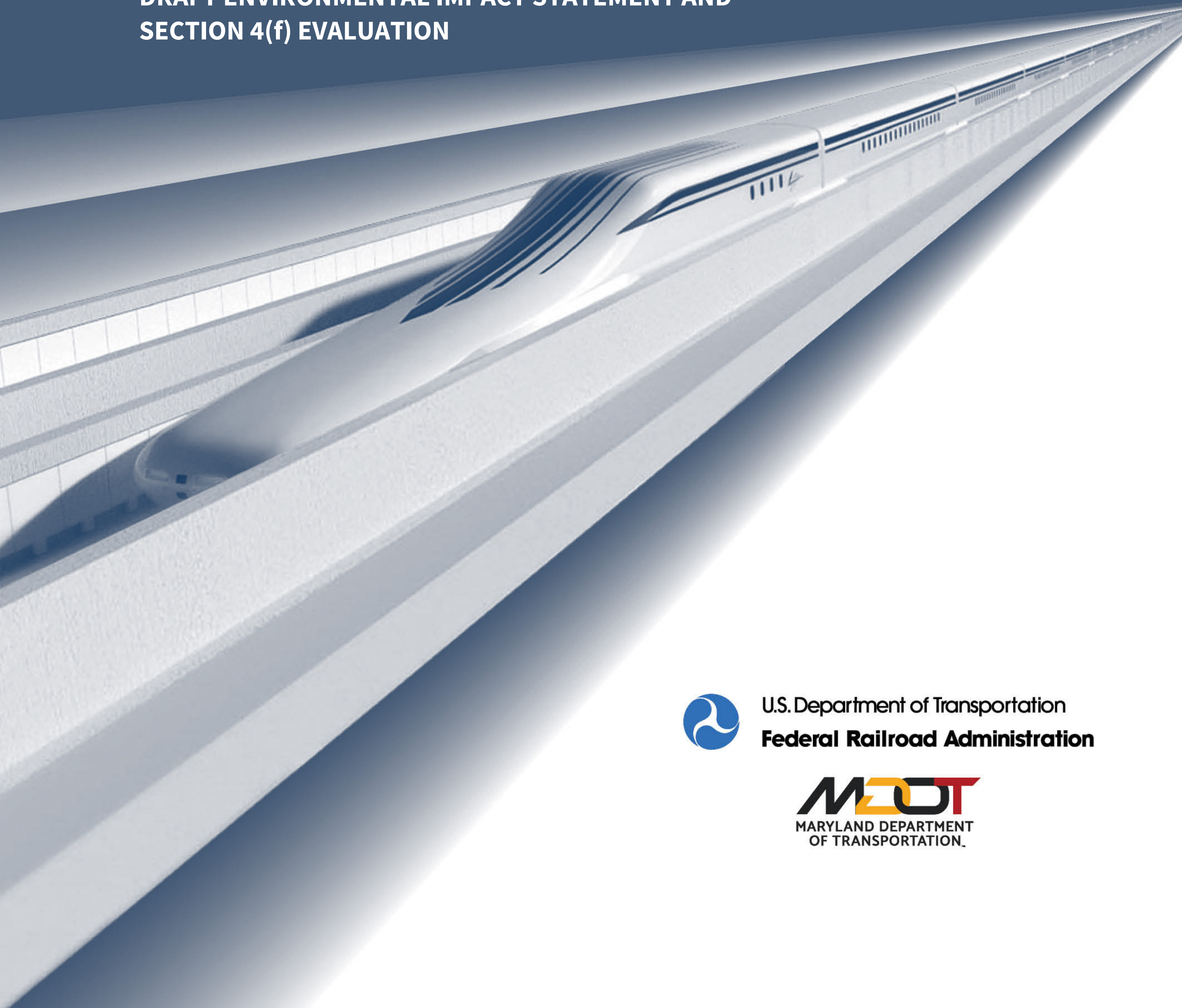
Appendix D.9

Air Quality Technical Report

BALTIMORE-WASHINGTON, D.C. SUPERCONDUCTING MAGLEV PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT AND SECTION 4(f) EVALUATION



U.S. Department of Transportation
Federal Railroad Administration

MARYLAND DEPARTMENT OF TRANSPORTATION

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Appendix D.9A Air Quality

D.9A.1 Introduction

This technical report presents an air quality impact analysis and findings of a proposed Superconducting Magnetic Levitation Project (SCMAGLEV Project) high speed rail system between Baltimore, Maryland (MD) and Washington, D.C. This report has been prepared in support of the Draft Environmental Impact Statement and Section 4(f) Evaluation (DEIS/Section 4(f) Evaluation) prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321–4327 and 40 C.F.R. Parts 1500–1508); Section 4(f) of the Department of Transportation Act; Federal Railroad Administration (FRA) Procedures for Considering Environmental Impacts (64 FR 28545, May 26, 1999; 78 FR 2713, January 14, 2013), and other applicable laws and regulations.

FRA is the lead Federal agency under NEPA and the Maryland Department of Transportation Maryland Transit Administration (MDOT MTA) is the joint lead agency. The Baltimore Washington Rapid Rail (BWRR), a private corporation, is the Project Sponsor and developer for the Baltimore-Washington SCMAGLEV Project (Project). More information about BWRR can be found on their website https://bwrapidrail.com/.

D.9A.2 Proposed Action

The Proposed Action includes the construction and operation of a SCMAGLEV system between Baltimore, MD and Washington, D.C. SCMAGLEV is a high-speed rail technology that runs on a grade-separated, fixed guideway powered by magnetic forces. This system can operate at speeds of well over 300 miles per hour. This system does not operate on standard steel wheel railroad tracks and therefore requires a separate operating environment.

The SCAMGLEV Project includes two terminal stations (Washington, D.C. and Baltimore, MD) and one intermediate station at the Baltimore-Washington International Thurgood Marshall Airport (BWI Marshall Airport Station). Additional facilities are required to operate the system and include maintenance of way (MOW) facilities, one trainset maintenance facility (TMF), and other ancillary facilities such as fresh air and emergency egress facilities, substations, and stormwater management facilities. The system proposes to operate on both underground (deep tunnel) and elevated (viaduct) guideway. Stations and ancillary facilities would generally be located adjacent to the guideway and would provide for access to passenger and employee parking, where necessary. These features make up the two corridor alignment alternatives that were retained for the detailed study and include the Build Alternatives J and J1 with each consisting a total of six alternatives per the combination of various station and additional facilities. **Figures D.9-1 and D.9-2** show the proposed Build Alternatives J and J1 under the Cherry Hill Station option.

Figure D.9-1: Build Alternatives J1 through J3 – BWP East with Cherry Hill Station

