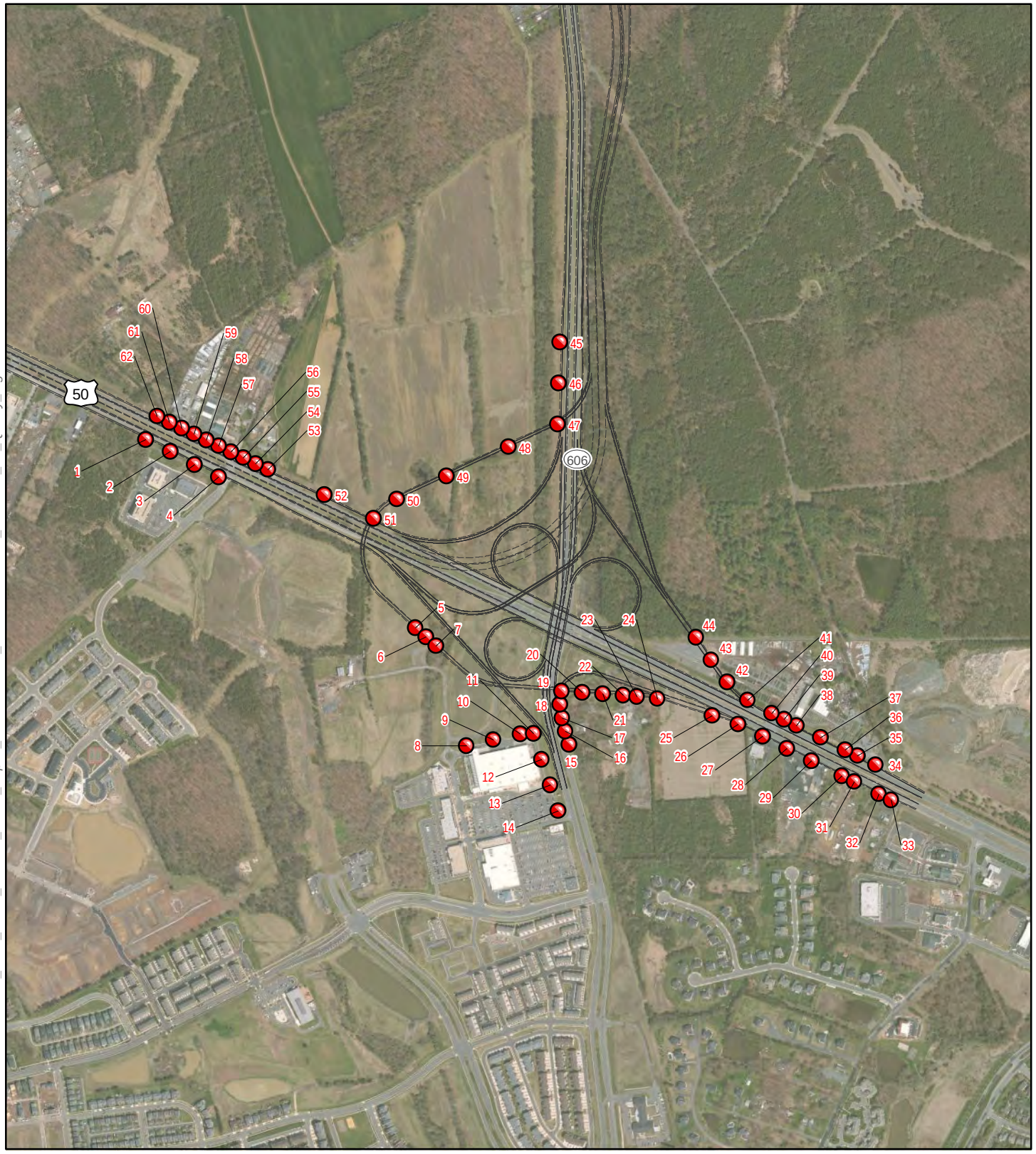
VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 10
CAL3QHC Receptor Locations:
US 50 at Loudoun County Parkway
No Build Conditions

HARRIS MILLER MILLER & HANSON INC.



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VDOT Virginia Department of Transportation

Dulles Air Cargo, Passenger, and Metro Access Highway

Project No. R000-053-032, P101; UPC No. 103929

Figure 11
CAL3QHC Receptor Locations:
US 50 at Loudoun County Parkway Alternative 3A

HARRIS MILLER MILLER & HANSON INC.

8.1.6 CAL3QHC Modeling Results

The results of the 1-hour and 8-hour CO hot-spot analysis for each interchange/intersection are presented in **Table 7** for the Existing, Build and No Build conditions. The table includes the overall worst-case modeled concentrations for each of the four intersections/interchanges for the AM and PM peak periods, including the modeled receptor number in parenthesis. The concentrations in **Table 7** also include the 1-hour and 8-hour background concentrations of 2.9 ppm and 2.3 ppm, respectively, for comparison to the CO NAAQS. The highest 1-hour predicted concentration from the four interchanges/intersections, including background, for the Existing, Interim and design No Build conditions are 3.9 ppm, 3.5 ppm, and 3.6 ppm, respectively. The highest 1-hour predicted concentrations for the Interim and design Build conditions are 3.9 and 4.1 ppm, respectively. The maximum 1-hour predicted Build concentration of 4.1 ppm was predicted to occur at US 50 at Gum Spring Road for 2040. The maximum predicted 1-hour Existing concentration of 3.9 ppm was predicted to occur at US 50 at Loudoun County Parkway, while the maximum No Build concentration of 3.6 ppm was predicted for 2040 at the same intersection. All predicted 1-hour CO concentrations are well below the 1-hour CO NAAQS of 35 ppm.

The 1-hour values generated by CAL3QHC were then scaled by a persistence factor of 0.7 to generate 8-hour CO concentrations for comparison to the CO NAAQS. The highest 8-hour concentrations predicted including background concentrations for the Existing, Interim and design No Build condition are 3.0 ppm, 2.7 ppm and 2.9 ppm, respectively. The highest 8-hour concentrations for the interim and design build conditions are 3.0 ppm and 3.1 ppm, respectively. Similar to the 1-hour concentrations, the maximum 8-hour predicted Build CO concentrations occurred at US 50 at Gum Spring Road, while the maximum Existing and No Build concentration of 2.9 ppm is expected to occur at US 50 at Loudoun County Parkway. All predicted 8-hour CO concentrations are also well below the 8-hour CO NAAQS standard of 9 ppm.

These results demonstrate that the project will not result in a violation of the CO NAAQS within the project corridor, and thereby satisfies all NEPA and CAA requirements pertaining to CO.

Table 7 CAL3QHC Modeling Results for Each Intersection/Interchange

		Existing 2012[1,2]		2025[1,2]				2040[1,2]				
				No Build		Build		No Build		Build		
Intersection/Interchange	Averaging Period	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	Peak AM (ppm)	Peak PM (ppm)	NAAQS (PPM)
Evergreen Mills Road at Belmont Ridge Road and Briarfield Lane	1-hour	3.4 (20)	3.3 (9)	3.2 (8)	3.2 (12)	3.2 (20)	3.1 (6)	3.2 (8)	3.2 (8)	3.2 (8)	3.5 (26)	35
	8-hour	2.7 (20)	2.6 (9)	2.5 (8)	2.5 (12)	2.5 (20)	2.4 (6)	2.5 (8)	2.5 (8)	2.5 (8)	2.7 (26)	9
US 50 at Gum Springs Road	1-hour	3.7 (12)	3.6 (13)	3.3 (1)	3.5 (19)	3.7 (16)	3.9 (19)	3.4 (20)	3.5 (19)	3.7 (2)	4.1 (19)	35
	8-hour	2.9 (12)	2.8 (13)	2.6 (1)	2.7 (19)	2.9 (16)	3.0 (19)	2.7 (20)	2.8 (19)	2.9 (2)	3.1 (19)	9
Loudoun County Parkway at Evergreen Mills Road	1-hour	3.4 (6)	3.7 (4)	3.4 (3)	3.4 (1)	3.4 (1)	3.5 (8)	3.4 (1)	3.4 (2)	3.4 (1)	3.5 (8)	35
	8-hour	2.7 (6)	2.9 (4)	2.7 (3)	2.7 (1)	2.7 (1)	2.7 (8)	2.7 (1)	2.7 (2)	2.7 (1)	2.7 (8)	9
US 50 at Loudoun County Parkway	1-hour	3.9 (50)	3.8 (50)	3.4 (27)	3.5 (47)	3.4 (41)	3.7 (58)	3.5 (27)	3.6 (47)	3.5 (2)	3.7 (47)	35
	8-hour	3.0 (50)	2.9 (50)	2.7 (27)	2.7 (47)	2.7 (41)	3.0 (58)	2.9 (27)	2.8 (47)	2.7 (2)	2.9 (47)	9

Notes:

1. Total concentration is the sum of the modeled concentration plus background concentrations.
2. Number in parenthesis represents the modeled receptor number of maximum modeled concentration. Please refer to Figures 6 through 11.

8.2 Particulate Matter

Loudoun County is located within a region that has been designated by EPA as non-attainment for $PM_{2.5}$; therefore, a determination was performed to determine if the project is considered to be one of "air quality concern". The EPA has established a list of criteria (40 CFR 93.123(b) (1)) in determining whether a project is of "air quality concern" for $PM_{2.5}$, and the project was evaluated against each of these criteria below;

(i) New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles;

The study Alternatives are designed to reduce congestion and improve capacity on the existing roadway network in the Dulles South area.

EPA guidance provides an example of a "project of air quality concern" covered under 40 CFR 93.123(b) (i) and (ii) as a project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with greater than 125,000 annual average daily traffic (AADT) and 8% or more of such AADT is diesel truck traffic (which equates to 10,000 or more diesel trucks per day).

