Appendix D
Air Quality Technical Report

VIRGINIA AVENUE TUNNEL RECONSTRUCTION PROJECT

Air Quality Technical Report

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Table of Contents

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1.0 Project Description

CSX Transportation, Inc. (CSX) is proposing to reconstruct the Virginia Avenue Tunnel. The tunnel is located in the Capitol Hill neighborhood of the District of Columbia beneath eastbound Virginia Avenue SE from 2nd Street SE to 9th Street SE, Virginia Avenue Park and the 11th Street Bridge right-of-way between 9th and 11th Streets SE, and is aligned on south side of Interstate 695 (I-695) (**Figure 1**). The tunnel portals are located a short distance west of 2nd Street SE and a short distance east of 11th Street SE. CSX also owns or has easements of the rail lines immediately east and west of the tunnel. The tunnel and rail lines running through the District are part of CSX's eastern seaboard freight rail corridor, which connects Mid-Atlantic and Midwest states.

The CSX proposal includes the complete reconstruction of the tunnel, which was built over 100 years ago. In addition to its age, the tunnel is also a bottleneck to the freight rail network with its single-track configuration and with a vertical clearance that does not allow for double-stack intermodal container freight trains. The Project will transform the tunnel to a two-track configuration, matching the number of tracks immediately east and west of the tunnel, and provide the minimum 21 feet of vertical clearance to allow double-stack intermodal container freight train operations. This will allow more efficient freight movement, especially in light of expected increases in freight volume.

Reconstructing the tunnel to allow double-stack intermodal container freight trains would require lowering the grade below the rail line's New Jersey Avenue SE Overpass to provide the 21-foot minimum clearance.

The following alternatives are being considered for the Project:

Alternative 1 - No Build: The No Build alternative, which is automatically carried forward into the Draft EIS. The tunnel would not be rebuilt under this alternative. However, the railroad would continue to operate trains through the tunnel and at some point, emergency or unplanned major repairs or rehabilitation could be required to this critical, aging infrastructure that might prove equally or even more disruptive to the community than the Build Alternatives.

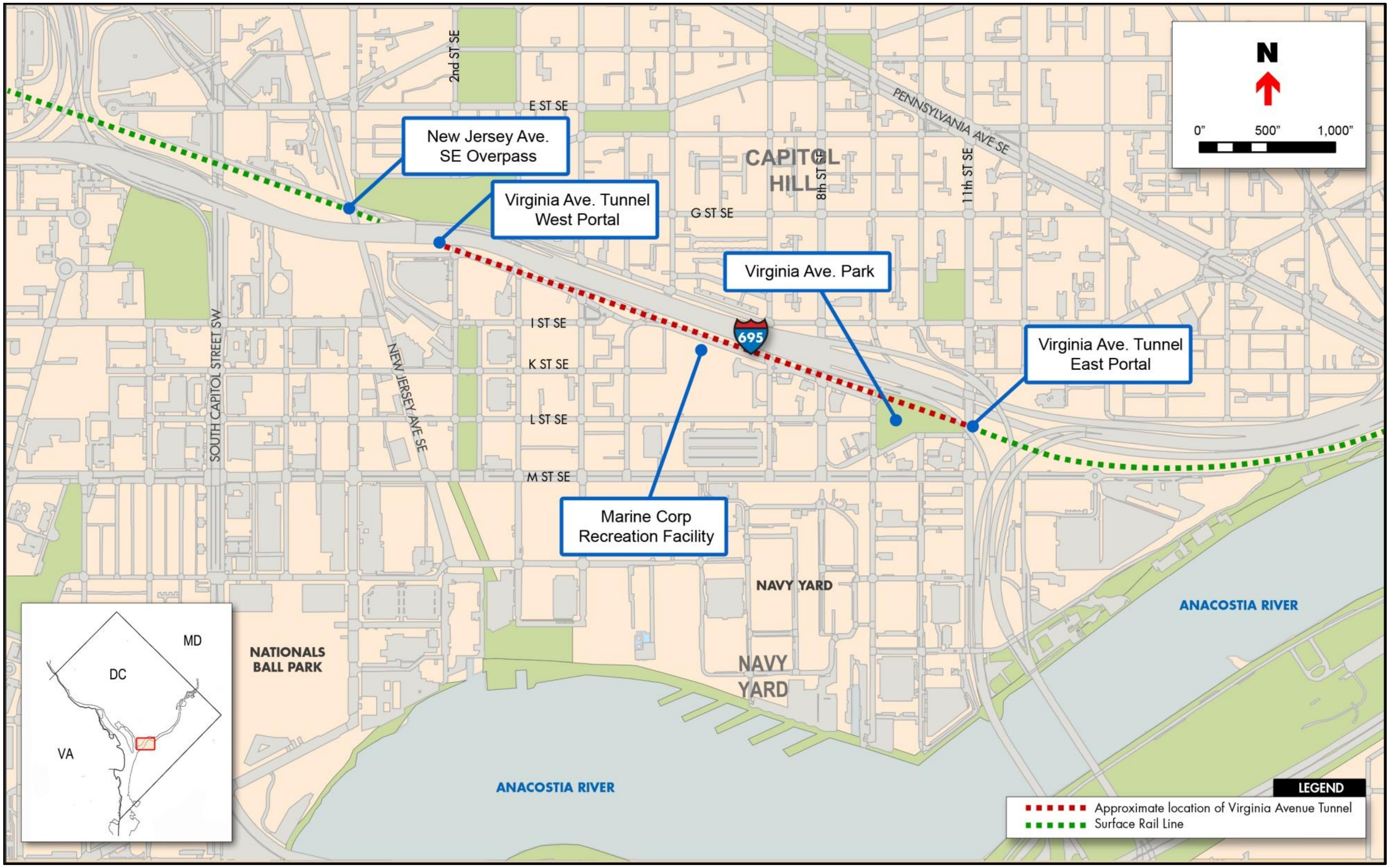
Alternative 2 -Rebuilt Tunnel / Temporary Runaround Track: This alternative involves rebuilding the existing Virginia Avenue Tunnel. It would be rebuilt with two tracks and enough vertical clearance to accommodate double-stack intermodal container freight trains. It would be rebuilt in generally the same location, except aligned approximately seven feet to the south of the existing tunnel center line. It would be rebuilt using protected open trench construction methods. During construction, freight trains would be temporarily routed through a protected open trench outside the existing tunnel (runaround track). The runaround track would be aligned to the south of the existing tunnel. It would be parallel to the existing tunnel and would be below street level. Due to new columns associated with the rebuilt 11th Street Bridge, the runaround track would slightly separate from the tunnel alignment on the east end starting just west of Virginia Avenue Park. Safety measures such as securing fencing would be used to prevent pedestrians and cyclists from accessing the runaround track.

Alternative 3 - Two New Tunnels: This alternative involves replacing the existing Virginia Avenue Tunnel with two new permanent tunnels constructed sequentially. Each new tunnel would have a single track with enough vertical clearance to allow double-stack intermodal container freight trains. A new parallel south side tunnel would be built first as trains continue operating in the existing Virginia Avenue Tunnel. After the south side tunnel is completed, train operations would switch over to the new tunnel and the existing Virginia Avenue Tunnel would be demolished and rebuilt. With the exception of operating in a protected open trench for approximately 230 feet immediately east of the 2nd Street portal (within the Virginia Avenue SE segment between 2nd and 3rd Streets SE), trains would operate in enclosed tunnels throughout construction under Alternative 3. Throughout most of the length, the two tunnels would be separated by a center wall. This center wall would be the new centerline of the two tunnels, and it would be aligned approximately 25 feet south of the existing tunnel centerline, between 2nd and 9th Streets SE. Due to new columns associated with the rebuilt 11th Street Bridge, the tunnels would be separated on the east end starting just west of Virginia Avenue Park, resulting in two separate single-track tunnels and openings at the east portal.

Alternative 4 - New Partitioned Tunnel / Online Rebuild: Alternative 4 would result in a new tunnel with a center partition wall separating two permanent single tracks. Similar to Alternative 3, the new tunnel would be partitioned and have enough vertical clearance to allow double-stack intermodal container freight trains. It would be aligned approximately 17 feet south of the existing tunnel's centerline. The new partitioned tunnel would be built using protected open trench construction methods. Safety measures such as secure fencing would be used to prevent pedestrians and bikers from accessing the protected open trench. The rebuild would occur 'online' meaning that during the period of construction, the protected open trench would accommodate both construction activities and train operations. Maintaining safe and reliable temporary train operations is a more complicated endeavor under Alternative 4 than under the other two Build Alternatives because of the online rebuild approach.

Regardless of Build Alternative, the Project would extend the east portal by approximately 330 feet to a location northeast of the 12th Street and M Street T-intersection.

FIGURE 1: PROJECT LOCATION



2.0 Environment

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 causing injury to agricultural lands and livestock, and adversely affecting human health.

2.1 Applicable Regulations

The Clean Air Act (CAA), as amended by the Clean Air Act Amendments of 1990 (CAAA) and Final Conformity Rule (40 CFR Parts 51 and 93), other rules and regulations such as the Final Conformity Rule (40 CFR Parts 51 and 93), and the Control of Hazardous Air Pollutants from Mobile Sources rule, promulgated by the US Environmental Protection Agency (EPA) implement environmental policies and regulations to promote and ensure acceptable levels of air quality. The Clean Air Act defines conformity as follows:

> "Conformity to an implementations plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS) and achieving expeditious attainment of such standards; and that such activities will not:
>
> - *cause or contribute to any new violation of any NAAQS in any area;*
> - *increase the frequency or severity of any existing violation of any NAAQS in any area; or*
> - *delay timely attainment of any NAAQS or any required interim emission reductions or other milestones in any area."*

2.2 National and State Ambient Air Quality Standards

As required by the Clean Air Act of 1970 (CAA), NAAQS have been established for six major air pollutants. These pollutants, known as criteria pollutants, are: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb).

The federal standards are summarized in **Table 1**. The "primary" standards have been established to protect the public health. The "secondary" standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation and other aspects of the general welfare.

Table 1: National Ambient Air Quality Standards

Pollutant [final rule cite]	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]	primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]	primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]	primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]	primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012 — $PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
	secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
	primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]	primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA Office of Air and Radiation, http://www.epa.gov/air/criteria.html (updated December 14, 2012)

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

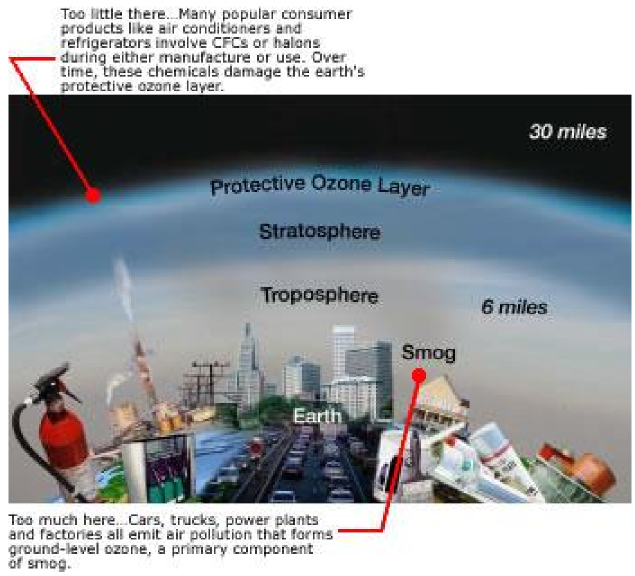
(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

2.3 Criteria Pollutants and Effects

Pollutants that have established national standards are referred to as "criteria pollutants". The sources of these pollutants, their effects on human health and the nation's welfare, and their final deposition in the atmosphere vary considerably. A brief description of each pollutant is provided below.

2.3.1 *Ozone*

Ozone (O_3) is a colorless, toxic gas. As shown in **Figure 2**, O_3 is found in both the Earth's upper and lower atmospheric levels. In the upper atmosphere, O_3 is a naturally occurring gas that helps to prevent the sun's harmful ultraviolet rays from reaching the earth. In the lower layer of the atmosphere, O_3 is man-made. Although O_3 is not directly emitted, it forms in the lower atmosphere through a chemical reaction between reactive organic gases (ROG), also referred to as volatile organic compounds (VOCs), and nitrogen oxides (NOx), which are emitted from industrial sources and from automobiles. As shown in **Figure 3** and **Figure 4**, mobile sources are the primary sources of O_3 precursors (VOCs and NOx) in the Washington D.C. area.