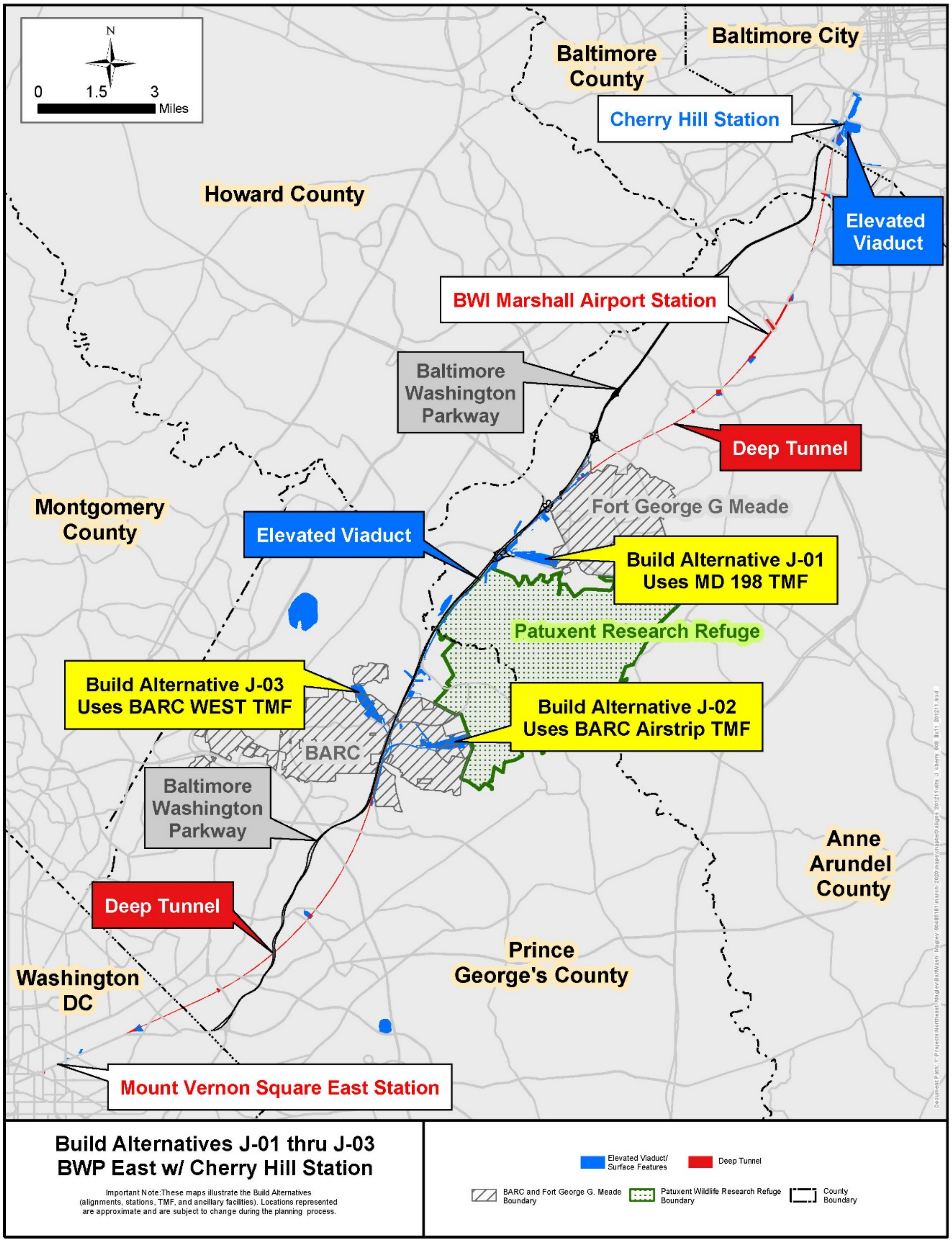
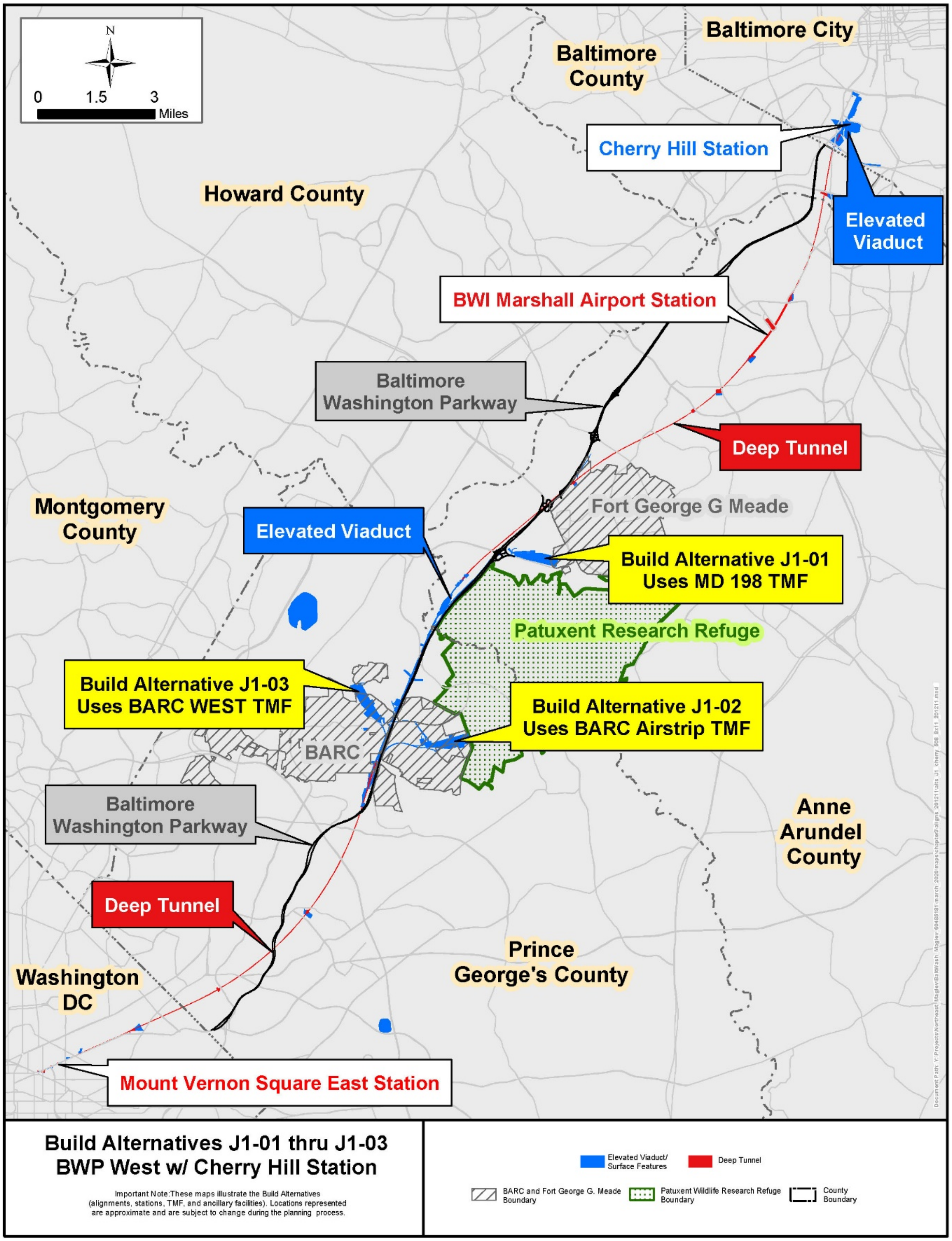


Figure D.9-2 Build Alternatives J1 through J3 – BWP West with Cherry Hill Station



Project Study Area

The initial Project Study Area for the SCAMGLEV Project is roughly bound by I-95 on the west and by the former Washington-Baltimore & Annapolis Electric Railroad alignment on the east. It spans approximately 40 miles north to south and ten miles east to west (**Figure D.9-3**). It includes portions of the City of Baltimore, Baltimore County, Howard County, Anne Arundel County and Prince George's County, MD and Washington, D.C.

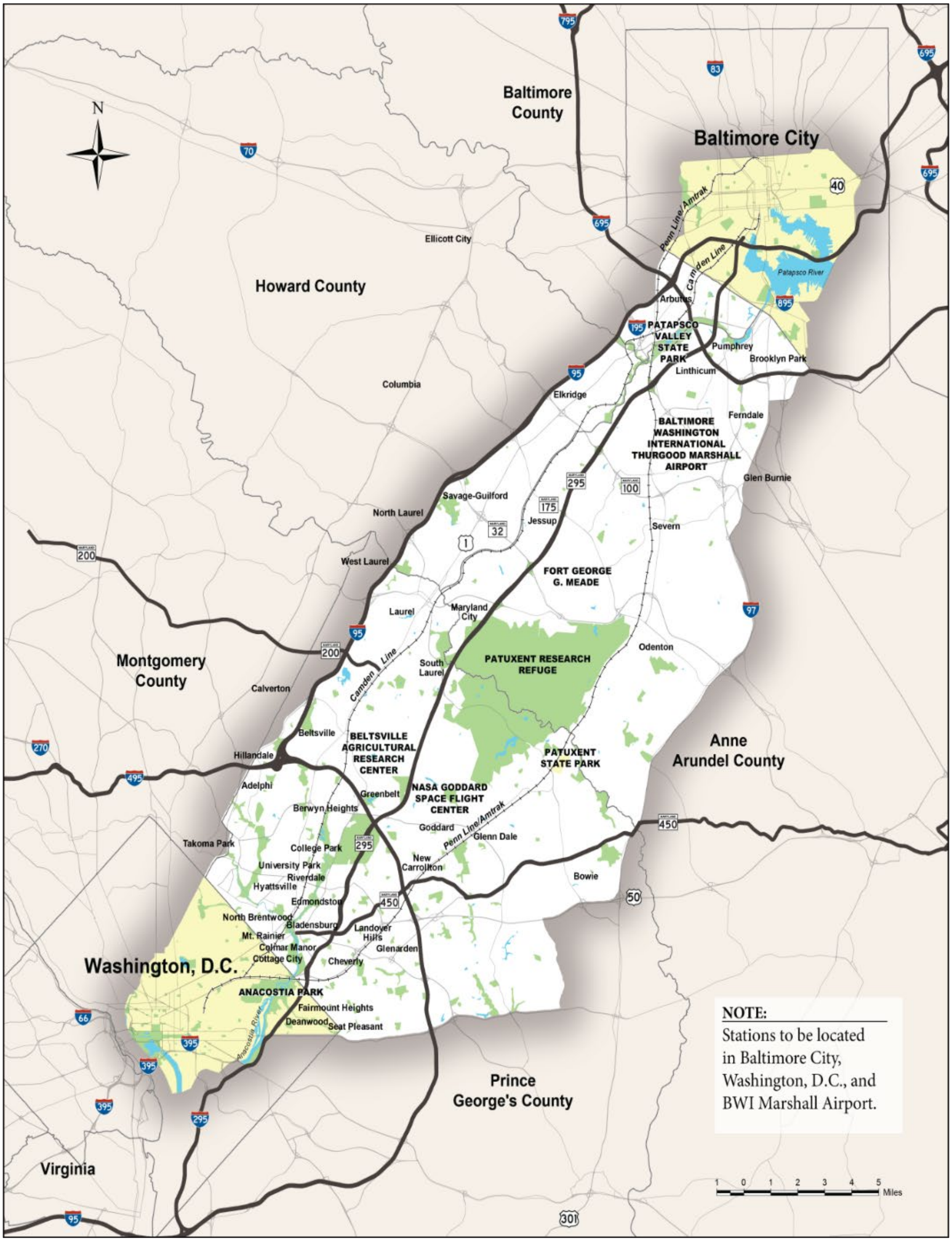
Appendix D.9B Regulatory Context and Methodology

Air quality is defined as the concentration of specific pollutants of concern in ambient air. Most air pollutants originate from human-made sources, including mobile sources (e.g., cars, trucks, buses, nonroad equipment) and stationary sources (e.g., factories, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). The levels of concern of air quality are set with respect to the health and welfare of the public. Receptors surrounding the SCAMGLEV Project may be sensitive to potential air quality effects because of implementing the proposed Project. This section describes existing air quality conditions and the potential impacts for the No Build and Build Alternatives, as well as provides an evaluation of greenhouse gas (GHG) emissions, the potential climate change impacts resulting from construction and operation, and potential mitigation measures.