Total traffic was estimated for the main roadways for each Build Alternative for 2025 and 2040 conditions. Included in the estimate are expected diesel truck volumes for each segment. **Table 8** and **Table 9** show the forecasted ADT and diesel truck volumes for 2025 and 2040 for each Build Alternative. The green highlighted segment links in the table represent proposed new roadway segments.

The truck percentages in the Study area were derived from a combination of (1) model truck percentage and (2) trucks from MWAA's new Dulles Access Cargo facility. Based on discussions with MWAA and Western Lands trip generation provided, it was assumed that approximately 20% of all trips into the new development would be cargo-related trucks.

These cargo trucks were further distributed along roadways adjacent to the Dulles interchange based on travel patterns observed from the model. The roadways included the new DACPMA highway, Loudoun County Parkway, Bi-County Parkway, US 50, and Old Ox Road. On these segments, model truck percentages were refined by adding the cargo facility trucks. For all other Study area roadways, truck percentages from the model were used.

A comparison of the 2025 and 2040 ADT shows that the worst-case or highest ADT are expected to occur for the 2040 condition, as are the highest volumes of total diesel truck traffic. Therefore, the 2040 ADT volumes were used for comparison to EPA criteria to determine if the project should be considered a "project of air quality concern".

Worst-case traffic in the region is forecast to reach up to 73,900 ADT for the 2040 Alternative 3B scenario for the Loudoun County Parkway roadway segment from Route 50 to Evergreen Mills Road. The 73,900 ADT is comprised of approximately 11% diesel vehicles, or about 8,012 total diesel vehicles, which is well below the level of 10,000 diesel trucks provided by EPA as an example of a project of air quality concern in their guidance.

All other roadways within the project corridor under each Alternative are projected to have total ADT well below 125,000 and total diesel trucks well below 10,000 per day, and therefore fall well below the level considered to be of air quality concern.

In addition, the Alternatives include the following three new roadway segments (as denoted in green shading in **Table 8** and **Table 9**):

1. MWAA Airport Road (Alternative 2, Alternative 3A and Alternative 3B);
2. New Alignment from Route 50 and Bi-County Parkway to Loudoun County Parkway/Old Ox Road/MWAA Interchange (Alternative 2); and
3. Elevated roadway segments from Route 50 and Bi-County Parkway interchange to Loudoun County Parkway/Old Ox Road/MWAA Interchange (Alternative 3A).

Of the three new roadway segments, the new alignment and the elevated roadway segment from Route 50 to the ramp to and from Loudoun County Parkway are expected to have the highest ADT of 72,600 for the 2040 Alternative 3A condition. The 72,600 ADT is comprised of approximately 8,237 diesel vehicles, which is well below the 10,000 diesel truck level provided by EPA as an example of a project of air quality concern. The other new roadway segments are all projected to operate with ADT lower than 72,600, and diesel truck traffic along these new roadway segments are all expected to be well below 10,000 ADT.

In summary, based on the criteria specified in the transportation conformity rule and associated guidance, this project is not considered to be one of air quality concern for fine particulate matter.

(ii) Projects affecting intersections that are at Level of Service D, E, or F with a significant number of diesel vehicles, or those that will change to Level of Service D, E, F because of increased traffic volumes from a significant number of diesel vehicles related to the project;

Table 8 Estimated ADT and Diesel Truck Volumes for 2025 Alternative Conditions

		Link Description		2025 No Build			2025 Alt-2			2025 Alt-3A			2025 Alt-3B		
Section	Roadway	From	To	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks
1	Loudoun County Parkway	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Creighton Road	27,000	8	2,160	32,600	7	2,282	32,300	7	2,261	36,900	7	2,583
2	Old Ox Road (Route 606)	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Carters School Road	23,900	11	2,629	34,500	11.17	3,855	29,000	11.89	3,447	32,700	11.13	3,641
3	MWAA Airport Road	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Dulles Airport	Does Not Exist			9,000	20	1,800	12,400	20	2,480	7,100	20	1,420
4	Loudoun County Parkway	Evergreen Mills Road	Loudoun County Parkway/Old Ox Road/MWAA Interchange	40,400	9	3,636	38,200	12.15	4,640	44,400	9.00	3,996	59,000	10.94	6,453
5	Loudoun County Parkway	Route 50	Evergreen Mills Road	47,200	9	4,248	54,200	10.16	5,507	29,900	8.00	2,392	61,800	10.84	6,700
6	Route 50	Loudoun County Parkway	South Riding Blvd	54,100	7	3,787	53,400	8.21	4,383	53,200	7.74	4,116	55,600	7.72	4,295
7	Loudoun County Parkway	Talls Cedar Parkway	Route 50	15,200	7	1,064	17,200	7	1,204	15,900	7	1,113	19,400	7	1,358
8	Route 50	Gum Spring Road	Loudoun County Parkway	61,500	7	4,305	44,800	6	2,688	46,100	6	2,766	66,500	9.96	6,622
9	Gum Spring Road	Talls Cedar Parkway	Route 50	27,700	5	1,385	27,000	6	1,620	25,900	5	1,295	33,500	5	1,675
10	Route 50	Northstar Blvd	Gum Spring Road	37,300	6	2,238	31,200	6	1,872	31,500	6	1,890	47,600	10.14	4,827
11	Northstar Blvd	Talls Cedar Parkway	Route 50	27,000	8	2,160	34,700	11.60	4,024	31,800	13.25	4,214	31,400	10.78	3,383
12	Route 50	West of Northstar Blvd	Northstar Blvd	23,300	6	1,398	31,000	9.03	2,799	22,900	10.26	2,348	23,300	8.33	1,940
13	Gum Spring Road	Route 50	Evergreen Mills Road	16,800	6	1,008	15,700	5	785	13,600	5	680	15,600	6	936
14	Evergreen Mills Road	Fleetwood Road	Belmont Ridge Road and Evergreen Mills Road Interchange	9,000	8	720	10,000	8	800	9,700	8	776	8,400	8	672
15	Belmont Ridge Road	Creighton Road	Belmont Ridge Road and Evergreen Mills Road Interchange	16,000	6	960	15,200	6	912	15,300	6	918	15,000	6	900
16	Evergreen Mills Road	Belmont Ridge Road	Gum Spring Road	22,100	7	1,547	21,900	6	1,314	21,900	6	1,314	21,900	6	1,314
17	Evergreen Mills Road	Gum Spring Road	Loudoun County Parkway	14,000	6	840	14,400	7	1,008	14,600	7	1,022	13,900	7	973
18	New Alignment	Route 50	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Does Not Exist			28,500	15	4,275	Does Not Exist			Does Not Exist		
19	Loudoun County Parkway (new)	Route 50	Ramp to and from Loudoun County Parkway	Does Not Exist			Does Not Exist			30,900	15	4,635	Does Not Exist		
20	Elevated Route 50	Northstar Blvd	Route 50 and Loudoun County Parkway	Does Not Exist			Does Not Exist			25,200	15	3,780	Does Not Exist		
21	Loudoun County Parkway (new)	Ramp to and from Loudoun County Parkway	Loudoun County Parkway/Old Ox Road/MWAA Interchange							11,800	20	2,360	Does Not Exist		

Table 9 Estimated ADT and Diesel Truck Volumes for 2040 Alternative Conditions

Section	Roadway	Link Description		2040 No Build			2040 Alt-2			2040 Alt-3A			2040 Alt-3B		
		From	To	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks	ADT Volumes	Percent Diesel	Diesel Trucks
1	Loudoun County Parkway	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Creighton Road	30,500	7	2,135	34,300	7	2,401	36,600	7	2,562	39,000	7	2,730
2	Old Ox Road (Route 606)	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Carters School Road	32,300	9	2,907	39,200	11.17	4,380	33,400	11.89	3,970	38,800	11.13	4,320
3	MWAA Airport Road	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Dulles Airport	Does Not Exist			14,100	20	2,820	18,500	20	3,700	12,900	20	2,580
4	Loudoun County Parkway	Evergreen Mills Road	Loudoun County Parkway/Old Ox Road/MWAA Interchange	51,000	8	4,080	40,100	12.15	4,871	52,100	9.00	4,689	71,500	10.94	7,820
5	Loudoun County Parkway	Route 50	Evergreen Mills Road	61,500	8	4,920	56,900	10.16	5,781	37,900	8.00	3,032	73,900	10.84	8,012
6	Route 50	Loudoun County Parkway	South Riding Blvd	54,900	7	3,843	54,600	8.21	4,482	55,200	7.74	4,270	58,000	7.72	4,480
7	Loudoun County Parkway	Talls Cedar Parkway	Route 50	18,100	7	1,267	18,100	8	1,448	18,200	7	1,274	21,600	7	1,512
8	Route 50	Gum Spring Road	Loudoun County Parkway	59,000	6	3,540	45,900	6	2,754	47,700	6	2,862	71,000	9.96	7,070
9	Gum Spring Road	Talls Cedar Parkway	Route 50	27,300	5	1,365	26,800	5	1,340	27,200	5	1,360	34,100	5	1,705
10	Route 50	Northstar Blvd	Gum Spring Road	38,000	6	2,280	32,200	6	1,932	34,800	6	2,088	53,500	10.14	5,425
11	Northstar Blvd	Talls Cedar Parkway	Route 50	29,500	8	2,360	37,800	11.60	4,384	36,300	13.25	4,810	35,600	10.78	3,836
12	Route 50	West of Northstar Blvd	Northstar Blvd	24,800	6	1,488	33,000	9.03	2,980	25,100	10.26	2,574	25,300	8.33	2,107
13	Gum Spring Road	Route 50	Evergreen Mills Road	19,000	5	950	17,200	6	1,032	16,700	5	835	17,000	5	850
14	Evergreen Mills Road	Fleetwood Road	Belmont Ridge Road and Evergreen Mills Road Interchange	11,000	8	880	11,400	8	912	11,300	8	904	10,000	10	1,000
15	Belmont Ridge Road	Creighton Road	Belmont Ridge Road and Evergreen Mills Road Interchange	17,800	7	1,246	16,300	7	1,141	17,000	6	1,020	16,300	7	1,141
16	Evergreen Mills Road	Belmont Ridge Road	Gum Spring Road	23,800	7	1,666	23,800	8	1,904	23,800	7	1,666	23,800	7	1,666
17	Evergreen Mills Road	Gum Spring Road	Loudoun County Parkway	15,600	7	1,092	16,300	8	1,304	16,800	8	1,344	15,100	8	1,208
18	New Alignment	Route 50	Loudoun County Parkway/Old Ox Road/MWAA Interchange	Does Not Exist			34,700	15	5,205	Does Not Exist			Does Not Exist		
19	Loudoun County Parkway (new)	Route 50	Ramp to and from Loudoun County Parkway	Does Not Exist			Does Not Exist			34,700	15	5,205	Does Not Exist		
20	Elevated Route 50	Northstar Blvd	Route 50 and Loudoun County Parkway	Does Not Exist			Does Not Exist			29,600	15	4,440	Does Not Exist		
21	Loudoun County Parkway (new)	Ramp to and from Loudoun County Parkway	Loudoun County Parkway/Old Ox Road/MWAA Interchange							14,200	20	2,840	Does Not Exist		