Source: www.epa.gov/oar/oaqps/gooduphigh/good.html

Figure 2: Ozone in the Atmosphere

Substantial O_3 formations generally require a stable atmosphere with strong sunlight, thus high levels of O_3 are generally a concern in the summer. O_3 is the main ingredient of smog. O_3 enters the blood stream through the respiratory system and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. O_3 also damages vegetation by inhibiting their growth.

2.3.2 *Particulate Matter*

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. In general, particulate pollution can include dust, soot, and smoke; these can be irritating but usually are not poisonous.

Particulate pollution also can include bits of solid or liquid substances that can be highly toxic. Of particular concern are those particles that are smaller than, or equal to, 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$) in size.

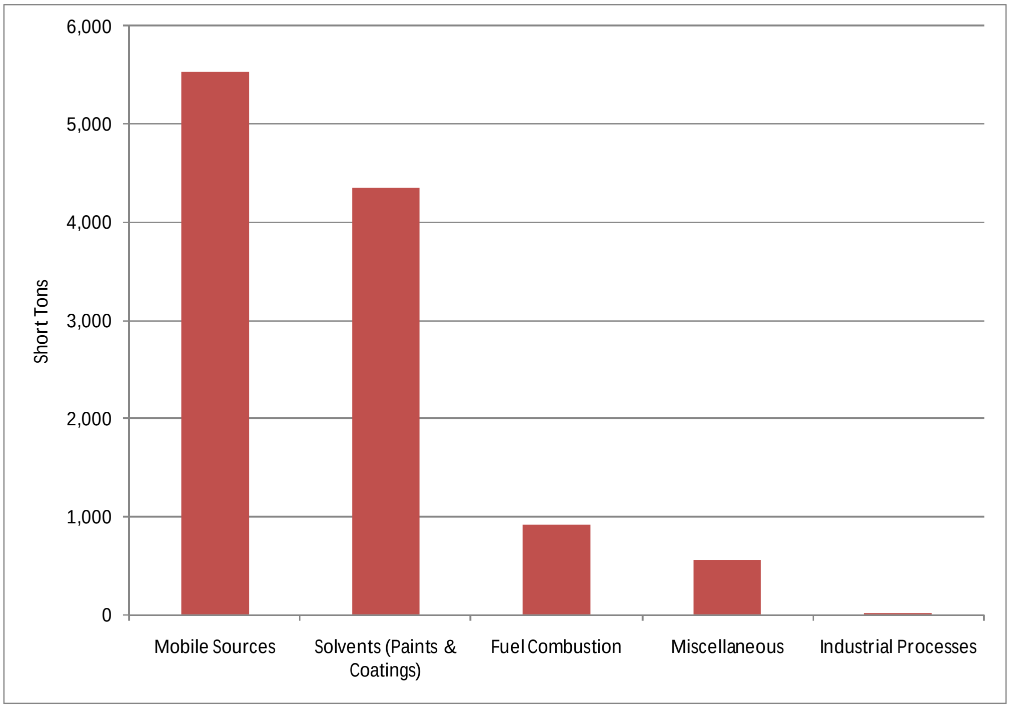


Figure 3: Sources of VOCs – District of Columbia (2008)

Source: http://www.epa.gov/air/emissions/index.htm

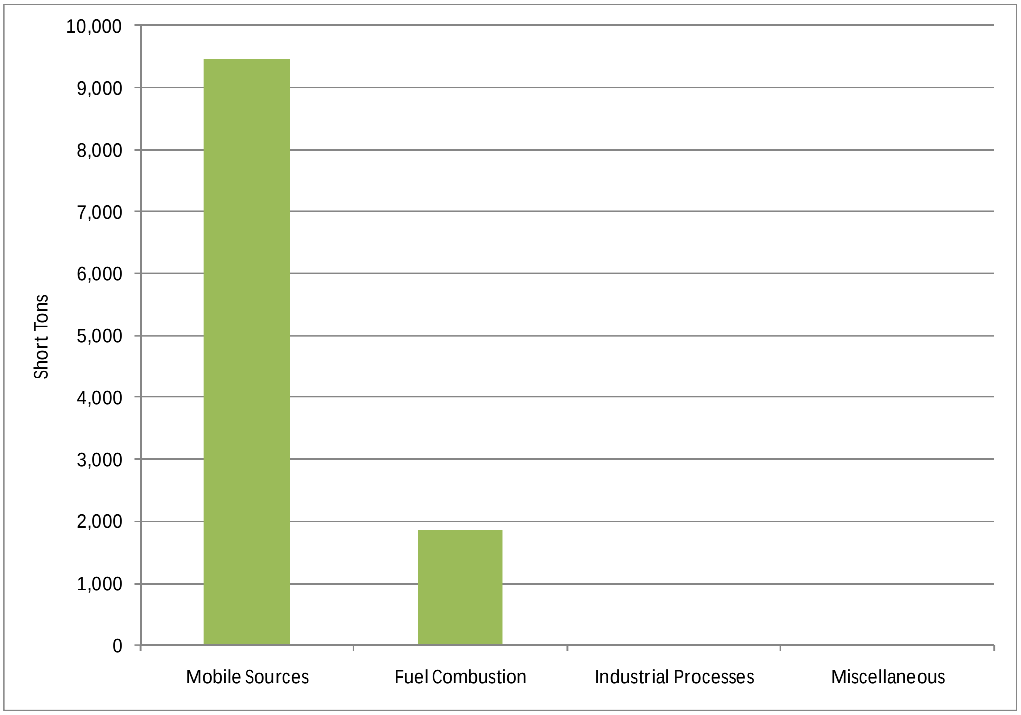
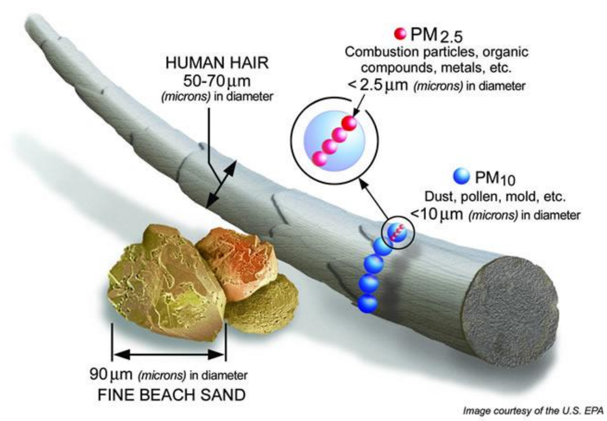


Figure 4: Sources of NOx – District of Columbia (2008)

Source: http://www.epa.gov/air/emissions/index.htm

PM_{10} refers to particulate matter less than 10 microns in diameter, about one/seventh the thickness of a human hair (**Figure 5**). Particulate matter pollution consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter also forms when industry and gases emitted from motor vehicles undergo chemical reactions in the atmosphere. Major sources of PM_{10} include motor vehicles; wood burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning, industrial sources, windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

Data collected through numerous nationwide studies indicate most PM_{10} comes from fugitive dust, wind erosion, and/or agricultural and forestry sources. A small portion of particulate matter is the product of fuel combustion processes. In the case of $PM_{2.5}$, the combustion of fossil fuels accounts for a significant portion of this pollutant. The main health effect of airborne particulate matter is on the respiratory system. $PM_{2.5}$ refers to particulates that are 2.5 microns or less in diameter, roughly 1/28th the diameter of a human hair. $PM_{2.5}$ results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. Like PM_{10}, $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Whereas, particles 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system, particles 2.5 microns or less are so tiny that they can penetrate deeper into the lungs and damage lung tissues.



Source: EPA Office of Research and Development

Figure 5: Relative Particulate Matter Size

2.3.3 *Carbon Monoxide*

Carbon Monoxide (CO), a colorless gas, interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. As shown in **Figure 6**, on-road motor vehicle exhaust is the primary source of CO in the Washington D.C. area. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO levels are generally highest in the colder months of the year when inversion conditions (warmer air traps colder air near the ground) are more frequent. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban “street canyon” conditions. Consequently, CO concentrations must be predicted on a localized, or microscale, basis.

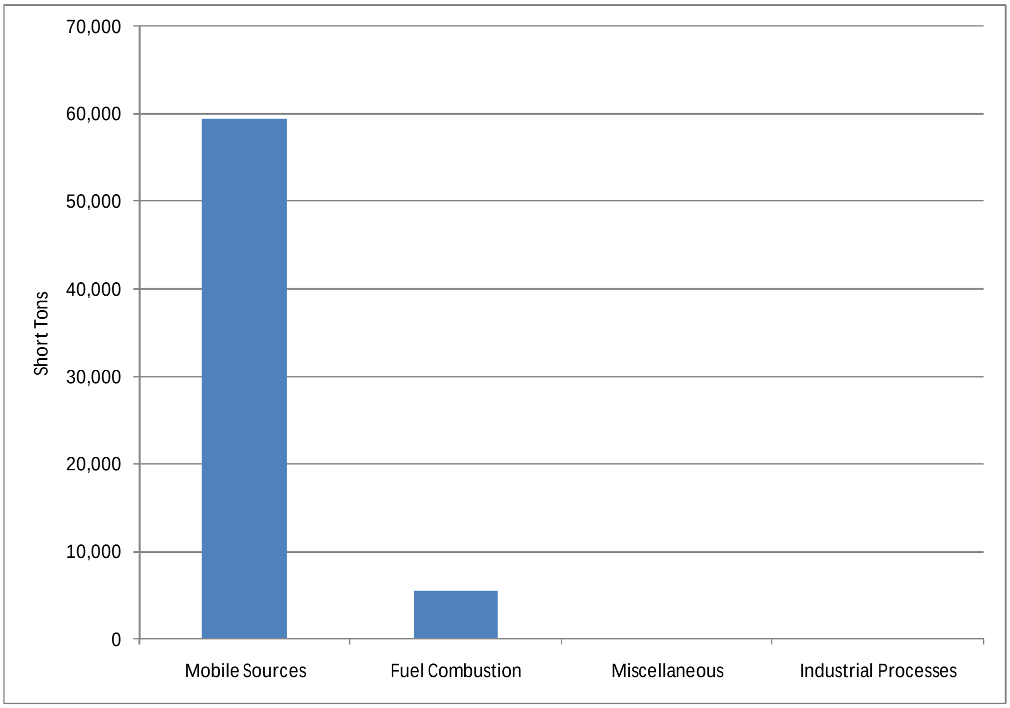


Figure 6: Sources of CO – District of Columbia (2008)

Source: http://www.epa.gov/air/emissions/index.htm

2.3.4 *Nitrogen Dioxide*

Nitrogen Dioxide (NO_2), a brownish gas, irritates the lungs. It can cause breathing difficulties at high concentrations. Like O_3, NO_2 is not directly emitted, but is formed through a reaction between nitric oxide (NO) and atmospheric oxygen. NO and NO_2 are collectively referred to as nitrogen oxides (NOx) and are major contributors to ozone formation. NO_2 also contributes to the formation of PM_{10}, small liquid and solid particles that are less than 10 microns in diameter (see discussion of PM_{10} below). At atmospheric concentration, NO_2 is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO_2 and chronic pulmonary fibrosis. Some increase in bronchitis in children (two and three years old) has also been observed at concentrations below 0.3 parts per million (ppm).

2.3.5 *Lead*

Lead (Pb) is a stable element that persists and accumulates both in the environment and in animals. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Lead levels in the urban environment from mobile sources have significantly decreased due to the federally mandated switch to lead-free gasoline.

2.3.6 *Sulfur Dioxide*

Sulfur Dioxide (SO_2) is a product of high-sulfur fuel combustion. The main sources of SO_2 are coal and oil used in power stations, industry and for domestic heating. Industrial chemical manufacturing is another source of SO_2. SO_2 is an irritant gas that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children. SO_2 can also yellow plant leaves and erode iron and steel.

2.4 Mobile Source Air Toxics

In addition to the criteria pollutants, USEPA also regulates air toxics. Most air toxics originate from human made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries).

Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the CAA. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted into 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 or gasoline.

The USEPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html). In addition, USEPA 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) (http://www.epa.gov/ttn/atw/nata1999/). These are:

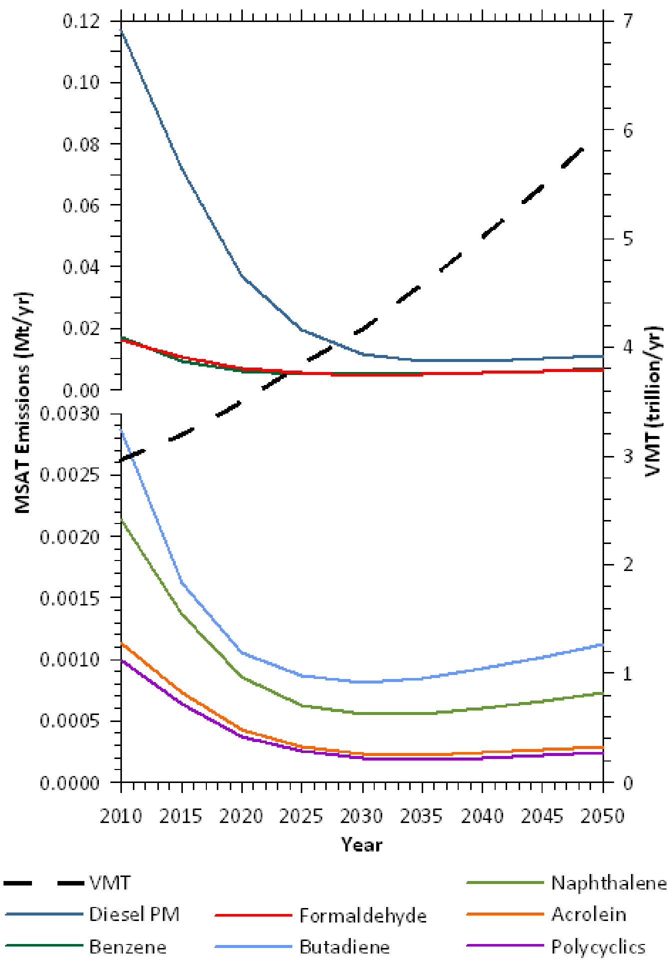
- ***Benzene –*** *characterized as a known human carcinogen.*
- ***Acrolein –*** *the potential carcinogenicity of acrolein cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.*
- ***Formaldehyde –*** *a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.*
- ***1,3-butadiene –*** *characterized as carcinogenic to humans by inhalation.*
- ***Diesel Exhaust*** *(DE)* ***–*** *likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases. Diesel exhaust also represents chronic respiratory effects, possibly the primary noncancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis.*
- ***Naphthalene –*** *the USEPA has classified naphthalene as a possible human carcinogen. Acute exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion.*
- ***Polycyclic Organic Matter (POM) –*** *defines a broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAHs), of which benzo[a]pyrene is a member. Cancer is the major concern from exposure to POM. The USEPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as probable human carcinogens.*

While FHWA considers these the priority MSATs, the list is subject to change and may be adjusted in consideration of future USEPA rules.

The USEPA is the lead federal agency for administering the CAA and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources (66 Federal Register 17229, March 29, 2001). This rule was issued under the authority in Section 202 of the CAA. In its rule, USEPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline program, its national low emission vehicle standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel requirements. According to an FHWA analysis, future emissions likely would be lower than present levels as result of the USEPA's national control programs that are projected to reduce MSAT emission by 83 percent from 2010 to 2050, even if VMT increases by 102 percent, as shown in **Figure 7**.

On February 9, 2007 and under authority of CAA Section 202(l), USEPA signed a Final Rule, Control of Hazardous Air Pollutants from Mobile Sources, which sets standards to control MSATs from motor vehicles. Under this rule, USEPA is setting standards on fuel composition, vehicle exhaust emissions, and evaporative losses from portable containers. The new standards are estimated to reduce total emissions of MSATs by 330,000 tons in 2030, including 61,000 tons of benzene. Concurrently, total emissions of volatile organic compounds (VOCs) will be reduced by over 1 .1 million tons in 2030 as a result of adopting these standards.

Figure 7: National MSAT Emission Trends 2010 – 2050 for Vehicles Operating on Roadways Using USEPA's MOVES2010b Model



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

Source: FHWA's *Interim Guidance Update on Air Toxic Analysis in NEPA Documents* (FHWA, 2012) - EPA MOVES2010b model runs conducted during May - June 2012 by FHWA.

2.5 Greenhouse Gases

In 2007, the Supreme Court decided in *Commonwealth of Massachusetts v. Environmental Protection Agency* that carbon dioxide is a pollutant, subject to regulation under the Clean Air Act. Since then, the federal government has taken a number of steps to regulate carbon dioxide emissions as part of an overall program addressing greenhouse gases. Thus, for example, EPA has adopted a Greenhouse Gas Monitoring, Recordkeeping and Reporting Rule requiring certain suppliers of fossil fuels or industrial greenhouse gases to report to EPA on emissions from particular facilities. That rule does not apply to the activities contemplated by the Virginia Avenue Tunnel Project.

Also, a number of federal agencies have concluded that it is not possible to link a project's emissions to particular climatic effects in a NEPA review. In particular, the 2010 Draft Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, authored by the Council on Environmental Quality, states that "it is not currently useful for the NEPA analysis to attempt to link specific climatological changes, or the environmental impacts thereof, to the particular project or emissions, as such direct linage is difficult to isolate and to understand."

Some greenhouse gases, such as carbon dioxide, occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g., fluorinated gases) are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities include:

- *Carbon Dioxide (CO_2);*
- *Methane (CH_4);*
- *Nitrous Oxide (N_2O); and*
- *Fluorinated Gases.*

For transportation projects involving fossil fuel consumption, CO_2 is the predominant GHG emitted.

2.6 Attainment Status and Conformity with Regional Air Quality Planning

Section 107 of the 1977 CAAA requires that the EPA publish a list of all geographic areas in compliance with the NAAQS, as well as those that are not in attainment of the NAAQS. The designation of an area is made on a pollutant-by-pollutant basis. The EPA's area designations are shown in **Table 2**.

Table 2: Attainment Classifications and Definitions

Classification	Definition
Attainment	Area is in compliance with the NAAQS
Unclassified	Area has insufficient data to make determination and is treated as being in attainment.
Maintenance	Area once classified as nonattainment but has since demonstrated attainment of the NAAQS.
Nonattainment	Area is not in compliance with the NAAQS

The Virginia Avenue Tunnel Reconstruction project area is classified as a maintenance area for CO, a nonattainment area for $PM_{2.5}$ (for the 1997 standard), a marginal nonattainment area for O_3, and an attainment area for all other criteria pollutants.

The CAA requires that a state implementation plan (SIP) be prepared for each nonattainment area and a maintenance plan be prepared for each former nonattainment area that subsequently demonstrated compliance with the standards. A SIP is a compilation of a state's air quality control plans and rules that are approved by EPA. Section 176(c) of the CAA provides that federal agencies cannot engage, support, or provide financial assistance for licensing, permitting, or approving any project unless the project conforms to the applicable SIP. The state and U.S. EPAs' goals are to eliminate or reduce the severity and number of violations of the NAAQS and to achieve expeditious attainment of these standards.

The District of Columbia is part of the Metropolitan Washington Council of Governments (MWCOG), a regional organization of Washington area local governments. MWCOG is composed of 20 local governments surrounding the nation's capital, plus area members of the Maryland and Virginia legislatures, the US Senate and the US House of Representatives. Among other responsibilities, the MWCOG provides daily reports and forecasts of regional air quality. Through the MWCOG, the Metropolitan Washington Air Quality Committee (MWAQC) prepares the air quality plan for the District of Columbia, Maryland and Virginia metropolitan area as regulated under Section 174 of the CAA. The Transportation Planning Board (TPB), housed within the MWCOG, is the organization that brings together key decision makers to coordinate planning and funding for the region's transportation system. TPB members include local officials, representatives of state transportation agencies, The Washington Metropolitan Area Transit Authority (WMATA), state legislators, and others. The TPB is designated as a Metropolitan Planning Organization (MPO) and is therefore responsible for meeting federal metropolitan planning requirements for transportation. The TPB is staffed by the MWCOG.

The TPB produces two basic documents. The first is the *Financially Constrained Long-Range Transportation Plan* (CLRP) which includes all major transportation projects and programs that are planned in the Washington region over the next 25 years. The second document, the *Transportation Improvement Plan* (TIP), lists projects and programs that will be funded in the next six years. The TIP serves as the basis for the regional mobile source air quality analysis, which utilizes vehicle miles traveled (VMT) and emissions factors to determine emissions estimates for the entire transportation system. The analysis results, presented under the Transportation Conformity Rule, demonstrate that the plan and the TIP are consistent with the goals of the *State Implementation Plan* (SIP). The SIP includes a list of measures to reduce pollution in order for the area to become attainment by a designated date.

The TPB approved the 2010 CLRP on November 17, 2010 and the 2012 CLRP and FY 2013-2018 TIP on July 18, 2012. The Virginia Avenue project is listed as ID # 5959 in the 2013-2018 TIP. As part of an approved TIP, the project is part of the region's plan to meet the required air quality goals as mandated in the Clean Air Act. The Virginia Avenue Tunnel is also included in the 2010 CLRP (page 34), "Accommodating Regional Freight Growth." The project is also part of the *National Capital Region Freight Plan 2010*, which was approved by the TPB on July 21, 2010.

2.7 Project Level Conformity

Pursuant to CAA Section 176(c) requirements, EPA promulgated Title 40 of the Code of Federal Regulations Part 51 (40 CFR 51) Subpart W and 40 CFR Part 93, Subpart B, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (see 58 Federal Register [FR] 63214, [November 30, 1993], as amended, 75 FR 17253 [April 5, 2010]). These regulations, commonly referred to as the General Conformity (GC) Rule, apply to all federal actions except for those federal actions which are excluded from review (e.g., stationary source emissions such as from power plants) or related to transportation plans, programs, and projects under Title 23 U.S. Code or the Federal Transit Act, which are subject to Transportation Conformity. The GC Rule applies to all federal actions not addressed by the Transportation Conformity Rule, which applies primarily to transportation and transit projects.

The GC Rule is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that air emissions related to the action do not:

- *Cause or contribute to new violations of a NAAQS.*
- *Increase the frequency or severity of any existing violation of a NAAQS.*
- *Delay timely attainment of a NAAQS or interim emission reduction.*

A conformity determination under the GC Rule may be required if the federal agency determines that the action will occur in a nonattainment or maintenance area. The determination would be required if the action is not included in the federal agency's "presumed to conform" list; the emissions from the proposed action are not within the approved emissions budget for an applicable facility; and the total direct and indirect emissions of a pollutant (or its precursors) are at or above the *de minimis* levels established in the General Conformity regulations (75 FR 17255).

GC Rule criteria are listed in 40 CFR 93.158. An action will be required to conform to the applicable SIP if, for each pollutant that exceeds the *de minimis* emissions threshold provided in 40 CFR 93.153(b) or otherwise requires a conformity determination due to the total of direct and indirect emissions from the action, the action meets the requirements of 40 CFR 93.158(c). For the project area, the applicable *de minimis* emission thresholds are (source: http://www.epa.gov/air/genconform/documents/20100324rule.pdf):

- *100 tons per year for CO*
- *100 tons per year for* $PM_{2.5}$
- *100 tons per year for* SO_2
- *50 tons per year for VOC*
- *100 tons per year for NOx*

The *de minimis* emission levels are applicable to both the operational and construction phases of the project. $PM_{2.5}$ levels include SO_2 since SO_2 is a precursor to $PM_{2.5}$ formation. VOCs have a limit of 50 tons per year because the DC area is part of the ozone transport region which is a multi-state region that works together to implement regional solutions to the ground-level ozone problem in the Northeast and Mid-Atlantic regions.

2.8 Ambient Air Quality in the Project Area

2.8.1 *Local Meteorology*

The nature of the surrounding atmosphere is an important element in assessing the ambient air quality of an area. The Virginia Avenue Tunnel is located in the Capitol Hill neighborhood of the District of Columbia.