D.9B.1 Regulatory Context

In accordance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., the Council on Environmental Quality (CEQ) regulations, 40 C.F.R. Parts 1500 - 1508, and the Federal Rail Administration's (FRA) Procedures for Considering Environmental Impacts, 64 Fed. Reg. 28545 (May 26, 1999), FRA assessed the consistency of the alternatives with Federal and state plans for the attainment and maintenance of air quality standards.

Figure D.9-3: Project Study Area



D.9B.1.1 Pollutants of Concern

D.9B.1.1.1 Criteria Pollutants

In accordance with the Clean Air Act (CAA) FRA has included methods to evaluate air quality according to National Ambient Air Quality Standards (NAAQS), project–level conformity with state and regional planning, localized impacts, mesoscale subarea impacts, and construction impacts. FRA defined the Project Study Area for Air Quality impact studies to vary dependent upon the pollutant criteria and type of analysis. As required under the CAA, the USEPA has established National Ambient Air Quality Standards (NAAQS) for six contaminants, referred to as criteria pollutants (40 Code of Federal Regulations (CFR) 50):

- carbon monoxide (CO),
- nitrogen dioxide (NO_2),
- ozone (O_3),
- particulate matter with diameters up to 10 µm (PM_{10}) and diameters up to 2.5 µm ($PM_{2.5}$),
- lead (Pb), and
- sulfur dioxide (SO_2)

Criteria pollutant details including pollutant sources and human and environmental impacts are provided in **Table D.9-1**. The NAAQS include primary and secondary standards. The primary standards were established at levels sufficient to protect public health with an adequate margin of safety. The secondary standards were established to protect the public welfare from the adverse effects associated with pollutants in the ambient air, such as damage to plants and ecosystems. The primary and secondary standards are presented in **Table D.9-2**. These standards have been adopted as the ambient air quality standards for Maryland and Washington, D.C.

Mobile Sources

Mobile sources of relevance to this project are primarily motor vehicles and nonroad vehicles under both operational and construction conditions within the Project Study Area. Primary vehicle-related air pollutants are CO and O_3 precursors (NO_x and volatile organic compounds [VOCs]). PM (PM_{10} and $PM_{2.5}$) can also be of concern from mobile sources especially from heavy-duty diesel trucks or nonroad equipment. Lead emissions from automobiles are not significant and have declined in recent years through the use of unleaded gasoline. Lead emissions from highway usage have been virtually eliminated as a result of regulations and legislation prohibiting the manufacture, sale, or introduction into commerce after 1992 of any engines requiring leaded gasoline. Potential emissions of SO_2 from mobile sources are insignificant in comparison with non-mobile emission sources.

Table D.9.1: Criteria Pollutants – Sources and Impacts

Pollutants and Their Sources	Health and Environmental Impacts
Ozone (O3): A gas composed of three oxygen atoms. It is not usually emitted directly into the air, but at ground level is created by a chemical reaction between oxides of nitrogen and volatile organic compounds (VOCs) in the presence of heat and sunlight. Ozone has the same chemical structure whether it occurs miles above the earth or at ground level and can be "good" or "bad," depending on its location in the atmosphere. "Good" ozone occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and forms a layer that protects life on earth from the sun's harmful rays. In the earth's lower atmosphere, ground-level ozone is considered "bad." VOC + NOx + Heat + Sunlight = Ozone: Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOCs that help to form ozone. Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. As a result, it is known as a summertime air pollutant. Many urban areas tend to have high levels of "bad" ozone, but even rural areas are also subject to increased ozone levels because wind carries ozone and pollutants that form it hundreds of miles away from their original sources.	Health Problems: Ozone can irritate lung airways and cause inflammation much like sunburn. Other symptoms include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people who are active outdoors can be affected when ozone levels are high. Repeated exposure to ozone pollution for several months may cause permanent lung damage. Anyone who spends time outdoors in the summer is at risk, particularly children and other people who are active outdoors. Even at very low levels, ground-level ozone triggers a variety of health problems, including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis. Plant and Ecosystem Damage: Ground-level ozone interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather. Ozone damages the leaves of trees and other plants, ruining the appearance of cities, national parks, and recreation areas. Ozone reduces crop and forest yields and increases plant vulnerability to disease, pests, and harsh weather.
Carbon Monoxide (CO): A colorless, odorless gas that is formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which contributes about 56 percent of all CO emissions nationwide. Other non-road engines and vehicles (such as construction equipment and boats) contribute about 22 percent of all CO emissions nationwide. Higher levels of CO generally occur in areas with heavy traffic congestion. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Other sources of CO emissions include industrial processes (such as metals processing and chemical manufacturing), residential wood burning, and natural sources such as forest fires. Woodstoves, gas stoves, cigarette smoke, and	**Health Problems**: CO can cause harmful health effects by reducing oxygen delivery to the body's organs (such as the heart and brain) and tissues. **Cardiovascular Effects** – The health threat from lower levels of CO is most serious for those who suffer from heart disease, such as angina, clogged arteries, or congestive heart failure. For a person with heart disease, a single exposure to CO at low levels may cause chest pain and reduce that person's ability to exercise; repeated exposures may contribute to other cardiovascular effects. **Central Nervous System Effects** – Even healthy people can be affected by high levels of CO.

Pollutants and Their Sources	Health and Environmental Impacts
unvented gas and kerosene space heaters are sources of CO indoors. The highest levels of CO in the outside air typically occur during the colder months of the year when inversion conditions are more frequent. The air pollution becomes trapped near the ground beneath a layer of warm air.	People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks. At extremely high levels, CO is poisonous and can cause death. **Smog** – CO contributes to the formation of smog (ground-level O_3), which can trigger serious respiratory problems.
Sulfur Dioxide (SO_2): SO_2 belongs to the family of sulfur-oxide gases (SO_x). These gases dissolve easily in water. Sulfur is prevalent in all raw materials, including crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SO_x gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment. Over 65% of SO_2 released to the air – more than 13 million tons per year – comes from electric utilities, especially those that burn coal. Other sources of SO_2 are industrial facilities that derive their products from raw materials like metallic ore, coal, and crude oil, or that burn coal or oil to produce process heat. Examples are petroleum refineries, cement manufacturing, and metal-processing facilities. Also, locomotives, large ships, and some non-road diesel equipment currently burn high-sulfur-content fuel and release SO_2 emissions to the air in large quantities.	SO_2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Particularly sensitive groups include people with asthma who are active outdoors and children, the elderly, and people with heart or lung disease. **Health Problems**: **Respiratory Effects from Gaseous SO_2** – Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease. **Respiratory Effects from Sulfate Particles** – SO_2 reacts with other chemicals in the air to form tiny sulfate particles. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death. **Visibility Impairment** Haze occurs when light is scattered or absorbed by particles and gases in the air. Sulfate particles are the major cause of reduced visibility in many parts of the U.S., including our national parks. **Plant and Ecosystem Damage**: **Acid Rain** – SO_2 and nitrogen oxides react with other substances in the air to form acids, which fall to earth as rain, fog, snow, or dry particles. Some may be carried by the wind for hundreds of miles. **Plant and Water Damage** – Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure over a long time changes the natural variety of plants and animals in an ecosystem. **Aesthetic Damage** – SO_2 accelerates the decay of building materials and paints, including