As noted above, the total AADT and diesel truck traffic associated with each of the Alternatives considered for this project are not expected to reach the 125,000 AADT or 10,000 diesel truck level that EPA has provided as an example of a project of air quality concern for fine particulate matter. In addition, as shown in **Table 2**, the LOS at each intersection within the project corridor is expected to either improve or remain the same under each of the Build Alternatives compared to the No Build conditions for both the 2025 and 2040 analysis years, and the total volume of diesel trucks are projected to be well below 10,000 ADT at all of the intersections within the project corridor.

The intersection at Evergreen Mills Road and Loudoun County Parkway is expected to have the highest number of diesel vehicles under Alternative 2 for the 2040 condition and is therefore considered to be the worst-case intersection. Under Alternative 2, this intersection is expected to operate at LOS B and E for the AM and PM peak periods, respectively, and shows an improvement over the No Build condition of LOS D and F for the respective AM and PM peak periods. Table 9 contains the 2040 ADT and diesel truck volumes for the three roadway links entering and exiting the intersection. These are summarized as follows:

1. Link 4 Evergreen Mills Road and Loudoun County Parkway/Old Ox Road/MWAA Interchange (40,100 ADT; 4,871 diesel trucks);
2. Link 5 Route 50 and Evergreen Mills Road (56,900 ADT; 5,781 diesel trucks);
3. Link 15 Creighton Road and Belmont Ridge Road and Evergreen Mills Road (16,300 ADT; 1,141 diesel trucks)

The roadway segment with the highest expected ADT and diesel truck traffic entering and exiting the intersection is estimated at 56,900 ADT and 5,781 diesel trucks, respectively. The total number of diesel trucks on this roadway segment is expected to increase from 4,920 to 5,781 between the No Build and Build conditions, respectively, or by 861 total diesel trucks per day. This increase is not considered to be a significant, especially when considering the improvement in LOS anticipated under the Build condition. The diesel truck volume at the Creighton Road and Belmont Ridge segment is expected to decrease compared to the No Build condition from 1,246 to 1,141 trucks, respectively. In addition, the Route 50 and Evergreen Mills roadway link is not expected to see a significant increase in diesel vehicles.

In summary, the roadway segments at this worst-case intersection, as well as the remaining intersections within the entire project corridor, are not expected to have either a significant number of diesel vehicles or see a significant increase in the number of diesel vehicles as a result of this project. In addition, the LOS at each intersection within the project corridor is expected to either improve or remain the same under each of the Build Alternatives. Therefore, this project is not considered to be one of air quality concern for fine particulate matter.

(iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;

The project does not involve bus or rail terminals.

(iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and

This project does not involve bus or rail terminals.

(v) *Projects in or affecting locations, areas, or categories of sites which are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan or implementation plan submissions, as appropriate, as sites of violation or possible violation.*

This project is not located in such an area.

Based on the criteria specified in the Transportation Conformity rule and associated guidance, the implementation of any of the proposed Alternatives are not considered to be ones of "air quality concern" for fine particulate matter. Therefore, the CAA and 40 CFR 93.116 requirements for $PM_{2.5}$ were met without a hot-spot analysis, since such projects have been found not to be of air quality concern under 40 CFR 3.123(b)(1).

8.3 Mobile Source Air Toxics Analysis Methodology

In December of 2012, the FHWA issued an interim guidance update regarding Mobile Source Air Toxic (MSAT) in a NEPA analysis to include the EPA MOVES emission model along with updated research on air toxic emissions from mobile sources. The guidance includes three categories and criteria for analysing MSATs in a NEPA documents:

1. No meaningful MSAT effects,
2. Low potential MSAT effects, and
3. High potential MSAT effects.

A qualitative analysis is required for projects which meet the low potential MSAT effects criteria while a quantitative analysis is required for projects meeting the high potential MSAT effects criteria.

Projects with Low Potential MSAT Effects are described as:

- *Those that serve to improve operations of highway, transit, freight without adding substantial new capacity or without creating a facility that is likely to significantly increase emissions. This category covers a broad range of project types including minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criteria.*

Projects with High Potential MSAT Effects must:

- *Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location;*
- *Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000 or greater by the design year; and*
- *Proposed to be located in proximity to populated areas.*

Table 8 and **Table 9** show the forecasted ADT for 2025 and 2040 within the study corridor for each Build Alternative. The study Alternatives will add capacity to Route 50 and Route 606 and/or construct a new limited access highway; however, daily volumes in the 2040 full build out year for each Build Alternative are expected to be well below the 140,000 to 150,000 threshold for projects considered to have High Potential MSAT effects. Since the Build Alternatives will not add significant capacity to roadways with 140,000 to 150,000 ADT or greater, and the project is designed to reduce congestion and

improve capacity on the existing roadway network, the proposed project falls into the category of one having Low Potential MSAT Effects; therefore, a qualitative analysis was conducted consistent with the latest FHWA guidance.

A qualitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, found at http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/methodology/methodology00.cfm as well as Appendix B and Appendix C of the guidance.

8.3.1 MSAT Background

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, when Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants (HAPs). The EPA assessed this expansive list in their 2007 rule on the *Control of Hazardous Air Pollutants from Mobile Sources* and identified a group of 93 compounds emitted from mobile sources that are listed in their *Integrated Risk Information System (IRIS).* In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA). The seven compounds identified were:

1. acrolein;
2. benzene;
3. 1,3 butadiene;
4. diesel particulate matter;
5. formaldehyde;
6. naphthalene; and
7. polycyclic organic matter.

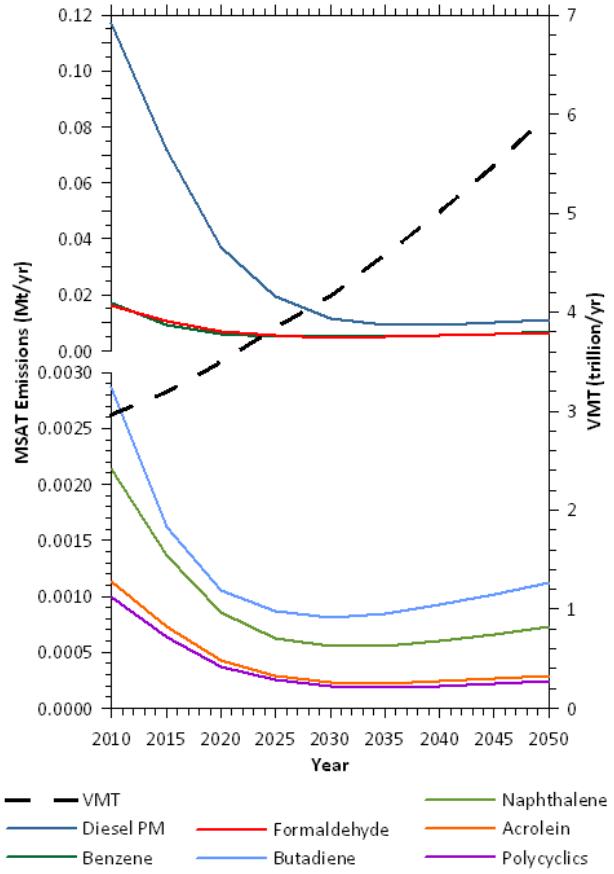
While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules. The 2007 EPA rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines.

8.3.2 Motor Vehicle Emissions Simulator (MOVES)

According to EPA, MOVES improves upon the previous MOBILE mode in several key aspects: MOVES is based on a vast amount of in-use vehicle data collected and analysed since the latest release of MOBILE, including millions of emissions measurements from light-duty vehicles. Analysis of this data enhanced EPA's understanding of how mobile sources contribute to emission inventories and the relative effectiveness of various control strategies. In addition, MOVES accounts for the significant effects that vehicle speed and temperature have on PM emission estimates, whereas MOBILE did not. MOVES2010b includes all air toxic pollutants in NATA that are emitted by mobile sources. EPA has incorporated more recent data into MOVES2010b to update and enhance the quality of MSAT emission estimates. These data reflect advanced emission control technology and modern fuels, plus additional data for older technology vehicles.

Based on an FHWA analysis using EPA's MOVES2010b model, as shown in the figure below, even if vehicle-miles travelled (VMT) increases by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period.

Figure 12 National MSAT Emission Trends 1999-2050 for Vehicles Operating on Roadways Using EPA's MOVES 2010b Model



Source: EPA MOVES2010b model runs conducted during May-June 2012 by FHWA.

Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

The implications of MOVES on MSAT emissions estimates compared to MOBILE are: lower estimates of total MSAT emissions; significantly lower benzene emissions, significantly higher diesel PM emissions, especially for lower speeds. Consequently, diesel PM is projected to be the dominant component of the emissions total.

