10.0 Air Quality

10.1 Introduction

An air quality assessment was conducted to identify the potential for impacts associated with the proposed Columbia Pike Transit Initiative project. The air quality assessment was prepared in accordance with the guidelines established by the Environmental Protection Agency (EPA) as required by the National Environmental Policy Act (NEPA). The results of the air quality assessment are described in the following sections.

10.1.1 Study Area

The study area for the air quality assessment included the study corridor between South 12th Street in Arlington County and Leesburg Pike in Fairfax County, and all street intersections. These intersection sites were further refined to two locations based on a screening assessment to select only those sites with the worst level of service. For the purposes of this analysis, construction activities assumed to have invasive or subsurface work would include the installation/upgrading of station stops and the installation of new transit guideway. All other project work is assumed to be completed at grade. As described in Section 5.0, short-term construction impacts on ambient air quality can result, although mitigation measures are available to eliminate their onset.

10.2 Current Use of Adjoining Properties

The majority of the project corridor lies along Columbia Pike, which includes a mix of commercial and residential land uses. Most of the corridor has been disturbed over the years to make way for the various developments that exist along Columbia Pike. Very little natural environment exists, with the exception of designated recreation areas, landscaped areas, and along Four Mile Run.

The Pentagon City and Crystal City areas in the northern part of the corridor are a mix of high-density residential and office uses. Development projects in the area include new residential buildings in Pentagon City and Crystal City as well as a possible conference center and office building in Pentagon City just south of the Pentagon reservation. Northeast of the proposed alignment is the North Tract site, a former industrial-commercial area which includes the former Davis Scrap Yard and is being redeveloped by Arlington County for recreational use and open space.

10.3 Pollutants and Regulatory Setting

10.3.1 Relevant Pollutants

"Air Pollution" is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Individual air pollutants degrade the atmosphere by reducing visibility, damaging property, reducing the productivity or vigor of crops or natural vegetation, or reducing human or animal health. Regulations for air pollutant emissions exist to protect human health and welfare, and the environment.

The federal agency that develops and enforces the regulations that help govern air quality is the Environmental Protection Agency (EPA). The federal *Clean Air Act*, as amended, establishes *National Ambient Air Quality Standards* (NAAQS) to protect the public health. Eight air pollutants have been identified by the EPA as being of concern nationwide: carbon monoxide, sulfur oxides, hydrocarbons, nitrogen oxides, ozone, particulate matter sized 10 micrometers or less, particulate matter with a size of 2.5 micrometers or less and lead. The sources of these pollutants, their effects on human health, and their concentrations in the atmosphere vary considerably. Below is a brief description of each pollutant.

Ozone (O_3) is a strong oxidizer and a pulmonary irritant that affects the respiratory mucous membranes, other lung tissues, and respiratory functions. Exposure to ozone can impair the ability to perform physical exercise, can result in symptoms such as tightness in the chest, coughing, and wheezing, and can ultimately result in asthma, bronchitis, and emphysema. Motor vehicles do not emit ozone directly. Emissions of volatile organic compounds (VOC) and nitrogen oxides (NO_x), which are the precursor pollutants to ozone formation, react in the presence of sunlight to form ozone in the atmosphere. These reactions occur over periods of hours to days during atmospheric mixing and transport downwind. Accordingly, ozone and its precursors VOC and NO_x are regulated at the regional level as part of the Metropolitan Washington Council of Government's (MWCOG) transportation plan.

Carbon Monoxide (CO) is a colorless and odorless gas, which is a product of incomplete combustion. CO is absorbed by the lungs and reacts with hemoglobin to reduce the oxygen carrying capacity of the blood. At low concentrations, CO has been shown to aggravate the symptoms of cardiovascular disease. It can cause headaches and nausea, and at sustained high concentration levels, can lead to coma and death. CO concentrations are not related to ozone levels. CO concentrations tend to be highest in localized areas because they are most affected by local traffic congestion, since motor vehicles are a major source of CO emissions.

Particulate matter (PM_{10} and $PM_{2.5}$) is made up of small solid particles and liquid droplets. PM_{10} refers to particulate matter with an aerodynamic diameter of 10 microns and smaller, and $PM_{2.5}$ refers to particulate matter with an aerodynamic diameter of 2.5 microns and smaller. Particulates enter the body by way of the respiratory system. Particulates over 10 microns in size are captured in the nose and throat and are readily expelled from the body. Particles smaller than 10 microns, and especially particles smaller than 2.5 microns, can reach the air ducts (bronchi) and the air sacs (alveoli). Particulates, especially $PM_{2.5}$, have been associated with increased incidence of respiratory diseases such as asthma, bronchitis, and emphysema; cardiopulmonary disease; and cancer. The majority of PM emissions from mobile sources are attributed to diesel vehicles.