Pollutants and Their Sources	Health and Environmental Impacts
	irreplaceable monuments, statues, and sculptures that are part of our nation's cultural heritage.
Nitrogen Oxides (NO_x): The generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, nitrogen dioxide (NO_2), along with particles in the air can often be seen as a reddish-brown layer over many urban areas. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary sources of NO_x are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.	NO_x can cause a wide variety of health and environmental impacts because of various compounds and derivatives in the family of nitrogen oxides, including nitrogen dioxide, nitric acid, nitrous oxide, nitrates, and nitric oxide. **Health Problems**: **Ground-level Ozone (smog)** is formed when NO_x and VOCs react in the presence of heat and sunlight. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects, such as damage to lung tissue and reduction in lung function. Ozone can be transported by wind currents and cause health impacts far from original sources. Millions of Americans live in areas that do not meet the health standards for ozone. Other impacts from ozone include damaged vegetation and reduced crop yields. **Particles** – NO_x reacts with ammonia, moisture, and other compounds to form nitric acid and related particles. Human health concerns include effects on breathing and the respiratory system, damage to lung tissue, and premature death. Small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory diseases such as emphysema and bronchitis, and aggravate existing heart disease. **Toxic Chemicals** – In the air, NO_x reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products, some of which may cause biological mutations. Examples of these chemicals include the nitrate radical, nitroarenes, and nitrosamines. **Visibility Impairment** – Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale in our national parks. **Plant and Ecosystem Damage**: **Acid Rain** – NO_x and sulfur dioxide react with other substances in the air to form acids that fall to earth as rain, fog, snow, or dry particles. Some may be carried by wind for hundreds of miles. Acid rain damage causes deterioration of cars, buildings and historical monuments; and causes lakes and

Pollutants and Their Sources	Health and Environmental Impacts
	streams to become acidic and unsuitable for many fish. **Water Quality Deterioration** – Increased nitrogen-loading in water bodies, particularly coastal estuaries, upsets the chemical balance of nutrients used by aquatic plants and animals. Additional nitrogen accelerates "eutrophication," which leads to oxygen depletion and reduces fish and shellfish populations. NO_x emissions in the air constitute one of the largest sources of nitrogen pollution in the Chesapeake Bay. **Global Warming** – One of oxides of nitrogen, nitrous oxide, is a greenhouse gas. It accumulates in the atmosphere with other greenhouse gasses causing a gradual rise in the earth's temperature. This leads to increased risks to human health, a rise in sea level, and other adverse changes to plant and animal habitat.
Particulates (PM_{10} and $PM_{2.5}$): Particulate matter (PM) is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particles can be suspended in the air for long periods of time. Some particles are large or dark enough to be seen as soot or smoke. Others are so small that individually they can only be detected with an electron microscope. Some particles are directly emitted into the air. They come from a variety of sources, such as cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, stone crushing, and the burning of wood. Other particles may be formed in the air from the chemical change of gases. They are indirectly formed when gases from burning fuels react with sunlight and water vapor. These can result from fuel combustion in motor vehicles, at power plants, and in other industrial processes.	**Health Problems**: Many scientific studies have linked breathing PM to a series of significant health problems, including: • Aggravated asthma. • Increases in respiratory symptoms (e.g., coughing and difficult or painful breathing) • Chronic bronchitis. • Decreased lung function. • Premature death. **Visibility Impairment** – PM is the major cause of reduced visibility (haze) in parts of the United States, including many of our national parks. **Plant and Ecosystem Damage** – Has to do with atmospheric deposition. Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: • Making lakes and streams acidic. • Changing the nutrient balance in coastal waters and large river basins. • Depleting the nutrients in soil. • Damaging sensitive forests and farm crops. • Affecting the diversity of ecosystems. **Aesthetic Damage** – Soot, a type of PM, stains and damages stone and other materials, including

Pollutants and Their Sources	Health and Environmental Impacts
	culturally important objects such as monuments and statues.
Particulates (PM_{10} and $PM_{2.5}$): Particulate matter (PM) is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particles can be suspended in the air for long periods of time. Some particles are large or dark enough to be seen as soot or smoke. Others are so small that individually they can only be detected with an electron microscope. Some particles are directly emitted into the air. They come from a variety of sources, such as cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, stone crushing, and the burning of wood. Other particles may be formed in the air from the chemical change of gases. They are indirectly formed when gases from burning fuels react with sunlight and water vapor. These can result from fuel combustion in motor vehicles, at power plants, and in other industrial processes.	**Health Problems**: Many scientific studies have linked breathing PM to a series of significant health problems, including: • Aggravated asthma. • Increases in respiratory symptoms (e.g., coughing and difficult or painful breathing) • Chronic bronchitis. • Decreased lung function. • Premature death. **Visibility Impairment** – PM is the major cause of reduced visibility (haze) in parts of the United States, including many of our national parks. **Plant and Ecosystem Damage** – Has to do with atmospheric deposition. Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: • Making lakes and streams acidic. • Changing the nutrient balance in coastal waters and large river basins. • Depleting the nutrients in soil. • Damaging sensitive forests and farm crops. • Affecting the diversity of ecosystems. **Aesthetic Damage** – Soot, a type of PM, stains and damages stone and other materials, including culturally important objects such as monuments and statues.

Source: https://www.epa.gov/criteria-air-pollutants

Table D.9-1: National, Washington, D.C., and Maryland Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide	primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead	primary and secondary	Rolling 3-month average	0.15 µg/m3	Not to be exceeded

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb	Annual mean
Ozone		primary and secondary	8-hour	0.070 ppm	Annual fourth-highest daily optimum 8-hr concentration, averaged over 3 years
Particulate Matter	$PM_{2.5}$	primary	Annual	12 µg/m3	Annual mean, averaged over 3 years
		secondary	Annual	15 µg/m3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 µg/m3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb	99th percentile of 1-hour daily optimum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: http://www.epa.gov/air/criteria.html

As the operation of SCMAGLEV trains will not generate any emissions associated with burning fossil fuels, the criteria pollutants related to the SCMAGLEV Project are on-road vehicle- and/or construction equipment-related CO, PM_{10} and $PM_{2.5}$, and O_3 precursors [nitrogen oxides (NO_x) and volatile organic compounds (VOCs)]. In addition to these pollutants, FRA also considered SO_2 because the SCMAGLEV Project would be constructed and operated within areas of Baltimore and Anne Arundel Counties, both of which are in nonattainment for SO_2 NAAQS. Lead emissions from gasoline-fueled vehicles have been virtually eliminated through the use of unleaded gasoline and are not of concern for this analysis.

Stationary Sources

Several stationary sources of air emissions may be developed as part of the Build Alternatives including tunnel portals, ventilation facilities, parking facilities, stations, TMF, etc. However, because all these stationary facilities would be powered by the grid and therefore the operation would not result in stationary source operational emissions.

D.9B.1.1.2 Air Toxics

In addition to the criteria pollutants, the CAA also lists 187 air toxins, known as hazardous air pollutants (HAPs). Toxic air pollutants include several substances that are known or suspected to cause cancer or other health effects in humans when they are exposed to certain levels of the pollutants. Of the 187 HAPs, 93 have been identified as mobile source air toxics (MSAT) and nine MSAT are considered priority MSAT. The following nine priority MSATs and their associated health effects are provided in **Table D.9-3.**

- Acetaldehyde
- Acrolein
- Benzene
- 1,3-butadiene
- Diesel particulate matter plus diesel exhaust organic gases (diesel PM)
- Ethylbenzene
- Formaldehyde
- Naphthalene
- Polycyclic organic matter (POM)

The MSAT are compounds emitted by highway-traveling vehicles and nonroad equipment. Some toxic compounds are present in fuel and are emitted when the fuel evaporates or passes through the engine unburned. Other toxics are generated by 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.

Table D.9-2: Priority Mobile Source Air Toxics – Sources and Impacts

Pollutant Description	Health Effects
Benzene: Benzene occurs as a volatile, colorless, highly flammable liquid that dissolves easily in water. Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust.	Human carcinogen. Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings.
Formaldehyde: Formaldehyde is a colorless gas with a pungent, suffocating odor at room temperature. Formaldehyde is used mainly to produce resins used in particleboard products and as an intermediate in the synthesis of other chemicals. Exposure to formaldehyde may occur by breathing contaminated indoor air, tobacco smoke, or ambient urban air. The major sources appear to be power plants, manufacturing facilities, incinerators, and automobile exhaust emissions.	Probable human carcinogen. Acute (short-term) and chronic (long-term) inhalation exposure to formaldehyde in humans can result in respiratory symptoms, and eye, nose, and throat irritation. Limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer.