8.3.3 MSAT Research

Air toxics analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how potential public health risks posed by MSAT exposure should be factored into project-level decision-making within the context of NEPA.

Nonetheless, air toxics concerns continue to be raised on highway projects during the NEPA process. Even as the science emerges, we are duly expected by the public and other agencies to address MSAT impacts in our environmental documents. The FHWA, EPA, the Health Effects Institute, and others have funded and conducted research studies to try to more clearly define potential risks from MSAT emissions

associated with highway projects. The FHWA will continue to monitor the developing research in this field.

8.3.4 Project MSAT Impacts

For each of the Build Alternatives, the amount of MSAT emitted is generally proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix and diesel vehicle percentages remain constant for each Alternative. The VMT estimated for Alternatives 3A and 3B is generally projected to be slightly higher when compared to the No Build Alternative in each analysis year. This increase in VMT means MSAT under Build Alternatives 3A and 3B may be slightly higher than the No Build Alternative in the study area. The VMT estimated for Alternative 2 will be higher in the vicinity of the new limited access highway. This increase in VMT would lead to higher MSAT emissions along the new highway corridor, along with a corresponding decrease in MSAT emissions on parallel routes. Any emissions increase under each of the Alternatives would be offset somewhat by the lower MSAT emissions rates due to the projected reduction in congestion and corresponding increase in vehicle speeds; according to EPA's MOVES 2010b model, emissions of all of the priority MSAT will decrease as speed increases. Because the estimated VMT across the entire project corridor under each of the Alternatives is nearly the same, it is expected there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of the alternative chosen, emissions will likely be significantly lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by over 80 percent between 2010 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be significantly lower in the future in nearly all cases.

The additional travel lanes contemplated as part of the project Alternatives may have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under each alternative there may be localized areas where ambient concentrations of MSAT could be higher under certain Build Alternatives than the No Build Alternative. The localized increases in MSAT concentrations would likely be most pronounced along any new or expanded roadway sections within the project corridor. However, the magnitude and the duration of these potential increases compared to the No Build alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSAT health impacts. In sum, when a highway is widened, the localized level of MSAT emissions for the Build Alternative could be higher relative to the No Build Alternative, but this would likely be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions). Also, MSAT will be lower in other locations when traffic shifts away from them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

Under each Alternative there may be localized areas where VMT would increase, and other areas where VMT would decrease. Therefore, it is possible that localized increases and decreases in MSAT emissions may occur. However, even if these increases do occur, they too will be substantially reduced in the future due to implementation of EPA's vehicle and fuel regulations.

In sum, under the Build Alternatives in the design year it is expected there could be slightly higher MSAT emissions in the study area relative to the No Build Alternative due to increased VMT. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, EPA's vehicle and fuel regulations will bring about significantly lower MSAT levels for the area in the future than today.

8.3.5 Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The U.S. EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the CAA and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/iris/). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance Update on Mobile source Air Toxic Analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are; cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the CAA to determine whether more stringent controls are

required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities, in addition to improved access for emergency response, that are better suited for a quantitative analysis.

8.3.6 MSAT Conclusions

What we know about mobile source air toxics is still evolving. Information is currently incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with each of the project Alternatives. Under each of the Build Alternatives, there may be slightly higher MSAT emissions in the design year relative to the No Build Alternative due to increased VMT. There could also be increases in MSAT levels in a few localized areas where VMT increases. However, EPA's vehicle and fuel regulations are expected to result in significantly lower MSAT levels in the future than exist today due to cleaner engine standards coupled with fleet turnover. The magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be significantly lower in the future than they are today, regardless of the preferred Alternative.

9 Construction Emission Analysis

The temporary air quality impacts from construction activities are not expected to be significant. Construction activities will be performed in accordance with VDOT's current "Road and Bridge Specifications". The specifications conform to the SIP and require compliance with all applicable local, state, and federal regulations.

The study is located in an EPA designated non-attainment area for ozone and $PM_{2.5}$ as well as an area designated by VDEQ as an emissions control area (Northern Virginia Emissions Control Area) for VOC and NO_x (9 VAC 5-20-206). As such, the following VDEQ air pollution regulations will be adhered to during the construction of this project: 9 VAC 5-130 et seq., Open Burning restrictions; 9 VAC 5-45, Article 7 et seq., Cutback Asphalt restrictions; and 9 VAC 5-50-60 et seq., Fugitive Dust precautions.

10 Mitigation

Mitigation measures will be employed to minimize environmental impacts during construction activities to comply with all federal, state, and local regulations as discussed in **Section 9.**

11 Conclusion

Loudoun County is located in an area that has been designated by the EPA as an attainment area for all criteria pollutants, except for the 8-hour ozone and annual $PM_{2.5}$ standards, for which the area has been designated non-attainment. The traffic analysis conducted by the design team showed ADT levels in the study area for the Build Alternatives are projected to be above the thresholds contained in the 2009 VDOT/FHWA Project-Level CO Air Quality Studies Agreement for the interim and design year conditions. As such, CO impacts were analysed at the four worst-case intersection/interchange locations in the study area. The results of the hot-spot analysis show that the maximum anticipated CO concentrations will fall well below the NAAQS for all conditions.

Since the area is designated as a non-attainment area for $PM_{2.5}$, an analysis was conducted to determine if the study Alternatives are considered to be ones of "air quality concern" under EPA regulations and guidance. Based on an evaluation of projected ADT and diesel truck traffic, the Alternatives are not considered to be ones of "air quality concern" for $PM_{2.5}$. Therefore, the CAA and 40 CFR 93.116 requirements for $PM_{2.5}$ were met without a hot-spot analysis, since such projects have been found to not be of air quality concern under 40 CFR 3.123(b)(1).

The study Alternatives were also evaluated against the latest FHWA guidance for addressing MSATs in a NEPA analysis. The Alternatives were identified as ones with Low Potential MSAT Effects; therefore, a qualitative analysis was conducted consistent with the FHWA guidance. The qualitative MSAT analysis demonstrated that there would be no long-term adverse impacts associated with the Alternatives, and that future MSAT emissions across the entire project corridor are expected to be significantly below today's levels due to cleaner engine emission standards and fleet turnover.

On February 20, 2013 the National Capital Region Transportation Planning Board (TPB) agreed to include the Dulles Air Cargo, Passenger, and Metro Access Highway Build and No Build Alternatives for regional air quality conformity testing. In July 2013, VDOT will formally request the TPB to select one of the alternatives for inclusion in the 2013 National Capital Region's Financially Constrained Long-Range Plan (CLRP) which includes projected transit and traffic, demographics, and air quality conditions through the 2040 horizon year.

Lastly, construction activities will be performed in accordance with VDOT's "Road and Bridge Specifications" as well as any applicable VDEQ regulations. These specifications conform to the SIP and require compliance with all applicable federal, state, and local regulations.

In conclusion, the air quality analysis has demonstrated that the study Alternatives are not expected to cause or contribute to a new violation of any NAAQS, increase the frequency or severity of any violation, or delay timely attainment of any NAAQS.

Appendix A. Traffic Analysis (Available Upon Request)

Appendix B. Sample MOVES Input and Output Files (Complete Set of Files Available Upon Request)

LCP and Evergreen Links and Emission Rates

linkID	countyID	zoneID	linkLength	linkAvgSpeed	linkDescription	linkAvgGrade	2012 MOVES Emission Rate (g/mi)	2025 MOVES Emission Rate (g/mi)	2040 MOVES Emission Rate (g/mi)
1	51107	511070	0.15	35	EB In	-1	3.15	1.89	1.77
2	51107	511070	0.15	35	WB Out	-1	3.15	1.89	1.77
3	51107	511070	0.15	55	NB In	-0.22	2.97	1.94	1.79
4	51107	511070	0.15	58	NB Out	-2	2.22	1.51	1.39
5	51107	511070	0.15	54	SB IN	-2	2.29	1.66	1.52
6	51107	511070	0.15	55	SB Out	-0.22	2.97	1.89	1.76
7	51107	511070	0	0	EB Queue	0	26.4	9.7	8.02
8	51107	511070	0	0	NB Queue	0	26.4	9.7	8.02
9	51107	511070	0	0	SB Queue	0	26.4	9.7	8.02

Notes: 1. Emission rate in grams per mile except queues which are in grams per hour.

US 50 at Gum Springs Road

linkID	countyID	zoneID	linkLength	linkAvgSpeed	linkDescription	linkAvgGrade	2012 MOVES Emission Rate (g/mi)	2025 MOVES Emission Rate (g/mi)	2040 MOVES Emission Rate (g/mi)
1	51107	511070	0.15	50	EB In	2.38	4.9	3.2	3
2	51107	511070	0.15	55	EB Out	2	4.53	2.95	2.79
3	51107	511070	0.15	55	WB In	2	4.53	2.95	2.79
4	51107	511070	0.15	50	WB Out	2.38	4.9	3.2	3
5	51107	511070	0.15	45	NB In	-1	2.9	1.76	1.64
6	51107	511070	0.15	35	NB Out	-2.6	2.6	1.51	1.4
7	51107	511070	0.15	35	SB IN	-2.6	2.6	1.51	1.4
8	51107	511070	0.8	50	Elevated EB	7	N/A	7.94	7.48
9	51107	511070	0.8	50	Elevated WB	7	N/A	7.94	7.48
10	51107	511070	0.15	45	SB Out	-1	2.9	1.76	1.64
11	51107	511070	0	0	EB Queue	0	26.4	9.7	8.02
12	51107	511070	0	0	WB Queue	0	26.4	9.7	8.02
13	51107	511070	0	0	NB Queue	0	26.4	9.7	8.02
14	51107	511070	0	0	SB Queue	0	26.4	9.7	8.02

Notes: 1. Emissions are in grams per mile except queues which are in grams per hour.
2. NA denotes Not Applicable, elevated roadway does not exist in the 2012 Condition

Route 50 and Rt 606 Link Information (Existing)

linkID[1]	countyID	zoneID	linkLength	linkAvgSpeed	linkDescription	linkAvgGrade	2012 MOVES Emission Rate (g/mi)
1	51107	511070	0.15	55	EB In	-1.79	2.36
2	51107	511070	0.15	55	EB Out	-0.38	2.89
3	51107	511070	0.15	55	WB In	-0.38	2.89
4	51107	511070	0.15	55	WB Out	-1.79	2.35
5	51107	511070	0.15	45	NB In	1.15	3.94
6	51107	511070	0.15	55	NB Out	-0.22	2.97
7	51107	511070	0.15	55	SB IN	-0.22	2.97
8	51107	511070	0.15	45	SB Out	1.15	3.94
9	51107	511070	0	0	EB Queue	0	26.39
10	51107	511070	0	0	WB Queue	0	26.39
11	51107	511070	0	0	NB Queue	0	26.39
12	51107	511070	0	0	SB Queue	0	26.39

Notes:

1. Links for the Existing condition at this intersection represent a signalized intersection. For the Build condition, the intersection is converted to an interchange and the extent of the interchange is much bigger compared to the Existing condition.