Sulfur dioxide (SO_2) is a gas that is formed during the combustion of fuels containing sulfur compounds. It can cause irritation and inflammation of tissues with which it comes into contact. Inhalation can cause irritation of the mucous membranes causing bronchial damage, and it can exacerbate pre-existing respiratory diseases such as asthma, bronchitis, and emphysema. Exposure to SO_2 can cause damage to vegetation, corrosion to metallic materials, and soiling of clothing and buildings. Due to the implementation of EPA's Ultra-Low Sulfur Diesel Fuel Requirements taking effect since 2006, SO_2 is not expected to be a concern as a result of the project.

Lead (Pb) is no longer considered to be a pollutant of concern for transportation projects. The major source of lead emissions to the atmosphere had been from motor vehicles burning gasoline with lead-containing additives. However, lead emissions have been nearly eliminated with the conversion to unleaded gasoline nationwide.

Mobile Source Air Toxics (MSAT) are a subset of the 188 air toxics defined by the Clean Air Act. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., locomotives, airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries). The EPA currently includes 21 air toxics in its full list of MSATs, and identifies six of those as primary MSATs. The six primary MSATs are benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust gases, acrolein, and 1, 3-butadiene. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil, diesel fuel, or gasoline. There currently are no established ambient air quality standards for MSATs.

10.3.2 Pollutants of Concern

For the current study, air quality analysis focuses on three pollutants: particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), and ozone (O_3).

Although recent ambient measurements in the project area do not exceed the NAAQS for Particulate matter (PM_{10} and $PM_{2.5}$), the metropolitan Washington area overall is in non-attainment for $PM_{2.5}$ due to violations elsewhere in the region. Particulate matter ($PM_{2.5}$) is made up of small solid particles and liquid droplets with an aerodynamic diameter of 2.5 microns and smaller. The majority of PM emissions from mobile sources are attributed to diesel vehicles.

In the study area, ambient concentrations of CO and O_3 are predominantly influenced by roadway motor vehicle activity. Emissions of VOCs, NO_x, PM_{10}, and $PM_{2.5}$ come from both mobile and stationary sources.

Although the metropolitan Washington area is in attainment for CO, it is the primary pollutant used to indicate the potential for adverse air quality impacts from motor vehicles in general, and at roadway intersections in particular. This is because roadway motor vehicles produce most of the ambient CO, and emission rates of CO from vehicles are relatively high in comparison to emissions of other pollutants.

Because O_3 is a regional pollutant that is formed in the presence of VOC and NO_X, O_3 is evaluated indirectly through its precursors. As a result, the regional effects of the project were evaluated as part of the SIP conformity process, which were determined by the MWCOG to conform to the NAAQS.

10.3.3 Regulatory Setting

The Federal Railroad Administration (FRA) *Procedures for Considering Environmental Impacts* (FRA Docket No EP-1, Notice 5, May 26, 1999), states under the topic of Air Quality, "There should be an assessment of the consistency of the alternatives with Federal and State plans for the attainment and maintenance of air quality standards."

The *Clean Air Act*, as amended, is the basis for most federal air pollution control programs. The EPA under the *Clean Air Act* regulates air quality nationally. The EPA delegates authority to the Virginia Department of Environmental Quality (DEQ) for monitoring and enforcing air quality regulations in the Commonwealth of Virginia. The *Virginia State Implementation Plan* (SIP), developed in accordance with the *Clean Air Act*, contains the major state-level requirements with respect to transportation in general. The DEQ is responsible for preparing the SIP and submitting it to the EPA for approval.

10.3.4 Evaluation Criteria

Under the authority of the *Clean Air Act*, the EPA established a set of *National Ambient Air Quality Standards* (NAAQS) for various "criteria" air pollutants. **Table 10-1**[1] lists the NAAQS and the *Virginia Ambient Air Quality Standards*, which are identical. Presently, there are NAAQS for seven criteria pollutants: O_3, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and Pb. Any project constructed in the Commonwealth of Virginia has to achieve compliance with these standards.

The *Clean Air Act* also requires the EPA to specify geographic areas of the country that have measured pollutant concentrations exceeding the levels prescribed by the air quality standards (non-attainment areas). It classifies non-attainment areas and specifies compliance deadlines for these areas. The Columbia Pike Transit Initiative Project is located in both Arlington and Fairfax Counties, which are part of the EPA-defined Metropolitan Washington Air Quality Designation Area. The greater metropolitan Washington area is currently designated as moderate non-attainment for 8-hour ozone and non-attainment for annual average $PM_{2.5}$. However, the metropolitan Washington area is in attainment for all other pollutants including CO, PM_{10}, NO_2, SO_2, and Pb. Therefore, the SIP requirements do not apply to CO with respect to this project.