Pollutant Description	Health Effects
Naphthalene: Naphthalene is used in the production of phthalic anhydride; it is also used in mothballs.	Acute (short-term) 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. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy.
Diesel Exhaust: Diesel Particulate Matter/Diesel Exhaust Organic Gases - Diesel exhaust is a complex mixture of carbon particles and associated organics and inorganics. Diesel exhaust includes components in the gas and particle phases.	Diesel exhaust is a probable human lung carcinogen. Acute exposure can result in physiologic symptoms consistent with irritation and inflammation.
Acrolein: Acrolein is a water-white or yellow liquid that burns easily and is easily volatilized. Acrolein is primarily used as an intermediate in the manufacture of acrylic acid. It can be formed from the breakdown of certain pollutants in outdoor air or from burning tobacco or gasoline.	Possible human carcinogen. Acrolein is extremely toxic to humans from inhalation and dermal exposure. Acute (short-term) inhalation exposure may result in upper respiratory tract irritation and congestion. The major effects from chronic (long-term) inhalation exposure to acrolein in humans consist of general respiratory congestion and eye, nose, and throat irritation.
Acetaldehyde: Acetaldehyde is a colorless mobile liquid that is flammable and miscible with water. It is an intermediate product of higher plant respiration and formed as a product of incomplete wood combustion in fireplaces and woodstoves, coffee roasting, burning of tobacco, vehicle exhaust fumes, and coal refining and waste processing.	Possible human carcinogen. Acute (short-term) exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract. Symptoms of chronic (long-term) intoxication of acetaldehyde resemble those of alcoholism.
Ethylbenzene: Ethylbenzene is a colorless liquid that smells like gasoline. Ethylbenzene is used primarily in the production of styrene. It is also used as a solvent, as a constituent of asphalt and naphtha, and in fuels.	Acute (short-term) exposure to ethylbenzene in humans results in respiratory effects, such as throat irritation and chest constriction, irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure to ethylbenzene by inhalation in humans has shown conflicting results regarding its effects on the blood.
1,3-butadiene: 1,3-butadiene is a colorless gas with a mild gasoline-like odor. Motor vehicle exhaust is a constant source of 1,3-butadiene. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas.	Probable human carcinogen. Acute (short-term) exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Epidemiological studies have reported a possible association between 1,3-butadiene exposure and cardiovascular diseases. Epidemiological studies of workers in rubber plants

Pollutant Description	Health Effects
	have shown an association between 1,3-butadiene exposure and increased incidence of leukemia.
Polycyclic Organic Matter (POM): The term 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. POM compounds are formed primarily from combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include cigarette smoke, vehicle exhaust, home heating, laying tar, and grilling meat.	Cancer is the major concern from exposure to POM. Epidemiologic studies have reported an increase in lung cancer in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke; all of these mixtures contain POM compounds. Animal studies have reported respiratory tract tumors from inhalation exposure to benzo[a]pyrene and forestomach tumors, leukemia, and lung tumors from oral exposure to benzo[a]pyrene. EPA 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.

Source: https://www.epa.gov/haps/health-effects-notebook-hazardous-air-pollutants

D.9B.1.1.3 Greenhouse Gases

Greenhouse gases (GHG) are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. The primary long-lived greenhouse gases directly emitted by human activities are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The heating effect from these gases is considered the probable cause of the global warming observed over the last 50 years (Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the CAA; Final Rule 2009).

The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe. Under Section 202(a) of the CAA, the USEPA Administrator has recognized potential risks to public health or welfare and signed an endangerment finding regarding greenhouse gases (USEPA 2009). This finding indicates that the current and projected concentrations of greenhouse gases in the atmosphere threaten the public health and welfare of current and future generations.

To estimate global warming potential (GWP), all potential greenhouse gas contributions are expressed relative to a reference gas, CO_2, which is assigned a GWP equal to one. All six greenhouse gases are multiplied by their GWP and the results are added to calculate the total equivalent emissions of carbon dioxide (CO_2e). However, the dominant greenhouse gas emitted is CO_2, mostly from fossil fuel combustion related to the Proposed Action. This EIS considers CO_2 as the representative greenhouse gas emission.

D.9B.1.2 Regulatory Guidance

D.9B.1.2.1 Criteria Pollutants

The CAA requires geographic areas to be designated according to ability to attain the NAAQS and these areas are categorized for each criteria pollutant as:

- **In attainment** – Areas where no exceedance of NAAQS for a specific criteria pollutant occurred.
- **Nonattainment** – Areas where exceedance of NAAQS for a specific criteria pollutant occurred. The nonattainment designations for certain pollutants include degrees of classifications. For example, for O_3, the classification could be extreme, severe, serious, moderate, or marginal nonattainment, which indicates the severity of the air quality problem.
- **Maintenance Area** – Area that had previously been designated as a nonattainment area but is still in need of efforts to maintain the improved conditions in the future. Most of the CAA rules for nonattainment areas are still applicable to a maintenance area.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a Federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires states to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as State Implementation Plans (SIPs), are developed by state and local air quality management agencies and submitted to USEPA for approval.

In order to demonstrate compliance to the SIP, the air quality impacts of a transportation project are generally evaluated on two scales:

- Microscale level for CO and PM (PM_{10} and $PM_{2.5}$). A microscale analysis of traffic-related impacts at specific "Hot Spot" intersections or free flow sites and sensitive receptors provides estimates of localized pollutant concentrations for direct comparison to the NAAQS for determining the potential localized impact significance.
- Mesoscale level for NO_x and VOC (precursors of O_3), CO, and PM (PM_{10} and $PM_{2.5}$). A mesoscale analysis is typically performed for each alternative by computing total nonattainment pollutant levels (or "burdens") within the affected roadway network in the region where the SCAMGLEV Project is located and the detail traffic forecasts can be reasonably forecasted on a project level. Changes in emissions that would occur as a result of a changes in travel patterns, would be estimated. Emissions change as a result of changes in "vehicle miles

traveled" (VMT) and parameters in terms of roadway type, travel speed, etc. If a project comes from a conforming Transportation Improvement Plan (TIP), a regional mesoscale impact analysis is not required.

Transportation Conformity

Transportation projects funded or approved by Federal Highway Administration (FHWA) or Federal Transit Administration (FTA) are entities that are governed by the Transportation Conformity Rule (TCR); this Rule applies to the roadway improvement elements of the SCAMGLEV Project. Non-FHWA/FTA projects or components of a FHWA/FTA transportation project requiring actions by other Federal agencies, which are governed by the General Conformity Rule (GCR) - applies to the "rail" (in this case SCMAGLEV guideway and stations) component of the SCAMGLEV Project.

General Conformity

The USEPA General Conformity Rule (GCR) applies to Federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called de minimis levels. De minimis levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a Federal action must be supported by a conformity determination. This is typically done by quantifying applicable direct and indirect emissions that are projected to result due to implementation of the Federal action. Indirect emissions are those emissions caused by the Federal action and originating in the region of interest, but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable and can be practicably projected. The Federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the Federal agency. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. If the results of the applicability analysis indicate that the total emissions would not exceed the de minimis emissions thresholds, then the conformity evaluation process is completed. De minimis threshold emissions are presented in **Table D.9-4.**

If the exceedances of applicable de minimis levels were predicted, a general conformity rule will be applicable and a GCR determination will be required to demonstrate conformity by meeting one or more of below methods:

1) Demonstrating that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;
2) Obtaining a written statement from the State, Tribe or local agency responsible for the SIP or TIP documenting that the total direct and indirect emissions from

the action along with all other emissions in the area will not exceed the SIP emission budget;

3) Obtaining a written commitment from the State or Tribe to revise the SIP or TIP to include the emissions from the action;
4) Obtaining a statement from the metropolitan planning organization (MPO) for the area documenting that any on-road motor vehicle emissions are included in the current regional emission analysis for the area's transportation plan or transportation improvement program;
5) Fully offsetting the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or maintenance area; or
6) Conducting air quality modeling that demonstrates that the emissions will not cause or contribute to new violations of the standards or increase the frequency or severity of any existing violations of the standards. Air quality modeling cannot be used to demonstrate conformity for emissions of ozone precursors or nitrogen dioxide (NO2). As stated in EPA's proposal of the 1993 regulations (58 FR 13845), due to the complex interaction of the ozone precursors, the regional nature of the ozone and NO2 problems, and limitations of current air quality models, it is not generally appropriate to use an air quality model to determine the impact on ozone or NO2 concentrations from a single emission source or a single Federal action.

Stationary Source Permitting

New Source Review (Preconstruction Permit)

New major stationary sources and major modifications at existing major stationary sources are required by the CAA to obtain an air pollution permit before commencing construction. This permitting process for major stationary sources is called New Source Review and is required whether the major source or major modification is planned for nonattainment areas or attainment and unclassifiable areas. In general, permits for sources in attainment areas and for other pollutants regulated under the major source program are referred to as Prevention of Significant Deterioration (PSD) permits, while permits for major sources emitting nonattainment pollutants and located in nonattainment areas are referred to as nonattainment new source review permits. In addition, a proposed project may have to meet the requirements of nonattainment new source review for the pollutants for which the area is designated as nonattainment and PSD for the pollutants for which the area is attainment. Additional PSD permitting thresholds apply to increases in stationary source greenhouse gas (GHG) emissions. PSD permitting can also apply to a new major stationary source (or any net emissions increase associated with a modification to an existing major stationary source) that is constructed within 6.2 miles of a Class I area, and which would increase the 24-hour average concentration of any regulated pollutant in the Class I area by 1 microgram per cubic meter ($\mu g/m^3$) or more. Navy installations shall comply with applicable permit requirements under the PSD program per 40 CFR section 51.166.