2. Emissions are in grams per mile except queues which are in grams per hour.

Evergreen and Belmont Link Information

linkID	countyID	zoneID	linkLength	linkAvgSpeed	linkDescription	linkAvgGrade	2012 MOVES Emission Rate (g/mi)	2025 MOVES Emission Rate (g/mi)	2040 MOVES Emission Rate (g/mi)
1	51107	511070	0.15	35	EB In	1.43	4.35	2.7	2.54
2	51107	511070	0.15	35	EB Out	-2.86	2.50	1.46	1.34
3	51107	511070	0.15	35	WB In	-2.86	2.50	1.46	1.34
4	51107	511070	0.15	35	WB Out	1.43	4.34	2.7	2.54
5	51107	511070	0.15	25	NB In	1.86	3.30	1.9	1.75
6	51107	511070	0.15	45	NB Out	1.86	2.45	1.5	1.37
7	51107	511070	0.15	45	SB IN	1.86	2.45	1.5	1.37
8	51107	511070	0.15	25	SB Out	1.86	3.30	1.9	1.76
9	51107	511070	0	0	EB Queue	0	26.39	9.7	8.02
10	51107	511070	0	0	WB Queue	0	26.39	9.7	8.02
11	51107	511070	0	0	NB Queue	0	26.39	9.7	8.02
12	51107	511070	0	0	SB Queue	0	26.39	9.7	8.02

Notes: 1. Emissions are in grams per mile except queues which are in grams per hour.

US 50 at Loudoun County Parkway (Route 606) No Build 2025 and 2040 Condition

linkID	countyID	zoneID	linkLength	linkAvgSpeed	linkDescription	2025 MOVES Emission Rate (g/mi)	2040 MOVES Emission Rate (g/mi)
1	51107	511070	0.05	40	RAMP_A_1	7.77	7.4
2	51107	511070	0.05	40	RAMP_A_2	7.77	7.4
3	51107	511070	0.05	40	RAMP_A_3	7.77	7.4
4	51107	511070	0.05	40	RAMP_A_4	7.77	7.4
5	51107	511070	0.09	40	RAMP_B_1	5.28	5.07
6	51107	511070	0.02	40	RAMP_B_2	5.28	5.07
7	51107	511070	0.02	40	RAMP_B_3	5.28	5.07
8	51107	511070	0.04	40	RAMP_B_4	5.28	5.07
9	51107	511070	0.03	30	RAMP_C_1	6.88	6.6
10	51107	511070	0.03	30	RAMP_C_2	6.88	6.6
11	51107	511070	0.03	30	RAMP_C_3	6.88	6.6
12	51107	511070	0.03	30	RAMP_C_4	6.88	6.6
13	51107	511070	0.03	30	RAMP_C_5	6.88	6.6
14	51107	511070	0.03	30	RAMP_C_6	6.88	6.6
15	51107	511070	0.08	40	RAMP_D_1	5.3	5.02
16	51107	511070	0.08	40	RAMP_D_2	5.3	5.02
17	51107	511070	0.08	40	RAMP_D_3	5.3	5.02
18	51107	511070	0.08	40	RAMP_D_4	5.3	5.02
19	51107	511070	0.08	40	RAMP_D_5	5.3	5.02
20	51107	511070	0.08	40	RAMP_D_6	5.3	5.02
21	51107	511070	0.08	40	RAMP_D_7	5.3	5.02
22	51107	511070	0.08	40	RAMP_D_8	5.3	5.02
23	51107	511070	0.08	40	RAMP_D_9	5.3	5.02
24	51107	511070	0.05	30	RAMP_E_1	6.87	6.6
25	51107	511070	0.05	30	RAMP_E_2	6.87	6.6
26	51107	511070	0.05	30	RAMP_E_3	6.87	6.6
27	51107	511070	0.05	30	RAMP_E_4	6.87	6.6
28	51107	511070	0.05	30	RAMP_E_5	6.87	6.6
29	51107	511070	0.05	30	RAMP_E_6	6.87	6.6
30	51107	511070	0.05	30	RAMP_E_7	6.87	6.6
31	51107	511070	0.05	30	RAMP_E_8	6.87	6.6
32	51107	511070	0.05	30	RAMP_E_9	6.87	6.6
33	51107	511070	0.05	30	RAMP_F_1	6.87	6.6
34	51107	511070	0.05	30	RAMP_F_2	6.87	6.6
35	51107	511070	0.05	30	RAMP_F_3	6.87	6.6
36	51107	511070	0.05	30	RAMP_F_4	6.87	6.6
37	51107	511070	0.05	30	RAMP_F_5	6.87	6.6
38	51107	511070	0.05	30	RAMP_F_6	6.87	6.6
39	51107	511070	0.05	30	RAMP_F_7	6.87	6.6
40	51107	511070	0.05	30	RAMP_F_8	6.87	6.6
41	51107	511070	0.06	40	RAMP_G_1	5.3	5.02
42	51107	511070	0.06	40	RAMP_G_2	5.3	5.02
43	51107	511070	0.06	40	RAMP_G_3	5.3	5.02
44	51107	511070	0.06	40	RAMP_G_4	5.3	5.02
45	51107	511070	0.05	40	RAMP_H_1	6.43	6.11
46	51107	511070	0.05	40	RAMP_H_2	6.43	6.11
47	51107	511070	0.05	40	RAMP_H_3	6.43	6.11
48	51107	511070	0.05	40	RAMP_H_4	6.43	6.11
49	51107	511070	0.05	40	RAMP_H_5	6.43	6.11
50	51107	511070	0.05	40	RAMP_H_6	6.43	6.11
51	51107	511070	0.05	40	RAMP_H_7	6.43	6.11
52	51107	511070	0.05	40	RAMP_H_8	6.43	6.11
53	51107	511070	0.05	40	RAMP_H_9	6.43	6.11
54	51107	511070	0.05	40	RAMP_H_10	6.43	6.11
55	51107	511070	0.06	40	RT_A_1	6.43	6.11
56	51107	511070	0.06	40	RT_A_2	6.43	6.11
57	51107	511070	0.06	40	RT_A_3	6.43	6.11
58	51107	511070	0.06	40	RT_A_4	6.43	6.11
59	51107	511070	0.05	40	RT_B_1	6.43	6.11
60	51107	511070	0.05	40	RT_B_2	6.43	6.11
61	51107	511070	0.05	40	RT_B_3	6.43	6.11
62	51107	511070	0.05	40	RT_B_4	6.43	6.11
63	51107	511070	0.3	55	RT50_EB_1	1.42	1.31
64	51107	511070	0.3	55	RT50_EB_2	1.42	1.31
65	51107	511070	0.3	55	RT50_EB_3	1.77	1.65
66	51107	511070	0.3	55	RT50_EB_4	1.77	1.65
67	51107	511070	0.3	55	RT50_WB_1	1.77	1.65
68	51107	511070	0.3	55	RT50_WB_2	1.77	1.65
69	51107	511070	0.3	55	RT50_WB_3	1.77	1.65
70	51107	511070	0.3	55	RT50_WB_4	1.42	1.31
71	51107	511070	0.3	55	RT50_WB_5	1.42	1.31
72	51107	511070	0.17	45	RT606_NB_1	2.5	2.3
73	51107	511070	0.17	45	RT606_NB_2	2.5	2.3
74	51107	511070	0.17	45	RT606_NB_3	2.5	2.3
75	51107	511070	0.17	45	RT606_NB_4	1.89	1.76
76	51107	511070	0.17	45	RT606_NB_5	1.89	1.76
77	51107	511070	0.17	55	RT606_SB_1	1.82	1.7
78	51107	511070	0.17	55	RT606_SB_2	1.82	1.7
79	51107	511070	0.17	55	RT606_SB_3	1.82	1.7
80	51107	511070	0.17	55	RT606_SB_4	2.44	2.29
81	51107	511070	0.17	55	RT606_SB_5	2.44	2.29
82	51107	511070	0.17	55	RT606_SB_6	2.44	2.29