Summers in the District of Columbia area are warm and humid and winters are cold, but generally not severe. The summertime temperature is in the upper 80s and the winter is in the upper 20s. Thunderstorms can occur at any time but are most frequent during the late spring and summer. Annual precipitation has ranged from about 25 inches to more than 55 inches. Rainfalls of over 10 inches in a 24-hour period have been recorded during the passage of tropical storms. The seasonal snowfall is nearly 24 inches, but varies greatly from season to season. Snowfalls of 4 inches or more occur only twice each winter on average.

Accumulations of over 20 inches from a single storm are extremely rare. Storm damage results mainly from heavy snows and freezing rains in winter and from hurricanes and severe thunderstorms during the other seasons. Precipitation helps cleanse the atmosphere of pollutants. Very small particles in the atmosphere act as condensation nuclei, triggering the formation of raindrops, while larger particles are literally washed from the air during precipitation events. Precipitation also prevents the drying of the ground, alleviating the formation of fugitive dust; however, precipitation can combine with the oxides of sulfur and nitrogen to produce another form of pollution, namely acid rain.

Prevailing winds are from the south except during the winter months when they are from the northwest. The windiest periods are late winter and early spring. Winds are generally less during the night and early morning hours and increase to a high in the afternoon. Winds may reach 50 to 60 miles per hour or even higher during severe summer thunderstorms, hurricanes, and winter storms. Wind speed direction and variability greatly influence on the dispersion of atmospheric pollutants.

2.8.2 *Monitored Air Quality*

MWCOG collects and distributes air quality data from monitors located throughout the District of Columbia. Five air quality monitors are located within the District of Columbia. The maximum pollutant concentrations collected at these locations for the years 2009-2011, and a comparison of these values with the applicable air quality standards are presented in Table 3. As shown, only exceedances of the 8-hour ozone standard were recorded; the recorded values for all of the other pollutants are less than (within) the NAAQS.

Table 3: Ambient Air Quality Monitor Data 2009-2011

Pollutant		Verizon Phone Co. 2055 L St., NW			420 34th St. NE			Takoma Sc., Piney Branch Road & Dahlia Street			2500 1st Street, N.W.			Park Services Office, 1100 Ohio Drive		
Carbon Monoxide (CO) [ppm]		**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
1-Hour	Maximum	2.5	2.8	5.0	4.2	3.7	2.7						3.1			
	2nd Maximum	2.5	2.7	4.2	4.2	3.7	2.7						3.0			
	# of Exceedences	0	0	0	0	0	0						0			
8-Hour	Maximum	2.0	2.4	2.2	4.0	3.5	2.5						2.5			
	2nd Maximum	1.9	2.0	1.9	3.8	3.1	2.3						2.4			
	# of Exceedences	0	0	0	0	0	0						0			
Particulate Matter [ug/m^3]																
PM_{10}	Maximum 24-Hour				47.0	85.0					41.0	51.0	40.0			
	# of Exceedences				0	0					0	0	0			
$PM_{2.5}$	98th Percentile				26.0	28.0	25.0				24.0	26.0	25.0	23.0	23.0	26.0
	Mean Annual				10.5	11.4	10.4				10.2	10.5	10.3	10.1	11.0	10.2
	# of Exceedences				0	0	0				0	0	0	0	0	0
Ozone (O_3) [ppm]																
8-Hour	Fourth Highest				0.064	0.086	0.080	0.072	0.079		0.071	0.082	0.085			
	# of Exceedences				2	15	6	1	6		2	16	11			
Nitrogen Dioxide (NO_2) [ppb]																
1-Hour	98th Percentile				63	59	55	53	55		62	57	52			
	# of Exceedences				0	0	0	0	0		0	0	0			
Sulfur Dioxide (SO_2) [ppb]																
1-Hour	99th Percentile				39	21	20						5			
	# of Exceedences				0	0	0						0			

Source: *EPA Office of Air Quality Planning and Standards (AIRSData); http://www.epa.gov/airquality/airdata/ad_reports.html*

Note: Grey shaded blocks represent areas of no measurement.

3.0 Environmental Consequences

This analysis looks at emissions from the Project both during the construction period and post-construction.

3.1 Pollutants for Analysis

Pollutants that can be traced principally to motor vehicles, construction equipment and diesel locomotives are relevant to the evaluation of the project's impacts. These pollutants include CO, HC, NO_x, O_3, SO_2, PM_{10}, $PM_{2.5}$ and MSAT. Transportation sources account for a small percentage of regional emissions of Pb; thus, a detailed analysis is not required.

HC (VOC) and NO_x emissions from transportation sources are a concern primarily because they are precursors in the formation of ozone and particulate matter. Ozone is formed through a series of reactions that occur in the atmosphere in the presence of sunlight. Since the reactions are slow and occur as the pollutants are diffusing downwind, elevated ozone levels often are found many miles from the sources of the precursor pollutants. Therefore, the effects of HC and NO_x emissions generally are examined on a regional or "mesoscale" basis.

PM_{10} and $PM_{2.5}$ impacts are both regional and local. A significant portion of particulate matter, especially PM_{10}, comes from disturbed vacant land, construction activity and paved road dust. $PM_{2.5}$ also comes from these sources. Vehicle exhaust, particularly from diesel vehicles and trains, is also a source of PM_{10} and $PM_{2.5}$. PM_{10}, and especially $PM_{2.5}$, can also be created by secondary formation from precursor elements such as sulfur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOCs) and ammonia (NH_3). Secondary formation occurs due to chemical reaction in the atmosphere generally downwind some distance from the original emission source. Thus it is appropriate to predict concentrations of PM_{10} and $PM_{2.5}$ on both a regional and a localized basis.

CO impacts are generally localized. Even under the worst meteorological conditions and most congested traffic conditions, high concentrations are limited to a relatively short distance (300 to 600 feet) of heavily traveled roadways. Vehicle emissions are the major sources of CO. The Virginia Avenue Tunnel Reconstruction Project could change traffic patterns within the project area. Consequently, it is appropriate to predict concentrations of CO on both a regional and a localized or "microscale" basis.

MSAT impacts are both regional and local. Through the issuance of EPA's Final Rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17229), it was determined that many existing and newly promulgated mobile source emission control programs would result in a reduction of MSATs. The FHWA projects that even with a 64 percent increase in VMT, the programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel PM emissions by 87 percent. As a result, EPA has concluded that no further motor vehicle emission standards or fuel standards were necessary to further control MSATs from on-road sources

3.2 Post-Construction Phase Analysis

3.2.1 *Regional Analysis*

A regional or mesoscale analysis of a project determines a project's overall impact on regional air quality levels. This analysis uses regional Vehicle Miles Traveled (VMT) and Vehicle Hours

Traveled (VHT) within the region with and without the project to determine daily "pollutant burden" levels. In as much as the project is not expected to increase regional VMT or VHT, the project is predicted to have no negative impact on regional air quality. As such, the operational phase of the project is not predicted to exceed the GC Rule's *de minimis* emission thresholds.

Furthermore, in a larger sense, the level of emissions within the tunnel of three Project Build Alternatives is expected to be positive. Transporting freight by railroad, especially in a double-stacked intermodal container configuration, produces significantly fewer emissions than if that same quantity of freight were moved by truck, and double-stacking reduces the number of trains (and locomotives) used to transport the expecting growth in East Coast freight traffic. (source: http://www.csx.com/index.cfm/media/press-releases/csx-named-greenest-railroad-by-newsweeks-2010-green-rankings/?keywords=greenhouse gas emissions)

3.2.2 *Greenhouse Gases*

In as much as the project is not expected to increase regional VMT or VHT, the project is predicted to have no negative impact on regional air quality or greenhouse gases. As such, the operational phase of the project is not predicted to increase greenhouse gas emissions.

Furthermore, in a larger sense, the climatological impacts of three Project Build Alternatives are expected to be positive. Transporting freight by railroad, especially in a double-stacked intermodal container configuration, produces significantly fewer emissions than if that same quantity of freight were moved by truck, and double-stacking reduces the number of trains (and locomotives) used to transport the expecting growth in East Coast freight traffic. (source: http://www.csx.com/index.cfm/media/press-releases/csx-named-greenest-railroad-by-newsweeks-2010-green-rankings/?keywords=greenhouse gas emissions)

3.2.3 *Microscale Analysis*

To determine if the project has the potential to cause a localized air quality impact post-construction, a screening analysis was conducted. As detailed in the project description, the Virginia Avenue Tunnel Reconstruction Project is predicted to reduce the number of diesel locomotives needed to move freight in the future Build Alternative, as compared to the No Build Alternative, assuming current market trends. As such, the project is not expected to have any localized impact due to the operation of the trains. The project may, however, affect local street traffic due to the roadway realignment. To determine if the project had the potential to adversely affect localized or microscale air quality levels, a screening analysis was conducted on those intersections expected to be impacted by the project.

A total of 24 locations were screened based on changes in intersection volumes, delay, and levels-of-service (LOS) from the No Build to the Build Alternatives for the years 2015 (**Table 4**) and 2040 (**Table 5**). Sites fail the screening evaluation if the LOS decreases below "D" in the Build Alternative, as compared to the No Build Alternative, or if the delay and/or volume increase from the No Build to Build Alternative along with a LOS below D. As shown in Tables 4 and 5, no sites fail the screening criteria. Therefore the Project is predicted to have no measurable impacts on localized air quality levels. As such, the project is not predicted to cause or exacerbate a violation of the applicable CO NAAQS.

Table 4: 2015 Intersection Screening Analysis

Intersection No	Intersection Name	2015 No-Build Conditions						2015 Ultimate					
		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
		Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS
1A	South Capitol Street and I (Eye) Street (Left)	11.6	0.67	B	15.9	0.70	B	11.6	0.67	B	15.9	0.70	B
1A	South Capitol Street and I (Eye) Street (Right)	19.3	0.73	B	19.5	0.60	B	19.3	0.73	B	19.5	0.60	B
1C	Ramps from freeway at South Capitol Street SB	101.5	1.01	F	40.8	0.68	D	101.5	1.01	F	40.8	0.68	D
2A	South Capitol Street at M Street - SB Intersection	296.7	1.55	F	35.3	0.65	D	296.7	1.55	F	35.3	0.65	D
2B	South Capitol Street at M Street - NB Intersection	38.3	0.70	D	89.6	0.72	F	38.3	0.70	D	89.6	0.72	F
3	M Street at 1st Street	23.9	0.67	C	34.9	0.76	C	23.9	0.67	C	34.9	0.76	C
4	M Street at New Jersey Avenue	15.4	0.40	B	14.3	0.56	B	15.4	0.40	B	14.3	0.56	B
5	M Street at 3rd Street	7.6	0.32	A	14.7	0.56	B	7.6	0.32	A	14.7	0.56	B
6	M Street at 4th Street	19.6	0.43	B	15.2	0.48	B	19.6	0.43	B	15.2	0.48	B
8	M Street at 8th Street	18.7	0.64	B	14.8	0.70	B	21.3	0.66	C	17.3	0.73	B
9	M Street at 9th Street	10.9	0.38	B	14.6	0.63	B	10.9	0.38	B	14.2	0.62	B
10	M Street at 11th Street	22.5	0.67	C	124.9	1.02	F	22.5	0.68	C	77.5	0.89	E
14	Virginia Avenue EB at 5th Street	35.1	0.12	D	46.6	0.36	D	N/A			N/A		
15	SE Freeway off-ramp at 6th Street/Virginia Avenue EB	17.4	0.53	B	15.4	0.43	B	15.4	0.58	B	18.5	0.49	B
16	Virginia Avenue EB at 7th Street	6.3	0.26	A	17.7	0.45	B	6.9	0.31	A	15.2	0.50	B
17A	Virginia Avenue EB at 8th Street	32.4	0.31	C	46.7	0.38	D	30.4	0.31	C	14.5	0.35	B
17B	Virginia Avenue ramp at 8th street	12.0	0.33	B	14.3	0.46	B	13.3	0.31	B	10.8	0.51	B
19	I (Eye) Street at 8th Street	19.1	0.52	B	19.9	0.52	B	19.1	0.52	B	19.9	0.52	B
20	I (Eye) Street at Virginia Avenue WB/7th Street	8.4	0.38	A	11.9	0.56	B	8.4	0.38	A	11.9	0.56	B
21	I (Eye) Street and Virginia Avenue WB at 6th Street	7.3	0.46	A	27.3	0.37	C	7.3	0.46	A	27.3	0.37	C
22	Virginia Avenue WB at 4th Street north of SE Freeway	30.3	0.47	C	28.4	0.43	C	30.3	0.47	C	28.4	0.43	C
23	Virginia Avenue WB at 3rd Street north of SE Freeway	44.8	0.84	D	122.5	1.25	F	44.8	0.84	D	122.5	1.25	F
27	G Street at 8th Street	9.0	0.31	A	11.1	0.42	B	9.0	0.31	A	11.1	0.42	B
28	M Street at Isaac Hall Avenue	4.4	0.40	A	21.2	0.64	C	4.4	0.40	A	21.2	0.64	C