Title V (Operating Permit)

The Title V Operating Permit Program consolidates all CAA requirements applicable to the operation of a source, including requirements from the SIP, preconstruction permits, and the air toxics program. It applies to stationary sources of air pollution that exceed the major stationary source emission thresholds, as well as other non-major sources specified in a particular regulation. The program includes a requirement for payment of permit fees to finance the operating permit program whether implemented by USEPA or a state or local regulator. Navy installations subject to Title V permitting shall comply with the requirements of the Title V Operating Permit Program, which are detailed in 40 CFR Part 70 and all specific requirements contained in their individual permits.

Table D.9-3: De Minimis Emission Levels for Criteria Air Pollutants

Pollutant	Area Type	tpy
Ozone (VOC or NOx)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NOx)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon monoxide, SO2 and NO2	All nonattainment & maintenance	100
PM-10	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
PM2.5 Direct emissions, SO2, NOx (unless determined not to be a significant precursor), VOC or ammonia (if determined to be significant precursors)	All nonattainment & maintenance	100
Lead (Pb)	All nonattainment & maintenance	25

Source: http://www.epa.gov/air/criteria.html

D.9B.1.2.2 Air Toxics

Stationary Source

The CAA authorizes the USEPA to characterize and control emissions of these pollutants. However, unlike the criteria pollutants, ambient air quality standards have not been established for most air toxics. The National Emission Standards for Hazardous Air Pollutants regulate HAP emissions from stationary sources (40 CFR part 61).

Mobile Source

Typical mobile sources include on-road and nonroad vehicles, other construction equipment, etc. The emissions from these mobile sources are regulated under the CAA Title II through establishing emission standards that manufacturers (as compared to users) have to achieve in producing these sources. Therefore, there is no permitting requirement for operating these sources. However, the mobile source emissions would still have air quality impacts on both local and regional scales although they are not regulated in the similar way as compared to the stationary sources,

HAPs emitted from mobile sources are called Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from highway vehicles and nonroad equipment that are known or suspected to cause cancer or other serious health and environmental effects. In 2001, USEPA issued its first MSAT Rule, which identified 201 compounds as being HAPs that require regulation. A subset of nine of the MSAT compounds was identified as having the greatest influence on health. USEPA issued a second MSAT Rule in February 2007, which generally supported the findings in the first rule and provided additional recommendations of compounds having the greatest impact on health. The rule also identified several engine emission certification standards that must be implemented (40 CFR parts 59, 80, 85, and 86; Federal Register Volume 72, No. 37, pp. 8427–8570, 2007). Unlike the criteria pollutants, there are no NAAQS for benzene and other HAPs. The primary control methodologies for these pollutants for mobile sources involves reducing their content in fuel and altering the engine operating characteristics to reduce the volume of pollutant generated during combustion.

In 2006, the Federal Highway Administration (FHWA) in conjunction with the USEPA, released guidelines for the assessment of MSAT in the NEPA process for highway projects. The FHWA subsequently updated the guidance on air toxic analysis in NEPA documents in 2009, 2012 and 2016. The guidance recommends a MSAT analysis as part of the NEPA process for a transportation project. The 2012 and 2016 updates reflect recent regulatory changes including the number of MSAT and the latest USEPA Motor Vehicle Emissions Simulator (MOVES) model and update stakeholders on the status of scientific research on air toxics.

FHWA's updated interim guidance on MSAT analysis in NEPA documents establishes a tiered approach with three categories for analyzing MSAT, depending on specific project circumstances (FHWA, October 18, 2016).

D.9B.1.2.3 Greenhouse Gases

Revised draft guidance from CEQ, dated June 26, 2019, recommends that agencies should attempt to quantify a proposed action's projected direct and reasonably foreseeable indirect GHG emissions when the amount of those emissions is substantial enough to warrant quantification, and when it is practicable to quantify them using available data and GHG quantification tools. Agencies should consider whether quantifying a proposed action's projected reasonably foreseeable GHG emissions would be practicable and whether quantification would be overly speculative. A projection of a proposed action's direct and reasonably foreseeable indirect GHG emissions may be used as a proxy for assessing potential climate effects. If the tools, methods, or data inputs necessary to quantify a proposed action's GHG emissions are not reasonably available, or it otherwise would not be practicable, a qualitative analysis with explanation should be provided.

Stationary Source

The USEPA issued the Final Mandatory Reporting of Greenhouse Gases Rule on September 22, 2009. GHGs covered under the Final Mandatory Reporting of Greenhouse Gases Rule are carbon dioxide (CO_2), methane, nitrogen oxide (NO_x), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydro fluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. The equivalent CO_2 rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of mobile sources and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions as CO_2e are required to submit annual reports to USEPA.

GHG emissions are also regulated under PSD and Title V permitting programs for major stationary sources such as a large power plant, which was initiated by a USEPA rulemaking issued on June 3, 2010 known as the GHG Tailoring Rule (75 Federal Register 31514). GHG emissions thresholds for permitting of stationary sources are an increase of 75,000 tons tpy of CO2e at existing major sources and facility-wide emissions of 100,000 tpy of CO2e for a new source or a modification of an existing minor source. The 100,000 tpy of CO2e threshold defines a major GHG source for both construction (PSD) and operating (Title V) permitting, respectively. However, on June 23, 2014, the U.S. Supreme Court issued its decision in Utility Air Regulatory Group v. USEPA (No. 12-1146). As a result of the decision USEPA will no longer apply or enforce Federal regulatory provisions or the USEPA approved PSD SIP provisions that require a stationary source to obtain a PSD permit if GHGs are the only pollutant that the source emits or has the potential to emit above the major source thresholds, or for which there is a significant emissions increase and a significant net emissions increase from a modification (e.g., 40 CFR section 52.21 (b)(49)(v)). Nor does USEPA intend to continue applying regulations that would require that states include in their SIP a requirement that such sources obtain PSD permits.

The indirect emissions as a result of the Proposed Action could be associated with energy consumptions related in production of grid power, material production and maintenance; and vehicle operations within the SMAGLEV Project Affected Environment within the Project Study Area as depicted in Figure 2.1-3. Given the uncertainty of fuel and facility source model types, the emissions associated with energy producing from indirect sources cannot be practicably estimated at this early planning stage. Moreover, because of above air permitting regulations such as PSD applicable to major source GHG emissions, these indirect GHG emissions and their impacts to climate change would be regulated under separate air regulations such as NSR and/or PSD program applicable to specific major stationary sources as discussed above. Therefore, per the CEQ guidance, FRA determined that the energy consumption related indirect GHG emissions from various potential affected stationary facilities such as power plants cannot be practicably estimated and included in the EIS. Nonetheless they would be quantified in future through more rigorous air permitting programs applicable to the affected facilities as warranted.

D.9B.1.2.4 Summary

In conclusion, the following air quality impact analyses are considered in the EIS:

1) Microscale impact analysis for CO, PM (PM10 and PM2.5), and MSAT for mobile sources.
2) Mesoscale emissions burden analysis for criteria pollutants and GHGs for mobile sources in a roadway network with available detail traffic forecasts within emissions can be practicably projected.
3) Corridor construction emissions including those around each station and stationary facilities.
4) General conformity rule applicability analysis through quantifying annual nonattainment or maintenance pollutant direct and indirect emissions within the mesoscale traffic network and around construction site along the corridor under both construction and operational conditions related to FRA’s Federal action.

D.9B.2 Methodology

In accordance with the CAA, FRA evaluated potential air quality impacts through analyses of localized impacts at congested intersections around each new station, corridor mesoscale emissions impacts as a result of changes in traffic patterns within the corridor subarea, construction period emissions impacts, and demonstration of project-level CAA general conformity for applicable nonattainment pollutants including O_3 and SO_2 for the Proposed Action. In the analysis, FRA demonstrated the compliance of the CAA general conformity requirements and used the methodologies and procedures established by Federal Highway Administration (FHWA) for assessing potential mobile source impacts from changes in traffic pattern for a transportation project.

D.9B.2.1 Localized (Microscale) Impact Analysis

Since the SCAMGLEV Project train operation between Baltimore and Washington, D.C. would not result in new pollutant emissions, FRA considers that there would be no negative air quality impacts because of train operations. Therefore, the localized impact analysis focuses on the potential for negative impacts because of the change in roadway traffic patterns around the three proposed new stations and maintenance facilities.

D.9B.2.1.1 CO Impact Analysis

The guideline identifies four categories of projects to be considered for a CO hot spot analysis (40 CFR 93.123[b][1]) to be used for the CO microscale analysis under NEPA.

- For projects in or affecting locations, areas, or categories of sites which are identified in the applicable implementation plan as sites of violation or possible violation;
- For projects affecting intersections that are at Level-of-Service (LOS) D, E, or F, or those that will change to LOS D, E, or F because of increased traffic volumes related to the project;
- For any project affecting one or more of the top three intersections in the nonattainment or maintenance area with highest traffic volumes, as identified in the applicable implementation plan; and
- For any project affecting one or more of the top three intersections in the nonattainment or maintenance area with the worst level of service, as identified in the applicable implementation plan.