US 50 and Route 606 Interchange Future Build Conditions Alternative 3A

linkID	countyID	zoneID	linkLength	2025 AM linkVolume	2025 PM linkVolume	2040 AM linkVolume	2040 PM linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade	2025 MOVES Emission Rate (g/mi)	2040 MOVES Emission Rate (g/mi)
1	51107	511070	0.25	2889	1186	3136	1279	55	RT50_EB_1	-1.79	1.41	1.31
2	51107	511070	0.25	1541	566	1597	587	55	RT50_EB_2	-1.79	1.41	1.31
3	51107	511070	0.25	2052	1129	2193	1224	55	RT50_EB_3	-0.38	1.77	1.65
4	51107	511070	0.25	2336	1414	2507	1551	55	RT50_EB_4	-0.38	1.77	1.65
5	51107	511070	0.25	1469	2835	1553	3194	55	RT50_WB_1	-0.38	1.77	1.65
6	51107	511070	0.25	334	1359	364	1530	55	RT50_WB_2	-0.38	1.77	1.65
7	51107	511070	0.25	533	1536	593	1723	55	RT50_WB_3	-1.79	1.41	1.31
8	51107	511070	0.25	1066	3461	1136	3882	55	RT50_WB_4	-1.79	1.41	1.31
9	51107	511070	0.25	1377	798	1512	834	45	RT606_NB_1	1.15	2.46	2.31
10	51107	511070	0.25	1125	546	1238	643	45	RT606_NB_2	1.15	2.46	2.31
11	51107	511070	0.25	1125	546	1238	643	45	RT606_NB_3	1.15	2.46	2.31
12	51107	511070	0.25	926	369	1009	836	45	RT606_NB_4	-0.22	1.89	1.76
13	51107	511070	0.25	2033	1546	2224	1749	45	RT606_NB_5	-0.22	1.89	1.76
14	51107	511070	0.25	2959	1991	3233	2199	45	RT606_NB_6	-0.22	1.89	1.76
15	51107	511070	0.25	1306	3483	1458	3818	55	RT606_SB_1	-0.22	1.82	1.7
16	51107	511070	0.25	733	1558	915	1659	55	RT606_SB_2	-0.22	1.82	1.7
17	51107	511070	0.25	733	1558	915	1659	55	RT606_SB_3	-0.22	1.82	1.7
18	51107	511070	0.25	733	1558	915	1659	55	RT606_SB_4	1.15	2.43	2.29
19	51107	511070	0.25	262	995	319	1022	55	RT606_SB_5	1.15	2.43	2.29
20	51107	511070	0.25	262	995	319	1022	55	RT606_SB_6	1.15	2.43	2.29
21	51107	511070	0.25	616	1494	1563	703	55	RT606_SB_7	1.15	2.43	2.29
22	51107	511070	0.8	1310	504	1545	594	50	FO_EN_1	7	7.94	7.5
23	51107	511070	0.8	1310	504	1545	594	50	FO_EN_2	7	7.94	7.5
24	51107	511070	0.8	1310	504	1545	594	50	FO_EN_3	7	7.94	7.5
25	51107	511070	0.8	1310	504	1545	594	50	FO_EN_4	7	7.94	7.5
26	51107	511070	0.8	1310	504	1545	594	50	FO_EN_5	7	7.94	7.5
27	51107	511070	0.8	1310	504	1545	594	50	FO_EN_6	7	7.94	7.5
28	51107	511070	0.8	1310	504	1545	594	50	FO_EN_7	7	7.94	7.5
29	51107	511070	0.8	1406	555	1665	658	50	FO_EN_8	7	7.94	7.5
30	51107	511070	0.8	738	2125	871	2512	50	FO_NW_1	7	7.94	7.5
31	51107	511070	0.8	706	2016	831	2376	50	FO_NW_2	7	7.94	7.5
32	51107	511070	0.8	706	2016	831	2376	50	FO_NW_3	7	7.94	7.5
33	51107	511070	0.8	706	2016	831	2376	50	FO_NW_4	7	7.94	7.5
34	51107	511070	0.8	706	2016	831	2376	50	FO_NW_5	7	7.94	7.5
35	51107	511070	0.8	706	2016	831	2376	50	FO_NW_6	7	7.94	7.5
36	51107	511070	0.8	706	2016	831	2376	50	FO_NW_7	7	7.94	7.5
37	51107	511070	0.8	706	2016	831	2376	50	FO_NW_8	7	7.94	7.5
38	51107	511070	0.06	1348	620	1539	692	40	RT_A_1	6	6.42	6.11
39	51107	511070	0.06	354	499	384	543	40	RT_B_1	6	6.42	6.11
40	51107	511070	0.06	284	285	314	327	40	RT_C_1	6	6.42	6.11
41	51107	511070	0.2	1135	1476	1189	1664	40	RT_D_1	6	6.42	6.11
42	51107	511070	0.2	1135	1476	1189	1664	40	RT_D_2	6	6.42	6.11
43	51107	511070	0.1	2033	1546	2224	1749	40	RT_E_1	6	6.42	6.11
44	51107	511070	0.3	237	177	257	193	40	RAMP_A_1	6	6.42	6.11
45	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_1	6	6.42	6.11
46	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_2	6	6.42	6.11
47	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_3	6	6.42	6.11
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51	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_7	6	6.42	6.11
52	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_8	6	6.42	6.11
53	51107	511070	0.4	1111	433	1282	499	40	RAMP_B_9	6	6.42	6.11
54	51107	511070	0.15	252	176	274	191	40	RAMP_C_1	6	6.42	6.11
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58	51107	511070	0.15	252	176	274	191	40	RAMP_C_5	6	6.42	6.11
59	51107	511070	0.15	252	176	274	191	40	RAMP_C_6	6	6.42	6.11
60	51107	511070	0.26	96	51	120	64	40	RAMP_D_1	6	6.42	6.11
61	51107	511070	0.15	922	1103	942	1250	40	RAMP_E_1	6	6.42	6.11
62	51107	511070	0.38	117	322	127	350	40	RAMP_F_1	6	6.42	6.11
63	51107	511070	0.38	117	322	127	350	40	RAMP_F_2	6	6.42	6.11
64	51107	511070	0.38	117	322	127	350	40	RAMP_F_3	6	6.42	6.11
65	51107	511070	0.38	117	322	127	350	40	RAMP_F_4	6	6.42	6.11
66	51107	511070	0.38	117	322	127	350	40	RAMP_F_5	6	6.42	6.11
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71	51107	511070	0.23	199	177	229	193	30	RAMP_G_1	7	6.81	6.6
72	51107	511070	0.23	199	177	229	193	30	RAMP_G_2	7	6.81	6.6
73	51107	511070	0.23	199	177	229	193	30	RAMP_G_3	7	6.81	6.6
74	51107	511070	0.23	199	177	229	193	30	RAMP_G_4	7	6.81	6.6
75	51107	511070	0.23	199	177	229	193	30	RAMP_G_5	7	6.81	6.6
76	51107	511070	0.23	199	177	229	193	30	RAMP_G_6	7	6.81	6.6
77	51107	511070	0.23	199	177	229	193	30	RAMP_G_7	7	6.81	6.6
78	51107	511070	0.23	199	177	229	193	30	RAMP_G_8	7	6.81	6.6
79	51107	511070	0.91	32	109	40	136	40	RAMP_H_1	6	6.42	6.11
80	51107	511070	0.91	32	109	40	136	40	RAMP_H_2	6	6.42	6.11
81	51107	511070	0.91	32	109	40	136	40	RAMP_H_3	6	6.42	6.11
82	51107	511070	0.91	32	109	40	136	40	RAMP_H_4	6	6.42	6.11
83	51107	511070	0.91	32	109	40	136	40	RAMP_H_5	6	6.42	6.11
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86	51107	511070	0.91	32	109	40	136	40	RAMP_H_8	6	6.42	6.11
87	51107	511070	0.91	32	109	40	136	40	RAMP_H_9	6	6.42	6.11
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92	51107	511070	0.34	533	1925	543	2159	40	RAMP_J_1	6	6.42	6.11
93	51107	511070	0.34	533	1925	543	2159	40	RAMP_J_2	6	6.42	6.11
94	51107	511070	0.34	533	1925	543	2159	40	RAMP_J_3	6	6.42	6.11
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96	51107	511070	0.34	533	1925	543	2159	40	RAMP_J_5	6	6.42	6.11
97	51107	511070	0.23	511	563	596	637	30	RAMP_K_1	7	6.87	6.6
98	51107	511070	0.23	511	563	596	637	30	RAMP_K_2	7	6.87	6.6
99	51107	511070	0.23	511	563	596	637	30	RAMP_K_3	7	6.87	6.6
100	51107	511070	0.23	511	563	596	637	30	RAMP_K_4	7	6.87	6.6
101	51107	511070	0.23	511	563	596	637	30	RAMP_K_5	7	6.87	6.6
102	51107	511070	0.23	511	563	596	637	30	RAMP_K_6	7	6.87	6.6
103	51107	511070	0.23	511	563	596	637	30	RAMP_K_7	7	6.87	6.6
104	51107	511070	0.23	511	563	596	637	30	RAMP_K_8	7	6.87	6.6

Notes: 1. Emissions are in grams per mile except queues which are in grams per hour.