Source: DEIS Traffic Analysis

Table 5: 2040 Intersection Screening Analysis

Intersection No	Intersection Name	2040 No-Build						2040 Ultimate					
		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
		Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS
1A	South Capitol Street and I (Eye) Street (Left)	61.3	1.20	E	82.4	1.35	F	61.3	1.20	E	82.4	1.35	F
1A	South Capitol Street and I (Eye) Street (Right)	100.4	1.17	F	57.3	1.09	E	100.4	1.17	F	57.3	1.09	E
1C	Ramps from freeway at South Capitol Street SB	395.2	1.36	F	233.5	1.19	F	395.2	1.36	F	233.5	1.19	F
2A	South Capitol Street at M Street - SB Intersection	689.2	3.94	F	127.3	1.09	F	689.2	3.94	F	127.3	1.09	F
2B	South Capitol Street at M Street - NB Intersection	217.6	1.12	F	311.1	1.25	F	217.6	1.12	F	311.1	1.25	F
3	M Street at 1st Street	88.4	1.11	F	200.0	1.54	F	88.4	1.11	F	200.0	1.54	F
4	M Street at New Jersey Avenue	25.1	0.70	C	86.5	1.14	F	25.1	0.70	C	86.5	1.14	F
5	M Street at 3rd Street	13.5	0.56	B	93.0	1.07	F	13.5	0.56	B	93.0	1.07	F
6	M Street at 4th Street	24.2	0.76	C	28.6	0.86	C	24.2	0.76	C	28.6	0.86	C
8	M Street at 8th Street	72.1	1.03	E	97.1	1.27	F	72.1	1.03	E	97.1	1.27	F
9	M Street at 9th Street	34.2	0.75	C	95.1	1.18	F	34.2	0.75	C	95.1	1.18	F
10	M Street at 11th Street	123.8	1.14	F	532.3	2.00	F	123.8	1.14	F	532.3	2.00	F
14	Virginia Avenue EB at 5th Street	36.7	0.20	D	126.8	0.62	F	N/A			N/A		
15	SE Freeway off-ramp at 6th Street/Virginia Avenue EB	132.4	0.85	F	47.4	0.75	D	89.1	0.94	F	30.9	0.84	C
16	Virginia Avenue EB at 7th Street	6.0	0.43	A	34.3	0.78	C	7.2	0.50	A	22.0	0.86	C
17A	Virginia Avenue EB at 8th Street	23.2	0.61	C	70.7	0.80	E	15.9	0.64	B	35.6	0.70	D
17B	Virginia Avenue ramp at 8th street	12.6	0.51	B	44.8	0.89	D	13.5	0.49	B	33.6	0.87	C
19	I (Eye) Street at 8th Street	40.8	0.92	D	138.6	1.27	F	40.8	0.92	D	138.6	1.27	F
20	I (Eye) Street at Virginia Avenue WB/7th Street	11.8	0.62	B	102.5	1.03	F	11.8	0.62	B	102.5	1.03	F
21	I (Eye) Street and Virginia Avenue WB at 6th Street	12.4	0.74	B	179.4	0.62	F	12.4	0.74	B	179.4	0.62	F
22	Virginia Avenue WB at 4th Street north of SE Freeway	107.9	0.77	F	122.3	0.75	F	107.9	0.77	F	122.3	0.75	F
23	Virginia Avenue WB at 3rd Street north of SE Freeway	313.6	2.25	F	693.6	2.94	F	313.6	2.25	F	693.6	2.94	F
27	G Street at 8th Street	10.4	0.51	B	13.9	0.72	B	10.4	0.51	B	13.9	0.72	B
28	M Street at Isaac Hall Avenue	7.9	0.67	A	85.1	1.10	F	7.9	0.67	A	85.1	1.10	F

Source: DEIS Traffic Analysis

As the Virginia Avenue Reconstruction Project is not predicted to increase the number of diesel locomotives and is not expected to increase traffic at local intersections, the Project is not predicted to cause or exacerbate a violation of the applicable $PM_{2.5}$ NAAQS.

3.2.4 *MSAT Assessment*

On February 3, 2006, the FHWA released *Interim Guidance on Air Toxic Analysis in NEPA Documents.* This guidance was superseded on December 6, 2012 by FHWA's *Interim Guidance Update on Air Toxic Analysis in NEPA Documents.* The purpose of FHWA's guidance is to advise on when and how to analyze MSATs in the NEPA process for highways. This is an interim guidance because MSAT science is still evolving. As the science progresses, FHWA will update the guidance.

Technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to estimate accurately the health impacts of MSATs at the project level, it is possible to assess qualitatively the levels of future MSAT emissions under the project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences in MSAT emissions, if any, from the alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA titled, *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives*, found at: www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm.

FHWA's interim guidance groups projects into the following categories:

- *Exempt Projects and Projects with No Meaningful Potential MSAT Effects;*
- *Projects with Low Potential MSAT Effects; and,*
- *Projects with Higher Potential MSAT Effects.*

The Project Build Alternatives are not predicted to change roadway VMT as compared to the No Build scenario. They are also not predicted to increase the number of diesel train engines. As such, based on the recommended tiering approach detailed in the FHWA methodology, the operational impacts of the project falls within the Tier 1 category as a project with no meaningful potential MSAT effects.

3.3 Construction Phase Analysis

3.3.1 *General Conformity Annual Emissions Analysis*

Under the GC Rule, construction and operational phase emissions must be compared to the *de minimis* thresholds. In as much as the project is not expected to increase regional VMT or VHT, the project is predicted to have no negative impact on regional air quality. As such, the operational phase of the project is not predicted to exceed the GC Rule's *de minimis* emission thresholds. Furthermore, in a larger sense, the level of emissions within the tunnel of three Project Build Alternatives is expected to be positive. Transporting freight by railroad, especially in a double-stacked intermodal container configuration, produces significantly fewer emissions than if that same quantity of freight were moved by truck, and double-stacking reduces the number of trains (and locomotives) used to transport the expecting growth in East Coast freight traffic. (source: http://www.csx.com/index.cfm/media/press-releases/csx-named-greenest-railroad-by-newsweeks-2010-green-rankings/?keywords=greenhouse gas emissions)

As emissions under the operational phase of the project would be less than these thresholds (i.e. regional emissions would be less with the project than under No Build conditions), the GC Rule would apply to the proposed project only if construction phase emissions would exceed the GC thresholds. As such, a quantitative analysis was conducted to estimate the amount of emissions generated by the construction of each of the proposed construction alternatives. The construction emission burdens estimated were then compared to the GC de minimis thresholds to determine if the GC Rule applies to the project.

The following activities associated with the construction of the project would generate air pollutant emissions within and near the major construction areas:

- *Excavation, demolition, grading;*
- *Handling and transport of construction material and debris;*
- *Operation of heavy-duty diesel-powered construction equipment; and*
- *Operation of heavy-duty diesel trucks for transport of construction materials within construction areas and on the area's roadways.*

These construction activities could have the potential to affect ambient air quality levels primarily within 200 to 300 feet of the activities, as pollutants tend to disperse beyond this distance. Pollutant emissions generated by construction activities and truck trips were estimated on an annual and monthly basis for the entire construction period, and potential air quality impacts were estimated during peak construction periods.

Methodology

The analysis to estimate the emission burden caused by on-site (e.g., demolition activities, construction equipment operations, and truck movements) and off-site (e.g., motor vehicle traffic effects due to truck trips and ramp closures) construction-phase activities includes the following:

- *Estimation of emissions generated by the construction activities, including fugitive dust emissions and emissions released from diesel-powered equipment and trucks based on the hours of operation of each piece of equipment;*
- *Identification of heavily traveled truck routes to estimate the cumulative effects of on-site construction activity emissions and off-site traffic emissions;*

Emission Sources: (On-Site and Off-Site)

On-site construction activities that could generate emissions include:

- *Earth moving, excavation, grading and deconstruction/demolition activities;*
- *The handling and transport of material and debris;*
- *Operations of heavy-duty diesel-powered construction equipment;*
- *Heavy-duty diesel trucks operating within construction areas, as well as traveling to the sites to deliver construction materials and from the sites transporting construction materials; and*
- *Re-entrained dust resulting from trucks and equipment traveling on paved public roads, and unpaved roads within the construction sites.*

Emission rates for these activities were estimated based on the following:

- *The number of hours per day and duration of each construction activity;*
- *The number and type of construction equipment to be used;*
- *Horsepower (HP) and utilization rates (hours per day) for each piece of equipment;*
- *The quantities of construction/demolition material produced and removed from each site; and*
- *The number of trucks trips needed to remove construction/demolition material, and to bring the supply materials to each site.*

Emissions from the off-site trucks and general traffic affected by construction truck traffic were estimated using EPA's Mobile6.2 emission factor model (*User's Guide to MOBILE 6.2, Mobile Source Emission Factor Model, Ann Arbor, Michigan,* EPA420-R-02-028*,* October 2002). MOBILE 6.2 is a mobile source emission estimate program that provides current and future estimates of emissions from highway motor vehicles. Input parameters were provided by Metropolitan Washington Council of Governments (MWCOG).

<u>*Emission Control Measures*</u>

MWCOG and DDOT guidelines will be followed during construction under any of the three Build Alternatives to minimize construction-phase emissions. In accordance with these guidelines, construction activities could be expected to include practices from the following package of measures designed to minimize air quality impacts:

- *Emission Control Measures for Diesel Equipment Exhaust*
  - Ultra-low sulfur diesel fuel for vehicles and equipment;
  - Majority of the engines for non-road construction equipment with a horsepower (HP) rating above 50 HP in compliance with EPA's Tier 2 standards;
  - Construction equipment with engines above 50 HP retrofitted with the best available control technology (BACT)
  - Limitation of extended idling of diesel-fueled vehicles; and
  - Use of electric compressors and pumps where possible, instead of diesel-powered equipment.
- *Emission Control Measures for Fugitive Dust*
  - Dust suppression with or without approved binding agents, used on-site on a routine basis that may be applied with hoses or a sprinkler system during deconstruction and material-handling activities;
  - Use of wheel-wash stations or crushed stone at construction ingress/egress areas;
  - Covering dump trucks during material transport on public roadways;
  - Limiting unnecessary idling times on diesel-powered engines; and

The control measures selected (for both diesel engines and fugitive dust) would be translated into construction specifications to ensure that the goals identified during the environmental review process are met during the construction phase.

Operating Scenarios

Emission rates of each pollutant were estimated for each type of construction activity. The construction schedules for each of the construction alternatives are presented in **Tables 6A, 6B and 6C**. These tables present the construction stages as well as the start and end dates of each stage of construction for each of the staging areas (west, middle, and east) and each of the phases (1 and 2, where applicable, as Alternative 3 only has one phase of construction).

Because different construction activities could range from a few months to several years in duration, separate analyses were conducted to estimate short-term (24 hours or less) and long-term (annual average) pollutant levels. Short-term emission estimates, based on peak-period activity levels at each site (defined as emissions per month), were used to compare the modeling results to short-term exposure standards (i.e., 8 hours and 24 hours). Annual average activity levels were used to compare modeling results to annual exposure standards.