[1] 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.

Under the *Clean Air Act*, it is the responsibility of federal agencies, such as the FTA, to ensure that a proposed project conforms to the SIP. Transportation conformity is a process required of the Metropolitan Washington Council of Governments (MWCOG) as the region's metropolitan planning organization pursuant to the *Clean Air Act Amendments* (CAAA), to ensure that those transportation activities that are consistent with air quality goals receive federal funding and approval. The EPA promulgated the *Transportation Conformity Rules* under the CAAA, effective December 27, 1993. The transportation conformity regulation, "Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Funded, Developed or Approved under Title 23 U.S.C. or the Federal Transit Act" (40 CFR Parts 51 and 93), is used for conformity determinations.

10.3.5 Rationale and Methodology for Modeling

$PM_{2.5}$: According to Section 2.2 of EPA's 2010 guidance, hot-spot analysis for particulate matter (PM) is required only for projects of air quality concern. Projects of air quality concern are defined in 40 CFR 93.123(b) (1):

> (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;
>
> (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, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project;
>
> (iii) New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location;
>
> (iv) Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and
>
> (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 submission, as appropriate, as sites of violation or possible violation."

The Columbia Pike Transit Initiative alternatives do not meet any of the definitions listed in 40 CFR 93.123(b)(1). Therefore, "the requirements of the CAA and 40 CFR 93.116 are met without a hot-spot analysis, since such projects have been found not to be of local air quality concern under 40 CFR 93.123(b)(1)." (EPA 2010 Guidance p.7)

CO: In accordance with EPA guidance, the analysis methodology consisted of an intersection assessment and a dispersion modeling analysis for computing CO concentrations at candidate intersections along the corridor. At congested intersections, CO is the main pollutant of concern for the air quality analysis since, should adverse impacts occur, the CO standard would most likely be exceeded first. The intersection screening methods were based on EPA criteria in the *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*[2]. The study area for air quality is the intersections modeled.

Intersection Screening

Motor vehicles emit CO at the highest rates when they are operating at low speeds or idling. For this reason, the potential for adverse air quality impacts is greatest at intersections where traffic is most congested. An initial screening of 43 traffic intersections in the traffic study area was performed that identified intersections where traffic volumes would be likely to increase due to the project. For all intersections included in the traffic study, the LOS was ranked from worst (F) to best (A) to correspond with increasing vehicle delay and congestion. Based on the results of this initial intersection screening, the following intersections were selected for analysis:

1. Seminary Road and George Mason Drive during the pm peak hour – Represents the worst performing intersection within the Fairfax County portion of the study corridor; and
2. Army Navy Drive and Eads Street during the pm peak hour – Represents the worst performing intersection within the Arlington County portion of the study corridor.

Figure 10-1 shows the locations of the intersections included in the hot spot modeling analysis.