Screening Analysis

Given the scale of this project evaluated for traffic performance, it is not realistic to conduct a microscale CO impact analysis at each studied intersection. However, the likely worst-case intersections are those with highest traffic volume, highest number of traffic lanes, and/or worst-case of Level of Service (LOS) conditions. Therefore, in order to conduct the impact analysis in a manageable and reasonable manner, FRA performed a screening analysis at a total of 65 intersections for which 2027 and 2045 LOS and traffic volume forecasts were made. A ranking of worst-cased intersections was made for the Build Alternatives and a total of three worst-case intersections were identified. FRA further conducted a microscale dispersion modeling analysis at each of these identified worst-case intersections. If the modeling results indicate that no significant CO impacts would occur for any of the Build Alternatives, other less congested intersections are anticipated to have better CO conditions resulting in no significant CO impact.

It should be noted that selecting intersections for a microscale analysis is consistent with the USEPA general guideline on mobile source microscale impact modeling for CO at roadway intersections (November 1992).

Emissions and Dispersion Modeling

The prediction of vehicle-generated emissions and their dispersion incorporates meteorological conditions, traffic inputs, and intersection configurations. The air pollutant dispersion model mathematically simulates the combined effect of these parameters on pollutant concentrations. The mathematical formulations contained in a dispersion model typically attempt to describe complex physical conditions as closely as possible. Simplifications and approximations of actual conditions were used to predict the most reasonable worst-case condition in a conservative way.

Emission Factor Modeling – FRA computed vehicular exhaust emission factors for future 2027 build year and 2045 design year using the USEPA most recent mobile source emissions factor model, Motor Vehicle Emission Simulator (MOVES) (Version 2014b – MOVES2014b), incorporating basic input parameters provided by the Metropolitan Planning Organizations (MPOs), Metropolitan Washington Council of Governments (MWCOG) and Baltimore Metropolitan Council (BMC), for their respective controlled regions. This emission factor model can calculate engine emission factors for various vehicle types, based on the fuel type (gasoline, diesel, or natural gas), meteorological conditions, vehicle speeds, vehicle age, roadway types, and various other factors that influence emissions, such as inspection maintenance programs. FRA utilized MOVES to predict CO emission factors for approach, departure, and queue links at each selected worst-case intersection under the future build condition.

Dispersion Model – FRA predicted the optimum concentrations resulting from vehicle emissions at the selected worst-case intersections around each new station using USEPA's CAL3QHC dispersion model to evaluate potential localized mobile source impacts because of change in traffic patterns as a result of the SCMAGLEV Project. The CAL3QHC model employs a Gaussian (normal distribution) dispersion assumption and includes an algorithm for estimating vehicular queue lengths at signalized intersections. CAL3QHC is used to conservatively predict the dispersion from idling and moving vehicles based on peak traffic (AM and PM peak periods) and worst-case meteorological conditions.

Following the USEPA guidelines, FRA performed the CAL3QHC computations using a wind speed of one (1) meter per second, and the neutral stability Class D (for urban environments), with a wind angle varied to determine the optimum concentrations at each receptor under all wind directions. An 8-hour average CO concentration was estimated by multiplying the predicted 1-hour average CO concentrations by a factor of 0.70 to account for persistence of meteorological conditions. These assumptions ensure that worst-case meteorology is used to estimate conservative impacts.

Traffic Inputs – FRA considered projected future traffic growth, future traffic signal phasing at each selected worst-case intersection, and other information developed as part of the traffic analysis for the SCAMGLEV Project. The peak hour periods were utilized for CO analysis at each selected worst-case intersection using CAL3QHC, producing the optimum anticipated Project-generated traffic and the greatest potential for air pollutant emissions.

Background Concentrations – FRA conducted a modeling analysis for vehicular emissions within 1,000 feet of the modeled intersection. Background concentrations are pollutant concentrations originating from distant sources beyond this distance that are not directly included in the modeling analysis. These concentrations were considered based on the most recent ambient monitoring levels close the modeled intersection and added to modeling results to obtain total pollutant concentrations at an analysis site.

Modeled Receptors – FRA predicted CO concentrations at multiple receptors at each analysis intersection for both 2027 and 2045 under AM and PM peak periods. Receptors were placed at spaced intervals along sidewalk with continuous public access that would expose the highest CO concentrations at congested intersections.

D.9B.2.1.2 PM2.5 and PM10 Impact Analysis

Consistent with the USEPA PM hot spot analysis guidance established in *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA, November 2015), FRA evaluated forecasted traffic conditions in the Project Study Area and determined whether the SCAMGLEV Project is a project with air quality concern which requires a microscale analysis for $PM_{2.5}$ and PM_{10}. The guideline identifies five categories of such projects (40 CFR 93.123[b][1]):

- New or expanded highway projects which have a significant number of or significant increase in diesel vehicles.
- Projects affecting intersections that are at LOS D, E, or F with a significant number of diesel vehicles, or those which would change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project.
- New bus and rail terminals and transfer points which have a significant number of diesel vehicles congregating at a single location.
- Expanded bus and rail terminals and transfer points which significantly increase the number of diesel vehicles congregating at a single location.
- Projects in or affecting locations, areas, or categories of sites identified in the applicable $PM_{2.5}$ and PM_{10} implementation plan or implementation plan submission, as appropriate, as the sites of violation or possible violation.

Furthermore, typical sample projects of air quality concern defined by 40 CFR 93.123(b)(1)(i), (iii) and (iv) include:

- A project on a new highway or expressway which serves a significant volume of diesel truck traffic, such as facilities with greater than a 125,000 annual average daily traffic (AADT) and eight percent or more of such AADT is diesel truck traffic.
- New exit ramps and other highway facility improvements to connect a highway or expressway to a major freight, bus, or intermodal terminal.
- Expansion of an existing highway or other facility which affects a congested intersection (operated at LOS D, E, or F) which has a significant increase in the number of diesel trucks.
- Similar highway projects which involve a significant increase in the number of diesel transit busses and/or diesel trucks.

- A major new bus or intermodal terminal considered to be a "regionally significant project" under 40 CFR 93.1019.
- An existing bus or intermodal terminal which has a large vehicle fleet where the number of diesel buses increases by 50% or more, as measured by bus arrivals.

Since the majority of affected vehicles are passenger vehicles within the affected roadway network around the three new station areas, FRA considered that change in diesel vehicle traffic would essentially remain the same under the proposed condition as compared to the No Build Alternative. The Project does not fall into the above project categories with potential for air quality concern with respect to potential PM impacts. FRA concluded that the SCAMGLEV Project would not cause or contribute to a $PM_{2.5}$ or PM_{10} violation in the area. Consequently, FRA determined that no further microscale analysis for $PM_{2.5}$ or PM_{10} is warranted.

D.9B.2.1.3 Localized Corridor MSAT Impact Analysis

FRA conducted MSAT analysis based on FHWA's updated interim guidance on MSAT analysis in NEPA documents that establishes a tiered approach with three categories for analyzing MSAT, depending on specific project circumstances (FHWA, October 18, 2016). Each project category is outlined below.

Exempt Projects or Projects with No Meaningful Potential MSAT Effects

The types of projects included in this category are:

- Projects qualifying as a categorical exclusion under 23 CFR 771.117;
- Projects exempt under CAA conformity rule under 40 CFR 93.126; or
- Other projects with no meaningful impacts on traffic volumes or vehicle mix.

Additionally, the FHWA's updated interim guidance indicates that "for other projects with no negligible traffic impacts, regardless of the class of NEPA environmental document, no MSAT analysis is required." Projects in this category do not require either a qualitative or a quantitative analysis for MSAT, although documentation of the project category is required.

Projects with Lower Potential MSAT Effects

The types of projects included in this category are those that serve to improve highway, transit, or freight operations without adding substantial new capacity or without creating a facility that is likely to meaningfully increase emissions. This category covers a broad range of projects. Examples are minor widening projects, new interchanges, replacing a signalized intersection on a surface street or projects where design-year traffic is projected to be less than 140,000 to 150,000 AADT. Projects in this category are to be addressed with a qualitative assessment of emissions projections.

Projects with Higher Potential MSAT Effects

This category includes projects that have the potential for meaningful differences in MSAT emissions among project alternatives. To fall into this category, a project should:

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

Projects in this category would be more rigorously assessed for impacts through a quantitative analysis to forecast local-specific emission trends of the MSAT for each alternative.