MOVES Input File


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useParameters No

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MOVES OUTPUT Gum Spring Road Route 50 2040 AM Build

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4	2040	1	5	9	2	CO	2.786124	NULL	
4	2040	1	5	9	3	CO	2.786124	NULL	
4	2040	1	5	9	4	CO	3.003844	NULL	
4	2040	1	5	9	5	CO	1.64258	NULL	
4	2040	1	5	9	6	CO	1.401168	NULL	
4	2040	1	5	9	7	CO	1.401169	NULL	
4	2040	1	5	9	8	CO	1.642585	NULL	
4	2040	1	5	9	9	CO	7.488996	NULL	
4	2040	1	5	9	10	CO	7.489011	NULL	
4	2040	1	5	9	11	CO	NULL	8.018116	
4	2040	1	5	9	12	CO	NULL	8.018152	
4	2040	1	5	9	13	CO	NULL	8.018133	
4	2040	1	5	9	14	CO	NULL	8.018133	

Appendix C. Sample CAL3QHC Input and Output Files (Complete Set of Files Available Upon Request)

CAL3QHC Input File

'Dulles Connector Roadway',60,175,0.0,0.0,36,0.3048,1,0
'Rec 1',5397.1,6116.9,5.9
'Rec 2',5424.1,6103.9,5.9
'Rec 3',5451.2,6090.8,5.9
'Rec 4',5478.2,6077.8,5.9
'Rec 5',5505.1,6064.6,5.9
'Rec 6',5526.7,6043.7,5.9
'Rec 7',5536.7,6015.5,5.9
'Rec 8',5537.8,5985.5,5.9
'Rec 9',5538.7,5955.5,5.9
'Rec 10',5584.9,5873.7,5.9
'Rec 11',5584.0,5903.7,5.9
'Rec 12',5583,5933.7,5.9
'Rec 13',5582.1,5963.7,5.9
'Rec 14',5581.2,5993.7,5.9
'Rec 15',5592.6,6021.4,5.9
'Rec 16',5622.6,6020.3,5.9
'Rec 17',5649.5,6007,5.9
'Rec 18',5676.4,5993.7,5.9
'Rec 19',5750,6117.6,5.9
'Rec 20',5723.1,6130.9,5.9
'Rec 21',5696.2,6144.1,5.9
'Rec 22',5669.3,6157.4,5.9
'Rec 23',5642.7,6171.2,5.9
'Rec 24',5623.6,6194.4,5.9
'Rec 25',5619.6,6224.1,5.9
'Rec 26',5627.6,6253.1,5.9
'Rec 27',5631.1,6281.8,5.9
'Rec 28',5612,6353.4,5.9
'Rec 29',5603.4,6324.7,5.9
'Rec 30',5594.8,6295.9,5.9
'Rec 31',5586.2,6267.2,5.9
'Rec 32',5576.9,6238.7,5.9
'Rec 33',5555,6218.1,5.9
'Rec 34',5525.1,6215.8,5.9
'Rec 35',5497.7,6228.1,5.9
'Rec 36',5470.7,6241.2,5.9
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180,156,2,598,8.02,1600,2,3
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'NB_Out','AG',5600.8,6218.9,5643.8,6362.8,955,1.4,0,44
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'WB_LT','AG',5613.1,6129.6,5747.6,6063.2,220,3.0,0,31
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1.0,0,4,1000,0.0,'Y',5,1,72

CAL3QHC Output File

```
                CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 95221                    PAGE  1


      JOB: Dulles Connector Roadway                          RUN: GumSpring&US50 2040 Alt3A AM


      DATE :  5/24/13

      TIME : 10:17:30


         The MODE flag has been set for calculating concentrations for POLLUTANT:  CO


       SITE & METEOROLOGICAL VARIABLES

       ------------------------------

       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM

        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0 PPM


       LINK VARIABLES

       --------------

         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH    EF      H   W    V/C QUEUE

                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)           (G/MI)  (FT) (FT)       (VEH)

      ------------------------*-----------------------------------------*-------------------------------------------------------
-
```

PAGE 2

JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

DATE : 5/24/13

TIME : 10:17:30

LINK VARIABLES

LINK DESCRIPTION	*	LINK COORDINATES (FT)				*	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
	*	X1	Y1	X2	Y2	*									
1. NB_in	*	5563.0	6074.2	5572.2	5770.1	*	304.	178.	AG	598.	1.6	0.0	44.0		
2. NB_Que	*	5565.8	6017.8	5605.3	4488.9	*	1529.	179.	AG	37.	100.0	0.0	24.0	1.69	77.7
3. NB_Out	*	5600.8	6218.9	5643.8	6362.8	*	150.	17.	AG	955.	1.4	0.0	44.0		
4. WB_In	*	5580.9	6163.3	5844.4	6033.4	*	294.	116.	AG	1087.	2.8	0.0	44.0		
5. WB_Que	*	5620.1	6143.9	10169.0	3902.9	*	5071.	116.	AG	39.	100.0	0.0	24.0	5.60	257.6
6. WB_LT	*	5613.1	6129.6	5747.6	6063.2	*	150.	116.	AG	220.	3.0	0.0	31.0		
7. WB_RT	*	5628.1	6160.1	5762.6	6093.7	*	150.	116.	AG	295.	3.0	0.0	32.0		
8. WB_Out	*	5528.6	6189.0	5303.4	6297.6	*	250.	296.	AG	987.	3.0	0.0	44.0		
9. SB_In	*	5572.5	6465.8	5660.9	6461.9	*	88.	93.	AG	652.	1.4	0.0	44.0		
10. SB_Que	*	5589.3	6222.4	6462.5	9143.3	*	3049.	17.	AG	40.	100.0	0.0	44.0	5.26	154.9
11. EB_IN	*	5542.0	6084.3	5264.6	6218.3	*	308.	296.	AG	2073.	3.0	0.0	44.0		
12. EQ_Que	*	5489.8	6109.8	-3516.0	10448.7	*	9997.	296.	AG	38.	100.0	0.0	24.0	7.30	507.8
13. EB_LT	*	5496.7	6124.2	5271.5	6232.8	*	250.	296.	AG	215.	3.0	0.0	31.0		
14. EB_RT	*	5497.0	6086.3	5361.9	6151.5	*	150.	296.	AG	100.	3.0	0.0	32.0		
15. EB_Out	*	5584.8	6063.2	5809.1	5952.7	*	250.	116.	AG	1893.	2.8	0.0	44.0		
16. SB_Out	*	5552.6	6019.6	5557.1	5869.7	*	150.	178.	AG	575.	1.6	0.0	44.0		
17. EB_EL50	*	6046.4	5863.9	5060.8	6351.8	*	1100.	296.	AG	1545.	7.5	0.0	44.0		
18. WB_EL50	*	5071.2	6373.4	6057.2	5885.3	*	1100.	116.	AG	831.	7.5	0.0	44.0		

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JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

DATE : 5/24/13

TIME : 10:17:30

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	* CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. NB_Que	180	156	2.0	598	1600	8.02	2	3
5. WB_Que	180	165	2.0	1087	1600	8.02	2	3
10. SB_Que	180	169	2.0	652	1600	8.02	2	3
12. EQ_Que	180	160	2.0	2073	1600	8.02	2	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. Rec 1	5397.1	6116.9	5.9
2. Rec 2	5424.1	6103.9	5.9
3. Rec 3	5451.2	6090.8	5.9
4. Rec 4	5478.2	6077.8	5.9
5. Rec 5	5505.1	6064.6	5.9
6. Rec 6	5526.7	6043.7	5.9
7. Rec 7	5536.7	6015.5	5.9
8. Rec 8	5537.8	5985.5	5.9
9. Rec 9	5538.7	5955.5	5.9

10. Rec 10	*	5584.9	5873.7	5.9	*
11. Rec 11	*	5584.0	5903.7	5.9	*
12. Rec 12	*	5583.0	5933.7	5.9	*
13. Rec 13	*	5582.1	5963.7	5.9	*
14. Rec 14	*	5581.2	5993.7	5.9	*
15. Rec 15	*	5592.6	6021.4	5.9	*
16. Rec 16	*	5622.6	6020.3	5.9	*
17. Rec 17	*	5649.5	6007.0	5.9	*
18. Rec 18	*	5676.4	5993.7	5.9	*
19. Rec 19	*	5750.0	6117.6	5.9	*
20. Rec 20	*	5723.1	6130.9	5.9	*
21. Rec 21	*	5696.2	6144.1	5.9	*
22. Rec 22	*	5669.3	6157.4	5.9	*
23. Rec 23	*	5642.7	6171.2	5.9	*
24. Rec 24	*	5623.6	6194.4	5.9	*
25. Rec 25	*	5619.6	6224.1	5.9	*
26. Rec 26	*	5627.6	6253.1	5.9	*
27. Rec 27	*	5631.1	6281.8	5.9	*
28. Rec 28	*	5612.0	6353.4	5.9	*
29. Rec 29	*	5603.4	6324.7	5.9	*
30. Rec 30	*	5594.8	6295.9	5.9	*
31. Rec 31	*	5586.2	6267.2	5.9	*
32. Rec 32	*	5576.9	6238.7	5.9	*
33. Rec 33	*	5555.0	6218.1	5.9	*
34. Rec 34	*	5525.1	6215.8	5.9	*
35. Rec 35	*	5497.7	6228.1	5.9	*
36. Rec 36	*	5470.7	6241.2	5.9	*

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JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
5.	0.6	0.6	0.6	0.6	0.5	0.4	0.5	0.3	0.2	0.3	0.4	0.4	0.3	0.5	0.5	0.7	0.7	0.7	0.0	0.1
10.	0.6	0.6	0.6	0.6	0.6	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.7	0.7	0.7	0.0	0.0
15.	0.6	0.6	0.6	0.7	0.6	0.5	0.4	0.3	0.3	0.1	0.3	0.4	0.4	0.5	0.5	0.7	0.6	0.6	0.0	0.0
20.	0.6	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.4	0.2	0.3	0.3	0.3	0.5	0.5	0.6	0.6	0.6	0.0	0.0
25.	0.7	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
30.	0.7	0.7	0.7	0.6	0.6	0.4	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
35.	0.7	0.7	0.7	0.6	0.5	0.3	0.3	0.2	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
40.	0.7	0.7	0.7	0.5	0.5	0.3	0.3	0.4	0.4	0.2	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
45.	0.6	0.6	0.6	0.5	0.4	0.3	0.4	0.4	0.4	0.1	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
50.	0.6	0.6	0.6	0.5	0.4	0.3	0.4	0.4	0.4	0.2	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.0	0.0
55.	0.6	0.6	0.6	0.5	0.4	0.3	0.4	0.4	0.4	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.6	0.0	0.0
60.	0.6	0.6	0.6	0.5	0.4	0.3	0.4	0.5	0.4	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.0	0.0
65.	0.6	0.6	0.5	0.5	0.4	0.3	0.4	0.5	0.4	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.0	0.0
70.	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.5	0.4	0.2	0.2	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.0	0.0