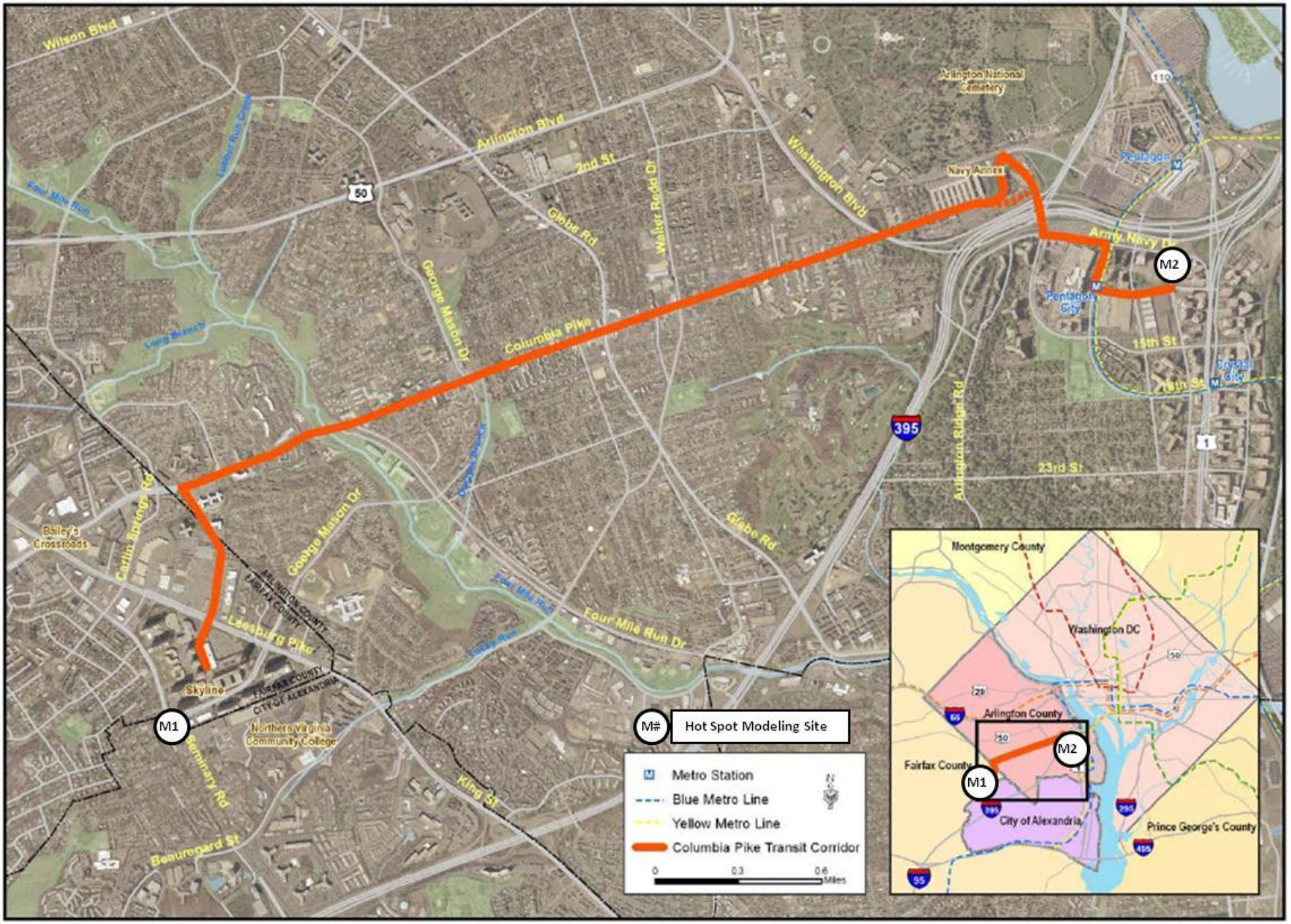
[2] *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*, US Environmental protection Agency, Office of Air Quality Planning and Standards, Research Triangle, NC, November 1992.

Table 10-1: National and Virginia Ambient Air Quality Standards

Pollutant	Standard Type	Averaging Period	Standard Value[a]
Carbon Monoxide (CO)	Primary[b] Primary	8-Hour average 1-Hour average	9 ppm (10 mg/m^3)[c] 35 ppm (40 mg/m^3)
Nitrogen Dioxide (NO_2)	Primary and Secondary Primary	Annual arithmetic mean 1-Hour average	53 ppb[d] 100 ppb
Ozone (O_3)	Primary and Secondary	8-Hour average	0.075 ppm (155 µg/m^3)[e]
Sulfur Dioxide (SO_2)	Primary Primary Secondary Primary	Annual arithmetic mean 24-Hour average[g] 3-Hour average 1-Hour average[h]	0.03 ppm (80 µg/m^3) 0.14 ppm (365 µg/m^3) 0.5 ppm (1300 µg/m^3) 75 ppb (0.075 ppm)
Particulate Matter (PM_{10})	Primary and Secondary	24-Hour average	150 µg/m^3[f]
Particulate Matter ($PM_{2.5}$)	Primary and Secondary	Annual arithmetic mean 24-Hour average	15 µg/m^3 35 µg/m^3
Lead (Pb)	Primary and Secondary	3-month rolling average	0.15 µg/m^3

a Short-term standards (1 to 24 hours) are not to be exceeded more than once per calendar year.
b Former national secondary standards for carbon monoxide have been repealed.
c Concentrations are shown in parts per million (ppm), milligrams per cubic meter (mg/m3) or micrograms per cubic meter (µg/m3).
d The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.
e Maximum daily one-hour (eight-hour) average. The ozone standard is attained when the expected number of days with maximum hourly (eight-hourly) average concentrations above the value of the standard, averaged over a three year period, is less than or equal to one. The O_3 criterion was updated by the EPA on May 27, 2008 from 0.08 to 0.075 ppm.
f For each particle size, the annual PM standard is met when the three-year average of the annual mean concentration is less than or equal to the value of the standard. The 24-hour PM_{10} ($PM_{2.5}$) standard is met when the three-year average of the annual 99th (98th) percentile values of the daily average concentrations is less than or equal to the value of the standard.
g National standards are block averages rather than moving averages.
h 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.
Note: CO, NO_2, O_3, and PM are transportation related pollutants
Source: 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.

Figure 10-1: Location of the Intersections included in the Hot Spot Modeling Analysis



Modeling Analysis

At each of the intersections selected for detailed air quality modeling, maximum one-hour and eight-hour CO concentrations were predicted at several receptor locations in the vicinity of the intersection where the maximum concentrations would be expected and where the public would have reasonable access. The traffic data used in the air quality analysis were based on traffic volumes and growth projections included in the *Columbia Pike Transit Initiative Traffic Report* [AECOM, October 2010].