Assumptions and Emission Factors

Project-specific information regarding the deployment and operation of construction equipment was applied to identify site-specific emission source parameters for use in the emission estimates and dispersion analysis. The following assumptions and emission factors were utilized:

- *Construction operations would occur 8 hours per day for 5 days per week;*
- *Estimated hourly emission rates of each pollutant from construction equipment, dust-generating activities, and project trucks operating at each construction site were summed to compute the total monthly emission rate by pollutant, reflecting the contribution of each type of emission source;*
- *Only diesel-powered construction equipment was considered in the analysis; emissions generated outside the project area to generate electricity for the electric-powered equipment were not considered;*
- *Construction-related dump trucks were considered as heavy-duty diesel vehicles with a 12 to 18 cubic-yard capacity;*
- *NO_2, PM_{10} and $PM_{2.5}$, and CO emission factors for moving vehicles (i.e., exhaust, brakes, and tires) and queuing vehicles were estimated using the EPA MOBILE 6 vehicular emission factor model;*
- *Total daily on-site vehicular emission rates of NO_2, CO, PM_{10}, and $PM_{2.5}$ were estimated by multiplying emission factors for moving vehicles (in grams per vehicle-mile) by the distance that an average vehicle would travel within the site, and by the number of on-site operating vehicles during the activity period;*
- *Re-entrained dust from the movement of trucks and vehicles within each active construction site was estimated using the current EPA equation for fugitive dust sources for PM_{10} and $PM_{2.5}$ emissions. Because of low vehicular speeds within the active construction sites (i.e., less than 5 mph), a speed reduction factor was applied, where appropriate;*

Table 6A: Construction Schedule, Alternative 2

Construction Stage	Phase 1						Phase 2					
	West		Middle		East		West		Middle		East	
	Start Date	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*
SOE/Slurry Wall	01/01/14	02/01/14	09/01/13	01/01/14	09/01/13	11/01/13	-	-	-	-	-	-
SOE/Soldier Beam	11/01/13	03/01/14	06/15/13	11/11/13	07/12/13	12/31/13	-	-	-	-	11/01/14	12/15/14
SOE/Tieback	02/21/14	05/15/14	10/04/13	02/04/14	12/15/13	07/01/14	-	-	-	-	12/15/14	03/09/15
SOE/Lagging	02/21/14	05/15/14	10/04/13	02/04/14	12/15/13	07/01/14	-	-	-	-	12/15/14	03/09/15
SOE/Internal Bracing	02/21/14	05/15/14	10/04/13	02/04/14	12/15/13	07/01/14	-	-	-	-	12/15/14	03/09/15
Excavation	02/19/14	04/17/14	10/03/13	05/28/14	12/13/13	03/26/14	12/08/14	02/10/15	11/25/14	04/07/15	12/03/14	04/03/15
Excavation/Demolition	08/28/13	10/30/13	-	-	-	-	08/13/14	02/02/15	09/11/14	03/30/15	12/17/14	06/12/15
Structural Concrete	-	-	-	-	-	-	12/15/14	08/10/15	12/10/14	09/04/15	12/24/14	12/22/15
Site Work/Paving	-	-	-	-	-	-	06/13/16	06/24/16	06/25/16	08/04/16	08/05/16	08/19/16
Site Work/Backfill	-	-	-	-	-	-	06/29/15	09/07/15	02/04/15	10/07/15	03/18/15	01/05/16
Site Work/Subgrade/Drainage	-	-	-	-	-	-	05/16/16	07/11/16	03/25/16	07/15/16	06/23/16	08/12/16
Major Deliveries	08/04/13	02/15/14	-	-	-	-	-	-	-	-	-	-
Street Decks	11/04/13	12/13/15	07/19/13	11/04/13	07/29/13	01/06/14	07/03/14	07/22/14	02/12/14	03/15/14	08/22/14	11/19/14
Dewatering	02/19/14	12/08/14	10/03/13	11/25/14	12/13/13	12/03/14	12/08/14	09/07/15	11/25/14	10/07/15	12/03/14	01/05/16
Track Installation	05/27/14	06/13/14	06/13/14	06/27/14	06/27/14	08/06/14	08/10/15	09/22/15	09/24/15	10/27/15	01/21/16	03/21/16

Table 6B: Construction Schedule, Alternative 3

Construction Stage	Phase 1						Phase 2					
	West		Middle		East		West		Middle		East	
	Start Date	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*
SOE/Slurry Wall	06/01/13	08/11/13	08/12/13	10/22/13	10/23/13	01/01/14	-	-	-	-	-	-
SOE/Soldier Beam	06/01/13	12/20/13	10/31/13	05/21/14	09/10/13	04/01/14	-	-	-	-	-	-
SOE/Soldier Beam	04/01/15	06/21/15	05/11/15	08/01/15	05/11/15	08/01/15	-	-	-	-	-	-
SOE/Tieback	08/01/13	11/11/13	10/16/13	01/26/14	09/21/13	01/01/14	-	-	-	-	-	-
SOE/Lagging	08/01/13	12/21/13	12/22/13	05/11/14	05/12/14	10/01/14	-	-	-	-	-	-
SOE/Lagging	07/01/15	07/31/15	08/01/15	08/30/15	08/31/15	10/01/15	-	-	-	-	-	-
SOE/Internal Bracing	08/01/13	05/12/14	03/02/14	12/11/14	12/21/13	10/01/14	-	-	-	-	-	-
Excavation	09/01/13	04/01/14	09/01/13	04/01/14	09/01/13	04/01/14	-	-	-	-	-	-
Excavation/Demolition	03/01/15	02/01/16	03/01/15	02/01/16	03/01/15	02/01/16	-	-	-	-	-	-
Structural Concrete	01/01/13	05/02/15	10/01/14	01/29/17	03/02/14	07/01/16	-	-	-	-	-	-
Site Work/Paving	02/01/16	04/01/16	04/02/16	05/31/16	06/01/16	08/01/16	-	-	-	-	-	-
Site Work/Backfill/Subgrade/Drainage	02/01/14	12/02/14	12/03/14	10/01/15	10/02/15	08/01/16	-	-	-	-	-	-
Major Deliveries	06/01/13	11/01/13	-	-	-	-	-	-	-	-	-	-
Street Decks	06/01/13	10/21/13	08/11/13	01/01/14	08/11/13	01/01/14	-	-	-	-	-	-
Street Decks	03/01/15	07/31/15	08/01/15	12/30/15	12/31/15	06/01/16	-	-	-	-	-	-
Dewatering	06/01/13	08/21/17	11/20/13	02/09/17	05/11/13	08/01/16	-	-	-	-	-	-
Track Installation	11/01/13	03/23/14	03/24/14	08/11/14	08/12/14	01/01/15	-	-	-	-	-	-
Track Installation	11/01/15	01/21/16	01/22/16	04/10/16	04/11/16	07/01/16	-	-	-	-	-	-

Table 6C: Construction Schedule, Alternative 4

Construction Stage	Phase 1						Phase 2					
	West		Middle		East		West		Middle		East	
	Start Date	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*	*Start Date*	*End Date*
SOE/Slurry Wall	10/09/13	12/17/13	12/17/13	04/18/14	04/18/14	08/07/14	-	-	-	-	-	-
SOE/Soldier Beam	08/01/13	08/13/13	08/13/13	10/24/13	10/24/13	02/24/14	01/31/16	03/15/16	03/15/16	06/01/16	06/01/16	09/15/16
SOE/Tieback	07/04/13	10/18/13	10/18/13	01/08/14	01/08/14	02/16/14	-	-	-	-	-	-
SOE/Lagging	-	-	-	-	-	-	02/15/16	03/30/16	03/30/16	06/16/16	06/16/16	09/30/16
SOE/Internal Bracing	-	-	-	-	-	-	02/15/16	03/30/16	03/30/16	06/16/16	06/16/16	09/30/16
Excavation	02/05/14	05/12/14	06/11/14	11/25/14	03/19/15	06/16/15	03/09/16	04/13/16	04/20/16	08/03/16	02/15/16	11/18/16
Excavation/Demolition	09/13/13	03/20/14	03/19/14	11/03/14	11/05/14	04/09/15	-	-	-	-	-	-
Structural Concrete	03/05/14	11/26/14	08/06/14	08/24/15	04/30/15	11/30/15	03/29/16	08/01/16	05/05/16	04/07/17	01/19/17	09/25/17
Site Work/Paving	-	-	-	-	-	-	09/20/16	09/26/16	07/01/17	08/08/17	12/08/17	12/15/17
Site Work/Backfill	11/11/14	12/03/14	02/11/15	08/31/15	11/30/15	01/04/16	08/08/16	09/06/16	09/06/16	04/18/17	06/20/17	10/03/17
Site Work/Subgrade/Drainage	-	-	-	-	-	-	08/31/16	10/19/16	04/01/17	06/05/17	10/19/17	12/09/17
Major Deliveries	08/04/13	06/15/14	-	-	-	-	-	-	-	-	-	-
Street Decks	08/06/13	09/10/13	09/10/13	10/23/13	05/30/14	10/30/14	08/24/16	08/31/16	09/15/16	10/25/16	09/15/17	10/19/17
Dewatering	02/05/14	02/08/16	06/11/14	02/08/16	03/19/15	02/08/16	02/09/16	09/06/16	02/09/16	04/18/17	02/09/16	10/03/17
Track Installation	10/14/15	11/11/15	11/11/15	12/02/15	12/02/15	01/01/16	08/21/17	09/18/17	09/18/17	10/09/17	10/09/17	11/08/17
SOE/Sheetpile	-	-	-	-	-	-	01/01/14	04/28/14	05/05/14	10/02/14	10/02/14	01/08/15

- *Emission rates of NO_2, CO, PM_{10} and $PM_{2.5}$ from diesel engines of construction equipment were estimated using the EPA NONROAD Emission Model (Report No. NR-009D, July 2010, EPA 420-R-10-018). Zero-hour emission factors were adjusted for transient operation, deterioration factors, and diesel-fuel sulfur content, following the EPA NONROAD Model guidance;*
- *As recommended in EPA's NONROAD Emission Mode, $PM_{2.5}$ emission factors for construction equipment were assumed to be 97 percent of the estimated PM_{10} emission factors for each type of equipment;*
- *Engine HP rating was provided by the project design team and utilization factors (peak usage during the working hours) for the different types of equipment were estimated based on the EPA NONROAD Model guidance. These values were used to produce an average HP usage per day; and*
- *Fugitive-dust emission factors for demolition, excavation, truck loading, and re-entrained dust were based on the equations recommended in EPA's AP-42 Report "Compilation of Air Pollutant Emission Factors," Sections 13.2.3.1/2/3 Heavy Construction Operations, 11.9.1 Uncontrolled Open Fugitive Dust Sources, and 13.2.1 Fugitive Dust from Paved Roads. The $PM_{2.5}$ to PM_{10} ratios varied depending on the type of activity performed.*

Equipment

Table 7 lists the approximate numbers and types of pieces of equipment that could be expected to operate over the project's construction period, which ranges from a little over 3 years for Alternative 2, to approximately 4½ years for Alternatives 3 and 4. This list is provided to indicate the range of types and sizes of equipment anticipated to be used. The analysis documented in this report was conducted using equipment projections specifically for the peak monthly and peak annual periods at each site.

Total Construction Emissions

Total annual estimated emissions generated during the project's construction period, are provided in **Tables 8A, 8B, and 8C.** These values are the peak on-site emissions during each analysis year plus the peak off site truck travel for each year. These values (for all three alternatives) are less than the CG *de minimis* thresholds. As such, air quality impacts are not considered to be significant and the project would not be subject to a conformity determination.

3.3.2 *Localized On-Site Dispersion Modeling Analysis*

In addition to the construction emission burden analysis, a localized air quality dispersion modeling analysis was conducted to determine whether the impacts of these emissions would significantly impact nearby sensitive land uses. It should be noted that this localized dispersion analysis was conducted to address community concerns regarding construction emissions and was not required under the GC Rule.