75.	*	0.7	0.7	0.6	0.6	0.5	0.4	0.4	0.5	0.4	0.2	0.2	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.0	0.0
80.	*	0.7	0.7	0.6	0.5	0.5	0.4	0.4	0.5	0.4	0.1	0.2	0.3	0.4	0.4	0.6	0.7	0.7	0.7	0.0	0.0
85.	*	0.7	0.7	0.6	0.5	0.5	0.4	0.4	0.5	0.4	0.1	0.1	0.2	0.4	0.4	0.6	0.7	0.7	0.7	0.0	0.0
90.	*	0.7	0.6	0.6	0.7	0.6	0.5	0.5	0.5	0.3	0.1	0.1	0.2	0.4	0.4	0.7	0.7	0.7	0.7	0.0	0.0
95.	*	0.7	0.6	0.6	0.7	0.6	0.6	0.5	0.5	0.2	0.1	0.1	0.1	0.2	0.4	0.7	0.8	0.7	0.7	0.0	0.0
100.	*	0.7	0.8	0.7	0.7	0.6	0.5	0.6	0.3	0.2	0.0	0.1	0.1	0.1	0.5	0.7	0.8	0.7	0.7	0.0	0.0
105.	*	0.6	0.7	0.7	0.7	0.5	0.5	0.5	0.2	0.2	0.0	0.0	0.1	0.1	0.4	0.6	0.8	0.7	0.7	0.0	0.0
110.	*	0.6	0.6	0.6	0.5	0.5	0.5	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.5	0.6	0.6	0.6	0.1	0.1
115.	*	0.4	0.5	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.5	0.4	0.4	0.1	0.1
120.	*	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.2	0.3	0.3
125.	*	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.4	0.4
130.	*	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.4
135.	*	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.5
140.	*	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
145.	*	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
150.	*	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
155.	*	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
160.	*	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
165.	*	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.5	0.6
170.	*	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.6	0.6
175.	*	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.6	0.6
180.	*	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.1	0.1	0.0	0.0	0.6	0.6
185.	*	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.0	0.6	0.6
190.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.6	0.6
195.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.6	0.6
200.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.6	0.6
205.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.6	0.6
210.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.6	0.6

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JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

WIND ANGLE (DEGR)	* CONCENTRATION (PPM)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
215. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.6	0.6
220. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.6	0.6
225. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.6	0.6
230. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.6	0.6
235. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.6	0.5
240. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.6	0.5
245. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.5	0.5
250. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.5	0.5
255. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5	0.5
260. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5	0.6
265. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.5	0.6
270. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.6	0.6
275. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.6	0.6
280. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.6	0.7
285. *	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.2	0.6	0.5
290. *	0.3	0.3	0.3	0.3	0.3	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.4	0.4	0.4
295. *	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.0	0.1	0.1	0.1	0.2	0.3	0.3	0.6	0.6	0.6	0.2	0.2
300. *	0.3	0.3	0.4	0.5	0.6	0.3	0.3	0.2	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.8	0.1	0.0
305. *	0.5	0.6	0.6	0.6	0.6	0.5	0.4	0.2	0.2	0.1	0.3	0.3	0.4	0.5	0.5	0.7	0.8	0.8	0.0	0.0
310. *	0.6	0.6	0.6	0.7	0.7	0.6	0.5	0.4	0.2	0.2	0.3	0.3	0.5	0.6	0.6	0.7	0.7	0.7	0.0	0.0
315. *	0.7	0.7	0.7	0.7	0.7	0.6	0.5	0.5	0.4	0.3	0.3	0.5	0.6	0.6	0.5	0.8	0.8	0.7	0.0	0.0
320. *	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.5	0.4	0.3	0.5	0.5	0.5	0.5	0.5	0.7	0.6	0.6	0.0	0.0

325.	*	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.4	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.0	0.0
330.	*	0.7	0.7	0.7	0.7	0.7	0.5	0.4	0.4	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.0	0.0
335.	*	0.7	0.7	0.7	0.7	0.7	0.5	0.4	0.4	0.3	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.0	0.0
340.	*	0.7	0.7	0.7	0.7	0.7	0.5	0.4	0.4	0.3	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.6	0.6	0.0	0.0
345.	*	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.5	0.5	0.5	0.4	0.4	0.4	0.6	0.6	0.6	0.0	0.1
350.	*	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.5	0.5	0.3	0.4	0.4	0.4	0.6	0.6	0.6	0.0	0.1
355.	*	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.4	0.4	0.3	0.4	0.3	0.4	0.6	0.7	0.7	0.0	0.1
360.	*	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.7	0.7	0.7	0.1	0.1
------	*																				
MAX	*	0.7	0.8	0.7	0.7	0.7	0.7	0.6	0.5	0.4	0.6	0.5	0.6	0.6	0.6	0.7	0.8	0.8	0.8	0.6	0.7
DEGR.	*	25	100	20	15	310	320	100	60	20	335	320	340	315	310	90	95	300	300	170	280

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JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM)															
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
5.	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0
10.	0.1	0.1	0.1	0.1	0.3	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0
15.	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.1	0.1	0.0
20.	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1
25.	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1
30.	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1
35.	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1
40.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
45.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
50.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
55.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
60.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
65.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
70.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1

75.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
80.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
85.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
90.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
95.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
100.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
105.	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
110.	*	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
115.	*	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.4
120.	*	0.4	0.4	0.4	0.3	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.4
125.	*	0.4	0.4	0.4	0.4	0.3	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.5
130.	*	0.4	0.4	0.4	0.4	0.3	0.2	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.6
135.	*	0.5	0.5	0.5	0.5	0.3	0.3	0.2	0.1	0.2	0.4	0.4	0.5	0.5	0.6	0.5	0.5
140.	*	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.3	0.4	0.4	0.6	0.5	0.5	0.6	0.5
145.	*	0.5	0.5	0.5	0.5	0.4	0.3	0.2	0.2	0.3	0.3	0.4	0.6	0.5	0.5	0.5	0.5
150.	*	0.5	0.5	0.6	0.6	0.5	0.3	0.2	0.3	0.3	0.3	0.3	0.5	0.5	0.4	0.4	0.4
155.	*	0.5	0.6	0.6	0.6	0.5	0.3	0.2	0.4	0.4	0.4	0.3	0.6	0.4	0.3	0.4	0.4
160.	*	0.6	0.6	0.6	0.6	0.5	0.2	0.2	0.4	0.4	0.4	0.3	0.6	0.3	0.3	0.4	0.5
165.	*	0.6	0.6	0.6	0.6	0.5	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.5	0.5
170.	*	0.6	0.6	0.6	0.6	0.4	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.3	0.5	0.6	0.5
175.	*	0.6	0.6	0.6	0.6	0.3	0.2	0.2	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.6	0.5
180.	*	0.6	0.6	0.6	0.6	0.3	0.2	0.2	0.4	0.4	0.4	0.4	0.3	0.4	0.6	0.5	0.5
185.	*	0.6	0.6	0.7	0.5	0.4	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.4	0.5	0.5	0.5
190.	*	0.6	0.7	0.7	0.5	0.3	0.2	0.3	0.3	0.4	0.4	0.3	0.2	0.3	0.5	0.5	0.5
195.	*	0.6	0.7	0.7	0.4	0.2	0.2	0.4	0.3	0.4	0.3	0.3	0.2	0.4	0.5	0.5	0.5
200.	*	0.6	0.6	0.5	0.4	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.2	0.4	0.5	0.5	0.5
205.	*	0.6	0.6	0.5	0.4	0.2	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5
210.	*	0.6	0.6	0.5	0.4	0.2	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.4	0.5	0.5	0.5

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JOB: Dulles Connector Roadway RUN: GumSpring&US50 2040 Alt3A AM

WIND ANGLE RANGE: 5.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
215.	0.6	0.5	0.5	0.4	0.2	0.3	0.4	0.2	0.3	0.3	0.4	0.3	0.4	0.5	0.5	0.5
220.	0.6	0.5	0.4	0.4	0.2	0.3	0.4	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5
225.	0.5	0.5	0.4	0.2	0.3	0.3	0.4	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5
230.	0.5	0.5	0.4	0.4	0.3	0.4	0.5	0.2	0.2	0.3	0.3	0.3	0.5	0.5	0.5	0.5
235.	0.5	0.5	0.5	0.4	0.3	0.4	0.5	0.2	0.2	0.3	0.3	0.3	0.5	0.5	0.5	0.5
240.	0.5	0.5	0.5	0.4	0.3	0.4	0.4	0.2	0.2	0.2	0.3	0.3	0.5	0.5	0.5	0.5
245.	0.5	0.5	0.5	0.4	0.3	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.5	0.5	0.5	0.5
250.	0.5	0.6	0.5	0.4	0.3	0.4	0.3	0.2	0.2	0.2	0.3	0.5	0.5	0.5	0.5	0.5
255.	0.6	0.6	0.5	0.4	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5
260.	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.5
265.	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.1	0.2	0.2	0.2	0.4	0.5	0.6	0.6	0.5
270.	0.6	0.5	0.5	0.4	0.3	0.3	0.3	0.1	0.1	0.2	0.2	0.3	0.4	0.6	0.6	0.6
275.	0.5	0.6	0.5	0.5	0.3	0.3	0.3	0.0	0.1	0.2	0.2	0.3	0.5	0.5	0.5	0.5
280.	0.6	0.5	0.4	0.5	0.3	0.3	0.2	0.0	0.0	0.1	0.2	0.2	0.5	0.5	0.5	0.5
285.	0.5	0.4	0.3	0.4	0.4	0.2	0.1	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.4	0.4
290.	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.4	0.4
295.	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.4
300.	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
305.	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
310.	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
315.	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
320.	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

325.	*	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
330.	*	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
335.	*	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
340.	*	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
345.	*	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
350.	*	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
355.	*	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
360.	*	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
------	*	----------															
MAX	*	0.6	0.7	0.7	0.6	0.5	0.4	0.5	0.4	0.4	0.4	0.4	0.6	0.5	0.6	0.6	0.6
DEGR.	*	160	190	185	150	150	230	230	155	155	135	130	140	130	135	125	130

THE HIGHEST CONCENTRATION OF 0.80 PPM OCCURRED AT RECEPTOR .