The MWCOG inputs included model year registration distributions and vehicle mix corresponding to the greater metropolitan Washington area. The MWCOG input values for the Project Corridor were applied to all intersections.

MWCOG used EPA's MOBILE6.2 program to develop the emission factors for free flowing traffic at intersections. These emission factors were adjusted to account for the stopped traffic in queues as well. Idling emission factors for CO were developed using the recommended procedure contained in EPA's MOBILE5 Information Sheet #2 (*Estimating Idle Emission Factors Using MOBILE5*, U.S. EPA Office of Mobile Sources, NVFEL, AQAB, July 30, 1993).

Maximum one-hour and eight-hour CO concentrations were estimated using EPA's CAL3QHC Version 2.0 dispersion model[3]. Specific modeling inputs were selected in accordance with MWCOG guidance. Consistent with EPA's 1992 guidelines, eight-hour CO concentrations were estimated by multiplying the modeled one-hour results by a persistence (scale) factor of 0.77 based on local monitored data at the VDEQ site at South 18th and Hayes Streets. Total CO concentrations were derived by adding to the modeled maximum concentrations a background level to account for sources of CO other than the traffic at the intersection being modeled. Background levels of 2.1 parts per million (ppm) for one hour and 1.6 ppm for eight hours were applied to all modeled concentrations. These background concentrations, which are based on ambient data from the closest monitoring sites at South 18th Street and Hayes, were held constant for all analysis years and project alternatives.

10.4 Affected Environment

10.4.1 Current Ambient Air Quality in the Region

The Virginia Department of Environmental Quality (VDEQ) develops and implements plans and programs to meet and maintain federal and Virginia air quality standards. The VDEQ monitors air quality to ensure that the county meets and maintains national air quality health standards. The VDEQ protects and manages the region's air resources in accordance with Commonwealth of Virginia State Air Pollution Control Board, Regulations for the Control and Abatement of Air Pollution (9 VAC 5 Chapter 20).

This section summarizes measured ambient air quality data for the region including the Columbia Pike study area. The VDEQ maintains an area wide network of monitoring stations that routinely measure pollutant concentrations in the ambient air. These stations provide data to assess compliance with the NAAQS and to evaluate the effectiveness of pollution control strategies. The relevant monitored pollutants are O_3, NO_2, CO, PM, and SO_2. **Table 10-2** presents the maximum concentrations for these pollutants measured at representative monitoring station sites closest to the study area, as reported by the VDEQ for the three most recent years for which data are available (2008 – 2010). As shown in **Figure 10-2**, the closest monitoring stations include South 18th and Hayes Streets in Arlington County (Site M1), Alexandria Health Department, 517 North St. Asaph Street in the City of Alexandria (Site M2) and Hugh Mercer Elementary School, 2100 Cowan Boulevard in the City of Fredericksburg (Site M3).

As shown in **Table 10-2**, the eight-hour O_3 concentrations at Site M1 (the monitoring station at South 18th and Hayes Streets in Arlington County) exceeded the new limit of 0.075 ppm in two of the previous three years. The full observed data for 2011 is not available yet but the past trends indicate current violations as well. However, the 24-hour PM_{10} concentration at Site M3 in Fredericksburg (the closest VDEQ monitoring site for PM_{10}) did not exceed the criterion limit of 150 µg/m3 in any of the previous three years. Similarly, recent concentrations of $PM_{2.5}$ are also reported below the new more stringent 24-hour standard of 35 $\mu g/m^3$ in each of the previous three years. All of the other pollutants, including CO, are reported to be well below their respective standards.

Recent monitored values of secondary particulate precursors, such as nitrogen dioxide (NO_2) and sulfur dioxide (SO_2), are decreasing. This downward trend in NO_2 and SO_2 may be due to the ultra-low sulfur diesel (ULSD) fuel that has been produced recently and will be required of all manufacturers by December 1, 2010. The ULSD fuel has a sulfur content of only 15 ppm compared to the previous diesel fuel, which had a sulfur content of 500 ppm.