Table 7: Estimated Numbers of Diesel-Powered Construction Equipment Operating Over the Full Construction Period

Equipment Type	Rated Horsepower	Quantity
Air Compressor (185 CFM)	55	3
Back Hoe (Cat 325 or equivalent)	190	3
Ballast Grader	270	1
Crane (Crawler, 150 Ton)	225	2
Crane (Crawler, 200 Ton)	250	1
Crane (RT, 60 Ton)	190	2
Crane (Truck, 200 Ton)	350	1
Dewatering Pump	50	4
Dill Rig (Tieback)	225	2
Dozer (Cat D7 or equivalent)	180	1
Drill Rig (Soilmec 622)	410	1
Dump Truck	400	25
Forklift (10000 lb)	105	8
Generator (150 kWh)	200	1
Generator (350 kWh)	475	1
Grout Plant	10	2
Hoe Ram	250	4
Light Plant	55	2
Motor Grader	200	1
Paver	225	1
Pile Hammer	125	1
Roller	135	1
Slurry Plant (75 HP Pump)	75	1
Tamping Machine	130	1
Track Loader (Cat 973 or equivalent)	210	3
Tractor Trailer	350	1
Truck Mixer	350	2
Welding Machine	25	4

Table 8A: Total Annual Emissions from Construction Equipment and Activities Alternative 2

Pollutant	Emissions (Tons/Year)				General Conformity *de minimis* Thresholds
	2013	*2014*	*2015*	*2016*	
CO	2.44	4.16	5.34	0.73	100
NOx	5.26	7.95	10.76	1.68	100
SO_2	0.01	0.01	.02	0.00	100
$PM_{2.5}$	0.41	0.94	1.52	0.23	100
VOCs	0.36	0.61	0.80	0.13	50

Table 8B: Total Annual Emissions from Construction Equipment and Activities Alternative 3

Pollutant	Emissions (Tons/Year)				General Conformity *de minimis* Thresholds
	2013	*2014*	*2015*	*2016*	
CO	4.27	3.87	4.40	2.78	100
NOx	9.11	8.14	9.37	5.67	100
SO_2	0.01	0.01	.01	0.01	100
$PM_{2.5}$	0.77	0.82	1.05	0.58	100
VOCs	0.64	0.61	0.70	0.41	50

Table 8C: Total Annual Emissions from Construction Equipment and Activities Alternative 4

Pollutant	Emissions (Tons/Year)				General Conformity *de minimis* Thresholds
	2013	*2014*	*2015*	*2016*	
CO	1.28	3.83	3.14	3.63	100
NOx	2.87	7.84	5.79	7.00	100
SO_2	0.01	0.01	.01	0.01	100
$PM_{2.5}$	0.23	0.76	0.57	0.83	100
VOCs	0.20	0.58	0.41	0.48	50

Approach

Analyses were performed to estimate the potential air quality impacts caused by the construction of the project. These analyses estimated the effects of construction activities on the criteria pollutants associated with construction operations as well health risks associated with the emissions of toxic pollutants from the diesel equipment. Potential impacts on nearby sensitive land uses were estimated. This analysis was conducted to address community concerns regarding construction emissions and was not required under the General Conformity Rule guidelines for a project that falls below the de minimis thresholds.

Emission rates of each pollutant from the total of all emission sources that are projected to be operating at the construction site were estimated for each type of construction activity. Short-term emission estimates were based on peak period activity levels and used to estimate short-term (i.e. 1-hour, 8-hour, and 24-hour) concentrations. For comparison to 24-hour standards, it was assumed that emissions would occur every hour of the 8-hour work period, with no emissions for the rest of the day. For comparison to annual standards, emissions were estimated assuming one working 8-hour shift per day, 21.25 days per month. Three construction alternatives were evaluated: Alternative 2, 3, and 4.

Analysis

Two detailed air quality dispersion modeling analyses were conducted to estimate the potential air quality impacts of construction emissions on nearby sensitive land uses.

1. The potential impacts of criteria pollutants associated with emissions from diesel equipment and dust from vehicles traveling on paved and unpaved roads were estimated. Four criteria pollutants with averaging time periods corresponding to the NAAQS were considered -- 1-hour NO2, 8-hour CO, 24-hour PM10, and 24-hour PM2.5.
2. The potential short-term and long-term impacts of the air toxic pollutants that have the potential to be released from the diesel-fueled construction equipment were estimated. Both carcinogenic and non-carcinogenic impacts were considered. All calculations of inhalation cancer risk and hazard quotients were based on EPA's *Human Health Risk Assessment Protocol* (HHRAP); inhalation unit risk factors and reference concentrations were obtained from EPA's *Integrated Risk Information System* (IRIS). The values used for each pollutant are presented in Appendix B.

Alternatives Considered

Short-term and annual emission rates of each of the three construction alternatives (Alternative 2, 3, and 4) were estimated. Alternative 2 in 2015 was estimated to have the highest emission rates; therefore, the estimated emissions of this alternative were evaluated in the dispersion analysis. The impacts of the other alternatives would be lower than those predicted in this analysis.

Emissions

The methodology for estimating criteria pollutant emission rates are discussed in Section 2.3.1. Emission rates of the toxic air pollutants were estimated using Total Organic Compound (TOC) emission factors from EPA's *Compilation of Air Pollutant Emission Factors* (AP-42), Table 3.3-1. "Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines" (e.g., 0.35 pound/million Btu) and emission factors for each toxic compound from Table 3.3-2 "Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines." Based on each compound emission factor (in pound/million Btu) and total TOC (or VOC) emission factors, ratios of emission factors were developed and applied to the 1-hour and annual estimated concentrations. Twenty three contaminants listed in Table 3.3-2 of AP-42, as associated with internal combustion diesel engines emissions, were considered in the analysis.

Dispersion Modeling Analysis

Dispersion modeling was conducted using the latest version of the EPA AERMOD atmospheric dispersion model (version 12060) to simulate physical conditions and predict pollutant concentrations at nearby receptor locations.

AERMOD can be used to estimate impacts from simple point-source emissions (e.g., stacks) as well as emissions from volume and area sources. The model accepts actual hourly meteorological observations and directly estimates hourly and average concentrations for various time periods. Regulatory default options and the urban dispersion algorithm of the AERMOD model were used in the analysis. Five consecutive years of meteorological data (2007-2011) from Reagan National Airport, which is located approximately 3 miles from the project area, were used.

Emissions from the on-site construction activities were simulated as polygon area sources. The total construction site, with concurrent activities, was divided into the three polygon areas -- the East, West and Middle areas. Emissions from vehicles (including the project's haul trucks) traveling on the road adjacent to the construction site (Virginia Avenue) were also simulated as an area source. An emission release height of 12 feet was used to simulate the height of the exhaust points of the construction equipment.

Emissions from all four source groups (i.e., the three construction areas and the Virginia Avenue traffic) were modeled in one modeling run to generate the total impacts from all sources combined. Maximum impacts were the added to appropriate pollutant background concentrations, and the total estimated concentrations were compared with applicable NAAQS for criteria pollutants.

Background Values

Background values are concentrations that are added to analytically predicted project increments to estimate total pollutant concentrations (for comparison to the NAAQS). Data obtained from the air quality monitoring station located at 420 34th Street NE were considered to be representative of project area land use, and were therefore used as background values for this analysis.

NO_2 Analysis

Emissions of nitrogen oxides (NOx) from combustion in diesel-fueled engines consist predominantly (at the emission source) of nitric oxide (NO), which then converts to NO_2 in the atmosphere in the presence of ozone and sunlight. This chemical transformation usually occurs as the exhaust plume travels downwind from the source.

A study conducted by California's South Coast Air Quality Management District[1] (where the ozone levels are the highest in the country and where greater conversions would therefore occur) estimated that the NOx/NO_2 ratio at 150 feet from a construction site is 5.9 percent. This value was applied to the modeled 1-hour NOx impacts to estimate 1-hour NO_2 impacts, which were then added to the appropriate background concentration. The resulting total values were then compared to the 1-hour NO_2 standard.

[1] *Final Localized Significance Threshold Methodology*, June 2003. Revised July 2008.

Air Toxics Analysis

The procedures to estimate cancer risk and the hazard index of toxic pollutants are based on inhalation exposure concentrations outlined in EPA's Human Health Risk Assessment Protocol (HHRAP (EPA520-R-05-006)). The HHRAP is a guideline that can be used to perform health risk assessment for individual compounds with known health effects in order to determine the level of health risk posed by an increased ambient concentration of that compound at a potentially sensitive receptor. The derived health risk values from the HHRAP were used in this analysis to determine the total risk posed by the release of multiple toxic contaminants.

The air toxics emissions were considered as both carcinogens and non-carcinogens. Carcinogenic compounds were evaluated using unit risk factors (URF); non-carcinogenic compounds were evaluated using the reference concentrations for inhalation exposure (RfC) and/or acute inhalation exposure (AIEC). RfC and AIEC were used to estimate non-carcinogenic health effects of substances that are also carcinogens. A conservative cancer threshold of one in one million, as recommended by the EPA for health-risk related assessments, was used in the analysis to determine whether estimated impacts would be considered significant. All calculations of inhalation cancer risk and hazard quotients were based on EPA's *Human Health Risk Assessment Protocol* (HHRAP); inhalation unit risk factors and reference concentrations were obtained from EPA's *Integrated Risk Information System* (IRIS). The values used for each pollutant are presented in Appendix B.

Receptor Sites

Two sets of receptors (i.e., locations where pollutant concentrations were estimated) were considered. The first are ground-level receptors located on a grid network around the construction area boundary and along the travelled roadway of Virginia Avenue. The second set is comprised of actual residences (and one hotel) located in the vicinity of construction area.

Results

Total estimated concentrations of each of the criteria pollutants, which are provided in **Table 9**, are below (within) their respective NAAQS. Therefore, the impacts of criteria pollutants from on-site construction activities are not considered to be significant.

Table 9: Maximum Total Estimated Criteria Pollutant Concentrations

Pollutant	Time Period	NAAQS	Max. Estimated Impacts	Background Conc.	Max. Estimated Concentrations	Exceed NAAQS?
CO (ppm)	1-hr	35	0.6	4.2	4.8	No
CO (ppm)	8-hr	9	0.4	3.8	4.2	No
NO_2 (ug/m^3)	1-hr	188	34	119	153	No
PM_{10} (ug/m^3)	24-hr	150	58	85	143	No
$PM_{2.5}$ (ug/m^3)	24-hr	35	6	28	34	No

The result of the air toxics analysis is that the overall incremental cancer risk from all pollutants combined is below the applicable significant threshold of one in-one million (1E-06), and both the total chronic non-cancer and acute health hazard risks are less than 1. As such, the potential cancer, chronic non-cancer, and acute health risks associated with the project's construction activities are well within acceptable ranges and thus not considered to be significant. Please see Appendix B for more information.

3.3.3 *Off-Site (Mobile Source) Analysis*

Potential construction-phase air quality impacts associated with the operation of vehicles (including trucks used for the transportation of rock and debris removal, transport of construction materials and cement, and construction workers' vehicles) on the roadway network and changes in ramp configurations were estimated.

The portion of Virginia Avenue near the construction site is expected to experience the largest increase in the number of construction trucks in the study area. The impact of these vehicles was included in the on-site analysis. The combined impact of the general traffic on Virginia Avenue, the construction traffic on Virginia Avenue, and the on-site construction equipment represents the worst-case localized hot-spot impact due to the project for particulate matter. As shown in **Table 9**, NAAQS were not exceeded for any of the pollutants analyzed at this location.

To determine if the increase in vehicular traffic due to construction activities (additional trucks and detours) would result in a violation of the NAAQS for CO, a microscale analysis was conducted at a location away from the construction site. As shown in **Table 10**, an intersection screening analysis was performed based upon LOS and delay of intersections in the project area under all phases of construction (Phase 1A, Phase 1B, and Phase 2), as compared to No Build conditions.

An intersection is considered to fail the screening analysis if the project causes the intersection to decrease below LOS D, or to experience a worsening in delay with an LOS below D in both No Build and project conditions. Those intersections that failed the screening analysis were then compared to the construction haul truck routes (**Figure 8**) to find those locations that would be most exposed to the haul routes. Finally, the intersections that failed were evaluated for sensitive receptors in the vicinity.

The intersection of M Street and 8th Street was selected for a microscale analysis for the following reasons:

- The intersection worsens from AM/PM LOS of B/B in No Build to D/E under Phase 1B and Phase 2 of construction. Although the intersection could be optimized to LOS C/C under Phase 1B, it is still expected to experience a LOS of D/E under Phase 2 conditions;
- As shown in Figure 7, the intersection of M Street and 8th Street is located at the intersection of haul truck routes on both M Street and on 8th Street; and
- The Eagle Academy Public Charter School is located at the northwest corner of the intersection.