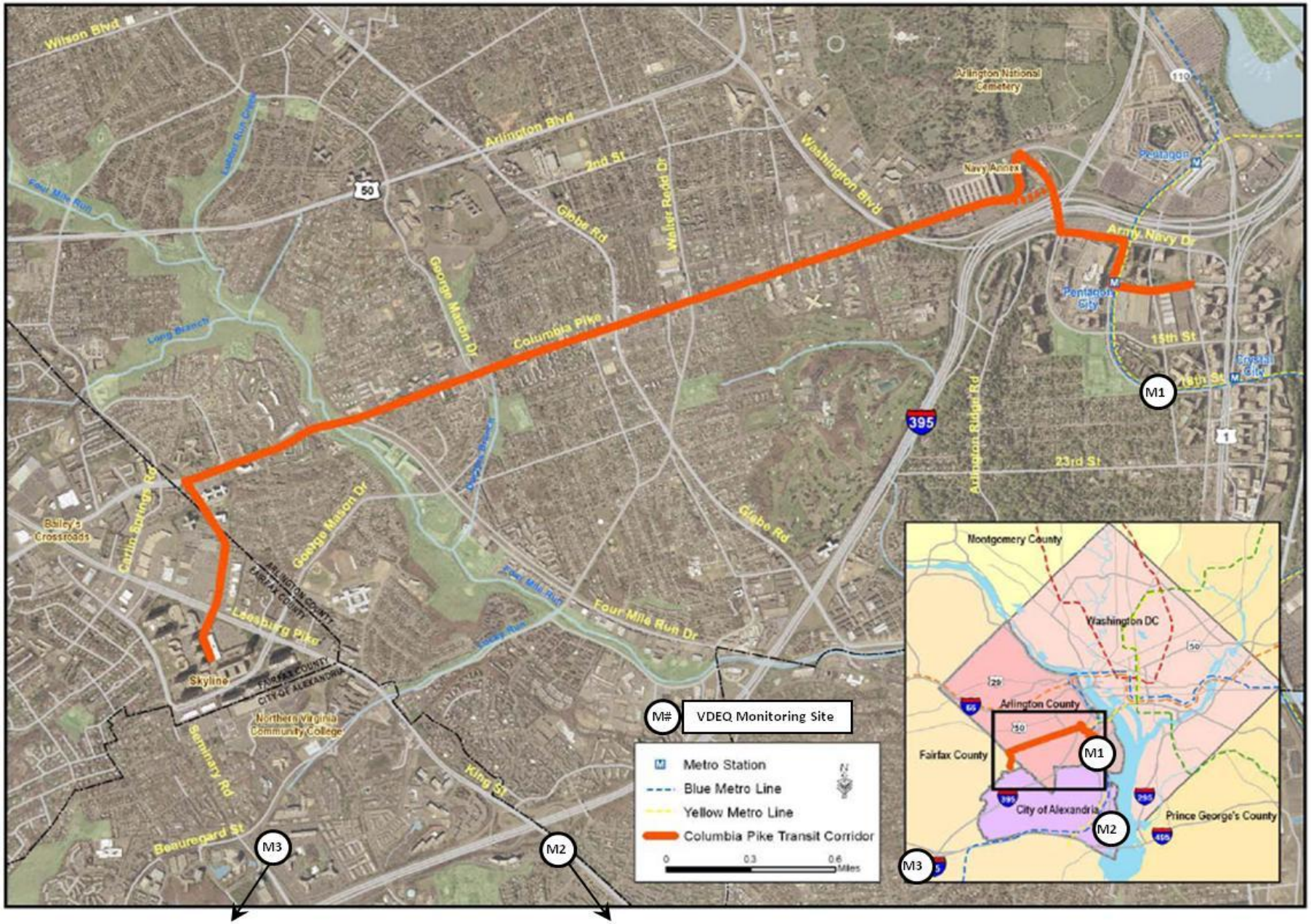
[3] *User's Guide to CAL3QHC Version 2: A Modeling Methodology for Predicting Pollutant Concentration near Roadway Intersections*, U.S. EPA-454/R-92-006, June 1993.

Table 10-2: Recently Monitored Ambient Air Quality in the Region

Criteria Pollutant	Averaging Period	NAAQS	2008		2009		2010	
			1st Max	2nd Max	1st Max	2nd Max	1st Max	2nd Max
Carbon Monoxide (CO)	1-hour	35 ppm	1.7	1.6	1.7	1.7	2.3	2.2
	8-hour	9 ppm	1.2	1.1	1.6	1.3	1.8	1.7
	Site	--	South 18th and Hayes Street, Arlington County (Site M1)					
Nitrogen Dioxide (NO_2)	1-hour	100 ppb	49	--	49	--	52	--
	Annual	53 ppb	13	--	13	--	13	--
	Site	--	South 18th and Hayes Street, Arlington County (Site M1)					
Ozone (O_3)[1]	8-hour	0.075 ppm	0.084	--	0.067	--	0.087	--
	Site	--	South 18th and Hayes Street, Arlington County (Site M1)					
Sulfur Dioxide (SO_2)	1-hour	75 ppb	31	--	36	--	17	--
	3-hour	0.03 ppm	0.042	--	0.055	--	0.017	--
	24-hour	0.14 ppm	0.015	0.012	0.025	0.016	--	--
	Annual	0.5 ppm	0.003	--	0.002	--	--	--
	Site	--	Alexandria Health Department, 517 North St. Asaph Street (Site M2)					
Particulate Matter ($PM_{2.5}$)[2]	24-hour	35 µg/m3	23.4	--	23.2	--	21.8	--
	Annual	15 µg/m3	12.0	--	10.1	--	10.3	--
	Site	--	South 18th and Hayes Street, Arlington County (Site M1)					
Particulate Matter (PM_{10})	24-hour	150 µg/m3	40	39	30	28	45	40
	Site	--	Hugh Mercer Elementary School, 2100 Cowan Boulevard, Fredericksburg (Site M3)					

1 The reported pollutant concentration for ozone is the 4th highest 8-hour level.
2 The reported pollutant concentration for $PM_{2.5}$ is the 98th percentile level.
Source: Virginia Department of Environmental Quality Air Monitoring Website (http://www.deq.state.va.us/airmon/publications.html).

Figure 10-2: Location of the Closest Air Quality Monitoring Stations to the Project Corridor



10.5 Environmental Consequences

10.5.1 No Build Alternative

Under the 2016 No Build Alternative, the maximum one-hour CO concentration in the project study area was predicted to be 4.3 ppm and occurred at Site 1, Seminary Road and George Mason Drive in Fairfax County. The maximum predicted eight-hour CO concentration was 3.3 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the other most congested intersection (Site 2, Army Navy Drive and Eads Street) was 2.9 ppm. The predicted maximum eight-hour CO concentrations at intersection Site 2 is 2.2 ppm.

Under the 2030 No Build Alternative, the maximum one-hour CO concentration in the project study area was predicted to be 4.1 ppm and occurred at Site 1, Seminary Road and George Mason Drive in Fairfax County. The maximum predicted eight-hour CO concentration was 2.2 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the other most congested intersection (Site 2, Army Navy Drive and Eads Street) was 2.8 ppm. The predicted maximum eight-hour CO concentrations at intersection Site 2 is 2.1 ppm.

All predicted CO concentrations for the 2016 and 2030 No Build Alternative are less than the NAAQS of 35 ppm for one hour and 9 ppm for eight hours.

The maximum one- and eight-hour CO levels for the 2030 No Build Alternative are also lower than the corresponding levels for the 2016 No Build Alternative. This decrease in CO concentrations is mainly due to the decrease in the exhaust emission factors from 2016 to 2030, as older and more polluting vehicles in the nation's fleet are replaced with new vehicles which have lower emission rates, as prescribed in the Federal Motor Vehicles Emission Control Program (FMVECP) mandated in the Clean Air Act. This reduction in the vehicle emission rates more than offsets the increase in traffic volumes from 2016 to 2030.

10.5.2 TSM Alternatives

As described above, a $PM_{2.5}$ hot spot analysis is not required in connection with the TSM 1 or TSM 2 Alternative because neither would increase the overall level of diesel-powered vehicles.

Under the TSM 1 and TSM 2 Alternatives, the maximum CO concentrations in the project study area would be equivalent to the levels predicted under the No Build Alternative. As a result, all predicted CO concentrations for the 2016 and 2030 TSM Alternatives would be less than the NAAQS of 35 ppm for one hour and 9 ppm for eight hours.

10.5.3 Streetcar Build Alternative

As described above, a $PM_{2.5}$ hot spot analysis is not required in connection with the Streetcar Build Alternative because it would not increase the overall level of diesel-powered vehicles.

Although traffic delays are expected to increase slightly at selected intersections due to the addition of streetcar service the differences in CO concentrations under the No Build and Streetcar Build Alternatives would be insignificant. Moreover, the CO concentrations under all western terminus Design Options of the Streetcar Build Alternative are predicted to be equivalent to the No Build Alternative.

Under the 2016 Streetcar Build Alternative, the maximum one-hour CO concentration in the project study area is predicted to be 4.1 ppm and occurred at Site 1, Seminary Road and George Mason Drive in Fairfax County. The maximum predicted eight-hour CO concentration is 3.1 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the other most congested intersection (Site 2, Army Navy Drive and Eads Street) is 2.9 ppm. The predicted maximum eight-hour CO concentrations at intersection Site 2 is 2.2 ppm.

Under the 2030 Streetcar Build Alternative, the maximum one-hour CO concentration in the project study area is predicted to be 4.1 ppm and occurred at Site 1, Seminary Road and George Mason Drive in Fairfax County. The maximum predicted eight-hour CO concentration is 3.1 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the other most congested intersection (Site 2, Army Navy Drive and Eads Street) is 2.8 ppm. The predicted maximum eight-hour CO concentrations at intersection Site 2 is 2.1 ppm.

All predicted CO concentrations for the 2016 and the 2030 Streetcar Build Alternative are less than the NAAQS of 35 ppm for one hour and 9 ppm for eight hours.