Table 10: 2015 Construction Screening Analysis

Intersection No.	Intersection Name	2015 No-Build Conditions						2015 Phase 1A					
		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
		Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS
1A	South Capitol Street and I (Eye) Street (Left)	11.6	0.67	B	15.9	0.70	B	11.6	0.67	B	15.9	0.70	B
1A	South Capitol Street and I (Eye) Street (Right)	19.3	0.73	B	19.5	0.60	B	19.3	0.73	B	19.5	0.60	B
1C	Ramps from freeway at South Capitol Street SB	101.5	1.01	F	40.8	0.68	D	101.5	1.01	F	40.8	0.68	D
2A	South Capitol Street at M Street - SB Intersection	296.7	1.55	F	35.3	0.65	D	296.7	1.55	F	35.3	0.65	D
2B	South Capitol Street at M Street - NB Intersection	38.3	0.70	D	89.6	0.72	F	38.3	0.70	D	89.6	0.72	F
3	M Street at 1st Street	23.9	0.67	C	34.9	0.76	C	23.9	0.67	C	34.9	0.76	C
4	M Street at New Jersey Avenue	15.4	0.40	B	14.3	0.56	B	15.4	0.40	B	14.3	0.56	B
5	M Street at 3rd Street	7.6	0.32	A	14.7	0.56	B	7.6	0.32	A	14.7	0.56	B
6	M Street at 4th Street	19.6	0.43	B	15.2	0.48	B	19.6	0.43	B	15.2	0.48	B
8	M Street at 8th Street	18.7	0.64	B	14.8	0.70	B	18.7	0.64	B	14.8	0.70	B
9	M Street at 9th Street	10.9	0.38	B	14.6	0.63	B	10.9	0.38	B	14.6	0.63	B
10	M Street at 11th Street	22.5	0.67	C	124.9	1.02	F	22.5	0.67	C	124.9	1.02	F
14	Virginia Avenue EB at 5th Street	35.1	0.12	D	46.6	0.36	D	N/A			N/A		
15	SE Freeway off-ramp at 6th Street/Virginia Avenue EB	17.4	0.53	B	15.4	0.43	B	30.7	0.98	C	21.0	0.85	C
16	Virginia Avenue EB at 7th Street	6.3	0.26	A	17.7	0.45	B	17.6	0.79	B	47.8	0.95	D
17A	Virginia Avenue EB at 8th Street	32.4	0.31	C	46.7	0.38	D	21.0	0.55	C	46.7	0.82	D
17B	Virginia Avenue ramp at 8th street	12.0	0.33	B	14.3	0.46	B	N/A			N/A		
19	I (Eye) Street at 8th Street	19.1	0.52	B	19.9	0.52	B	19.1	0.52	B	19.9	0.52	B
20	I (Eye) Street at Virginia Avenue WB/7th Street	8.4	0.38	A	11.9	0.56	B	7.6	0.44	A	37.4	0.69	D
21	I (Eye) Street and Virginia Avenue WB at 6th Street	7.3	0.46	A	27.3	0.37	C	9.5	0.45	A	38.5	0.34	D
22	Virginia Avenue WB at 4th Street north of SE Freeway	30.3	0.47	C	28.4	0.43	C	30.3	0.47	C	28.4	0.43	C
23	Virginia Avenue WB at 3rd Street north of SE Freeway	44.8	0.84	D	122.5	1.25	F	44.8	0.84	D	122.5	1.25	F
27	G Street at 8th Street	9.0	0.31	A	11.1	0.42	B	9.0	0.31	A	11.1	0.42	B
28	M Street at Isaac Hall Avenue	4.4	0.40	A	21.2	0.64	C	4.4	0.40	A	21.2	0.64	C

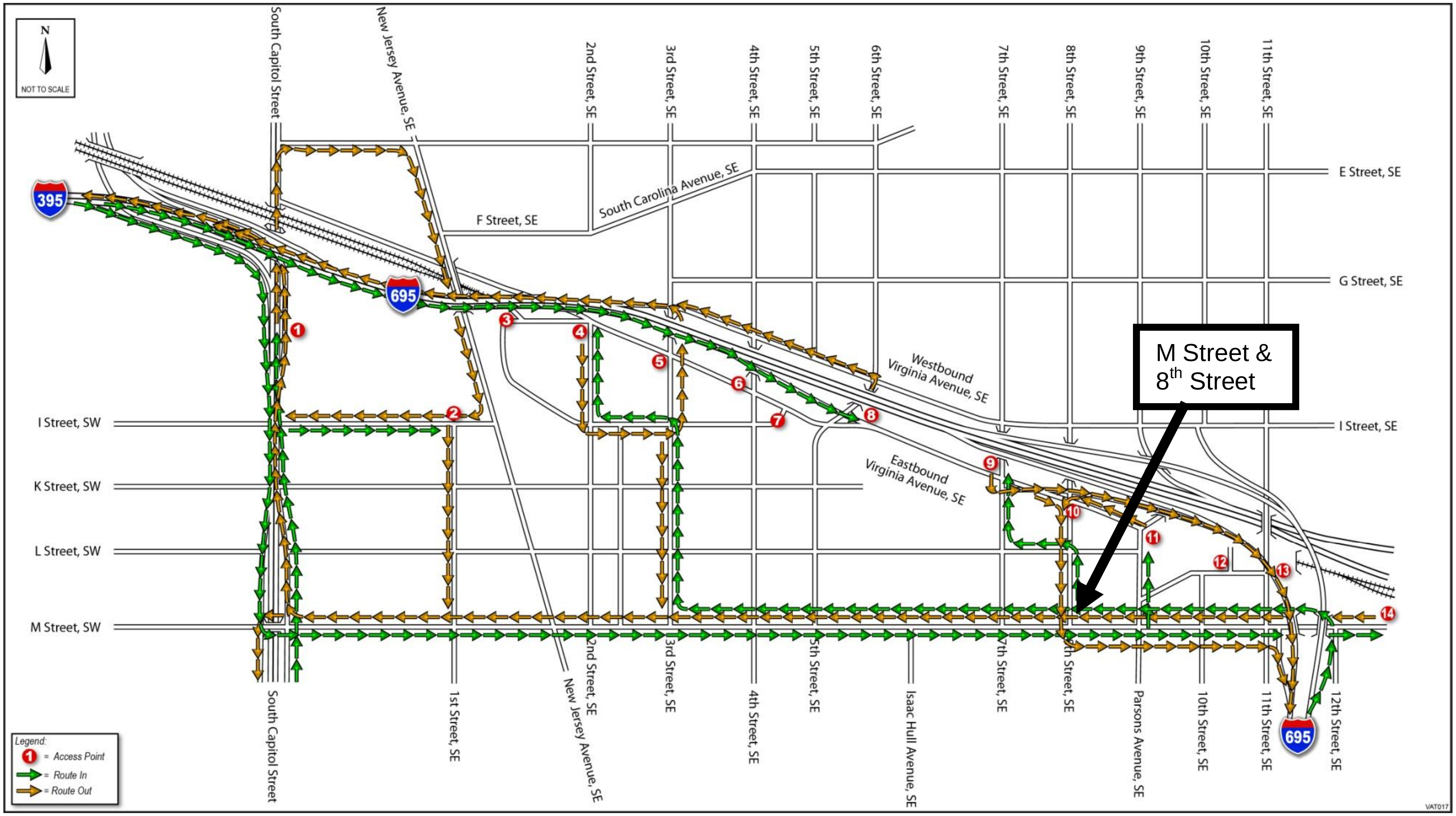
Source: DEIS Traffic Analysis

Table 10: 2015 Construction Screening Analysis (Cont'd)

Intersection No.	Intersection Name	2015 Phase 1B						2015 Phase 2					
		AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
		Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS
1A	South Capitol Street and I (Eye) Street (Left)	11.6	0.67	B	15.9	0.70	B	11.6	0.67	B	15.9	0.70	B
1A	South Capitol Street and I (Eye) Street (Right)	19.3	0.73	B	19.5	0.60	B	19.3	0.73	B	19.5	0.60	B
1C	Ramps from freeway at South Capitol Street SB	101.5	1.01	F	40.8	0.68	D	101.5	1.01	F	40.8	0.68	D
2A	South Capitol Street at M Street - SB Intersection	296.7	1.55	F	35.3	0.65	D	296.7	1.55	F	35.3	0.65	D
2B	South Capitol Street at M Street - NB Intersection	38.3	0.70	D	89.6	0.72	F	38.3	0.70	D	89.6	0.72	F
3	M Street at 1st Street	23.9	0.67	C	34.9	0.76	C	23.9	0.67	C	34.9	0.76	C
4	M Street at New Jersey Avenue	15.4	0.40	B	14.3	0.56	B	15.4	0.40	B	14.3	0.56	B
5	M Street at 3rd Street	7.6	0.32	A	14.7	0.56	B	7.6	0.32	A	14.7	0.56	B
6	M Street at 4th Street	19.6	0.43	B	15.2	0.48	B	19.6	0.43	B	15.2	0.48	B
8	M Street at 8th Street	51.0	0.77	D	65.9	0.88	E	51.0	0.77	D	65.9	0.88	E
9	M Street at 9th Street	12.5	0.39	B	15.6	0.69	B	12.5	0.39	B	15.6	0.69	B
10	M Street at 11th Street	22.7	0.71	C	247.0	1.21	F	22.7	0.71	C	247.0	1.21	F
14	Virginia Avenue EB at 5th Street	N/A			N/A			N/A			N/A		
15	SE Freeway off-ramp at 6th Street/Virginia Avenue EB	30.7	0.98	C	21.0	0.85	C	N/A			N/A		
16	Virginia Avenue EB at 7th Street	17.6	0.79	B	47.8	0.95	D	N/A			N/A		
17A	Virginia Avenue EB at 8th Street	16.2	0.51	B	33.9	0.68	C	N/A			N/A		
17B	Virginia Avenue ramp at 8th street	N/A			N/A			N/A			N/A		
19	I (Eye) Street at 8th Street	19.1	0.52	B	19.9	0.52	B	35.8	0.70	D	20.1	0.49	C
20	I (Eye) Street at Virginia Avenue WB/7th Street	7.6	0.44	A	37.4	0.69	D	49.1	0.70	D	30.2	0.84	C
21	I (Eye) Street and Virginia Avenue WB at 6th Street	9.5	0.45	A	38.5	0.34	D	46.5	0.94	D	179.2	0.75	F
22	Virginia Avenue WB at 4th Street north of SE Freeway	30.3	0.47	C	28.4	0.43	C	30.3	0.47	C	28.4	0.43	C
23	Virginia Avenue WB at 3rd Street north of SE Freeway	44.8	0.84	D	122.5	1.25	F	44.8	0.84	D	122.5	1.25	F
27	G Street at 8th Street	9.0	0.31	A	11.1	0.42	B	10.1	0.27	B	11.6	0.32	B
28	M Street at Isaac Hall Avenue	4.4	0.40	A	21.2	0.64	C	4.4	0.40	A	21.2	0.64	C

Source: DEIS Traffic Analysis

Figure 8: Haul Truck Routes



The microscale analysis was performed for CO using the CAL3QHC dispersion model. Emission factors were estimated using the EPA Mobile 6.2 emission algorithm and the same input assumptions as were used for the project's operational phase. AM and PM peak traffic conditions were considered. The higher of the second maximum monitored CO levels (**Table 3**) were used for background concentrations.

The analysis was performed for future year conditions with the proposed construction scenario and future conditions without the proposed action to obtain the increment due to truck movement and the effect of lane closings in the project area. **Table 11** presents the results of the microscale analysis for No Build and Phase 2 (worst-case) construction conditions. No violations of the NAAQS are predicted.

Table 11: CO Microscale Results, M Street & 8th Street

Pollutant	No Build		Phase 2 Construction	
	AM	*PM*	*AM*	*PM*
CO 1-Hour* (ppm)	4.8	4.8	4.8	4.8
CO 8-Hour** (ppm)	4.2		4.2	

*1-Hour results include a background concentration of 4.2 ppm.
**8-Hour results include a background concentration of 3.8 ppm.
ppm = parts per million

3.4 *Summary of Results*

The following is the result of the air quality analysis:

- Construction phase emissions are not predicted to exceed the GC Rule's *de minimis* emission thresholds. As such, air quality impacts from construction of any of the Build Alternatives would not be subject to a conformity determination;
- Construction phase impacts are not predicted to exceed a NAAQS at applicable sensitive land uses adjacent to the project area; and
- Construction-phase of the Project has no potential for MSAT effects.

4.0 References

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