10.5.4 Conformity

Based on the results of the hot spot analysis, none of the modeled CO concentrations are predicted to exceed the NAAQS one- or eight-hour standards during any of the analysis years. Therefore, the Columbia Pike Transit Initiative alternatives comply with the federal Transportation Conformity Rule since the project would not create or contribute to any new or existing CO violations of the NAAQS and conform to the purpose of the regional SIP. Furthermore, the Streetcar Build Alternative has been included in the Metropolitan Washington Council of Governments' (MWCOG) Financially Constrained Long-Range Transportation Plan (CLRP) for projects planned between 2010 and 2040. The Streetcar Build Alternative is also included in the 2011-2016 Transportation Improvement Program (TIP), which was approved by the Transportation Planning Board (TPB) on November 17, 2011.

10.6 Minimization and Mitigation Measures

With respect to regional emissions and conformity, the Streetcar Build Alternative is included in the conforming MWCOG CLRP and therefore conforms to the SIP, and no mitigation measures are necessary with respect to compliance with the transportation conformity requirements.

The TSM 1, TSM 2, and Streetcar Build Alternatives are associated with predicted reductions in vehicle miles traveled (VMT) as shown in **Table 10-5**. With reduced automobile travel, pollutants associated with vehicle emissions would be reduced proportionally. While improved air quality is not a primary goal of the Columbia Pike Transit Initiative, the expected reductions in automobile travel and related emissions indicate no negative effects of the alternatives at the regional level.

With respect to localized air quality impacts, the modeled one-hour and eight-hour CO concentrations were compared to the NAAQS. To demonstrate compliance with the ambient CO standards, predicted CO concentrations must not equal or exceed the NAAQS. Based on the analyses presented above, there would be no adverse air quality impacts associated with the No Build, TSM 1, TSM 2, or Streetcar Build Alternative, and therefore no mitigation measures would be required.

Direct emissions from construction equipment would not be expected to produce adverse effects on local air quality provided that all equipment is properly operated and maintained. If required, traffic management techniques would be available during the construction period to mitigate increased emissions from traffic congestion due to lane closures, detours, and construction vehicles accessing sites. Mitigation techniques could include development of site-specific traffic management plans; temporary signage and other traffic controls; designated staging areas, worker parking lots (with shuttle bus service if necessary), and truck routes; and prohibition of construction vehicle travel during peak traffic periods.

Potential fugitive dust impacts would be mitigated through good "housekeeping" practices such as water sprays during demolition; wetting, paving, or landscaping exposed earth areas; covering dust-producing materials during transport; limiting dust-producing construction activities during high wind conditions; and providing street sweeping and tire washes for trucks leaving the site.

10.7 Summary of Analysis

The Columbia Pike Transit Initiative Alternatives are not predicted to cause or exacerbate a violation of the applicable NAAQS. Furthermore, with respect to regional emissions and conformity, the project has been shown to conform to the SIP. As shown in **Tables 10-3 and 10-4**, none of the predicted CO concentrations exceed the federal and state ambient air quality standards at any of the two most congested intersections within the study area. Therefore, no mitigation measures would be necessary with respect to compliance with the transportation conformity requirements.

Table 10-3: Predicted Maximum One-Hour CO Concentrations at Selected Intersections (ppm)

Traffic Intersection			No Build		TSM 1/2		Streetcar Build	
No.	Description	Municipality	2016	2030	2016	2030	2016	2030
1	Seminary Road and George Mason Drive	Fairfax County	4.3	4.1	4.3	4.1	4.1	4.1
2	Army Navy Drive and Eads Street	Arlington County	2.9	2.9	2.9	2.9	2.8	2.8

Table 10-4: Predicted Maximum Eight-Hour CO Concentrations at Selected Intersections (ppm)

Traffic Intersection			No Build		TSM 1/2		Streetcar Build	
No.	Description	Municipality	2016	2030	2016	2030	2016	2030
1	Seminary Road and George Mason Drive	Fairfax County	3.3	3.1	3.3	3.1	3.1	3.1
2	Army Navy Drive and Eads Street	Arlington County	2.2	2.2	2.2	2.2	2.1	2.1

Table 10-5: Regional Vehicle Miles Traveled by Alternative

	2010 Base	2016 No Build	2016 TSM 1	2016 TSM 2	2016 Streetcar Build
VMT	130,011,227	141,173,009	141,167,357	141,159,310	141,156,686
VMT Change (vs. No Build)			-5,652	-13,699	-16,323
		2030 No Build	**2030 TSM 1**	**2030 TSM 2**	**2030 Streetcar Build**
VMT		159,630,921	159,624,581	159,615,713	159,612,181
VMT Change (vs. No Build)			-6,341	-15,208	-18,740

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