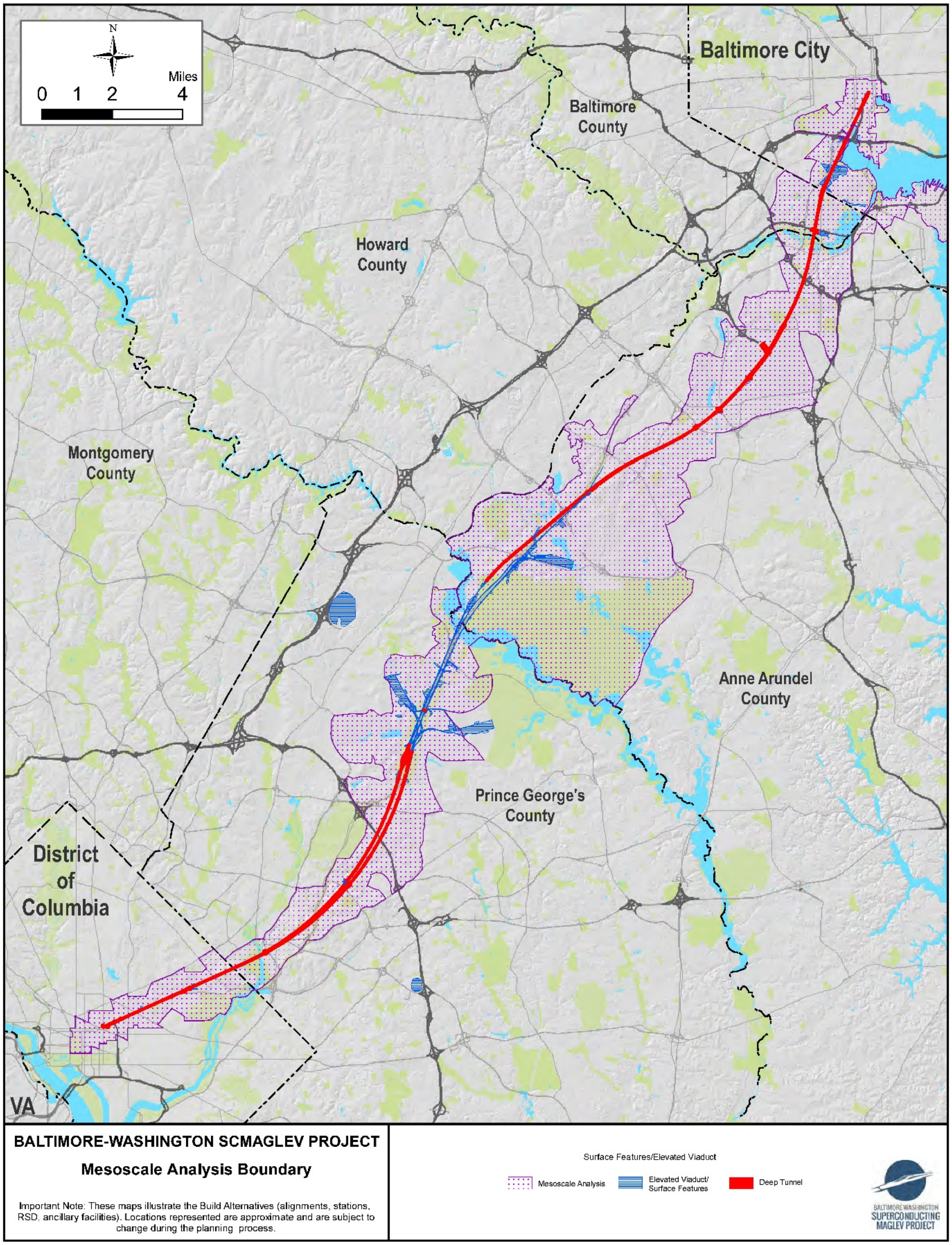
Since the corridor affected by the SCAMGLEV Project would have AADT that are below the 140,000 threshold for potential high MSAT effects, the SCAMGLEV Project falls into the category of "Project with Lower Potential of MSAT Effects" and FRA determined that a qualitive analysis is warranted.

D.9B.2.2 Mesoscale Impact Analysis

As compared to a localized microscale impact analysis at specific congested traffic or site location, the purpose of conducting a mesoscale emission analysis is to provide a comparison of pollutant emission levels within the affected roadway network for each Build Alternative to the No Build Alternative. FRA performed such a mesoscale analysis within a subarea road network immediately adjacent to the corridor (i.e., roadways within approximately a quarter mile buffer along the corridor alignment and around new stations and other maintenance facilities) within which the detail traffic forecasts are available for this analysis. This mesoscale subarea boundary is illustrated in **Figure D.9-4**. This analysis provides the criteria pollutant emission burden as well as GHG emissions on a mesoscale or corridor level.

Because the SCMAGLEV Project will use grid power to operate trains, stations and other facilities resulting in no new power generating facilities within this mesoscale subarea along the corridor, no new operational emissions will occur during train and facility operations.

Figure D.9-4: Mesoscale Boundary



It should be noted that the mesoscale analysis results cannot be used as a measure of the regional impact. A regional level emissions analysis over the entire region to be affected by the SCMAGLEV Project cannot be practicably or reasonably performed on a project-level given the lack of detail traffic forecasts in terms of roadway type, vehicle classification, travel speed, . Only MPOs responsible for demonstrating the regional conformity conduct this level of analysis using their regional conformity model by including all projects within the region in a cumulative manner. FRA will consult with MPOs during the Final Environmental Impact Statement (FEIS) to demonstrate emissions of conformity of a Preferred Alternative and to incorporate the SCMAGLEV Project into regional conformity models. Therefore, the project-level mesoscale analysis is only applicable to the impacts within the mesoscale subarea network documented in the EIS.

FRA utilized the MOVES2014b model to estimate emission factors for criteria pollutants and GHGs at the mesoscale level based on MWCOG- and BMC-provided county-specific parameters for their respective regions for applicable road types and speed bins. The average daily vehicle miles travelled (VMT) predicted within the affected roadway network along the corridor using MWCOG- and BMC-developed regional transportation models were multiplied by MOVES2014b-predicted emission factors to predict daily emission levels for each applicable Build Alternative and the No Build Alternative. Because the majority of roadway links within this mesoscale network (**Figure D.9-4**) are within Prince George's County from MWCOG transportation model and Anne Arundel County for BMC transportation model, to simply the emissions calculation, FRA applied MOVES2014b model-predicted emission factors applicable for these two counties with the two respective mesoscale transportation roadway models.

Since the subarea (mesoscale) traffic network along the corridor will remain essentially unchanged for the majority of the Build Alternatives, FRA evaluated two scenarios based on the new station selection in the Baltimore area, which includes either the Cherry Hill or Camden Yards Station scenario. FRA conducted mesoscale emissions analysis for the two station scenarios, respectively.

D.9B.2.3 Construction Period Impact

In contrast to operational activities, construction activities are relatively short-term conditions with the potential to produce temporary air quality effects. However, the impacts of construction vehicle and equipment emissions from large-scale construction activities occurring over many years (typically over five years) at a specific local site could cause adverse air quality effects and may need to be quantitatively addressed.

According to 40 CFR § 93.123(c)(5), "CO, PM_{10}, and $PM_{2.5}$ hot spot analyses are not required to consider construction-related activities which cause temporary increases in emissions. Each site which is affected by construction-related activities shall be considered separately, using established 'Guideline' methods. Temporary increases are defined as those which occur only during the construction phase and last five years or less at any individual site." Based on current construction schedule as described in

Construction Planning Memorandum (BWRR, May 14, 2020), no site-specific construction element or section will last more than five years with the exceptions of overall construction schedule for stations and trainset maintenance facilities (TMF) in six years, respectively. However, according to the Construction Planning Memorandum (BWRR, May 14, 2020), given the number of stations to be constructed, at a specific station, the construction will not last more than five years. For each TMF option, the entire facility will have a standardized size of 170 acres involving many phases and moving elements anticipated to occur over the entire TMF facility area. Given such a large TMF area, within a specific adjacent neighborhood, it is anticipated that those construction activities occurring in close proximity could result in potential negative air quality impacts. As construction activities move away to other sites within the TMF area, such negative impacts will become diminished. Construction activities will unlikely last more than five years with measurable continuing negative impacts to a specific neighborhood around the TMF site. Therefore, FRA concludes at a specific local site that construction activities are considered temporary and will not require a quantitative hot spot analysis.

FRA estimated construction manpower and equipment including truck activities for each construction element such as viaduct, above ground activities associated with tunnel construction, shaft, portal, substation, station, TMF, MOW, etc. using the following RSMeans data:

The construction and associated land clearing/demolition activity in terms of the equipment, material, and manpower requirements to calculate construction-related emissions. Estimates of construction crew and equipment requirements and productivity are based on data presented in:

- 2003 RSMeans Facilities Construction Cost Data (RSMeans 2002)
- 2011 RSMeans Facilities Construction Cost Data (RSMeans 2010)

The construction and demolition associated elements may include, but are not limited to:

- General clearing and grading
- Existing structure demolition
- Cut and fill
- Tunnel boring and construction
- Station, parking facility, and maintenance facility construction including foundation, superstructure, interior fit-out, etc.
- SCMAGLEV track installation.

FRA performed MOVES14b modeling to predict construction nonroad equipment and on-road truck and commuter vehicle emissions factors and multiplied them with manpower and equipment activity data to determine total emissions from each project construction component such as viaduct, TMF, station, etc. Based on the construction schedule for each construction component, FRA evenly distributed total emissions for each component over the corresponding duration for that component and then determined the overall annual emissions for the SCAMGLEV Project by combining overlapping emissions from each component on an annual basis over the entire construction duration. For the tunnel boring, it is anticipated that standby generators will be installed and operated under power outage conditions. However, the actual emissions from these generators cannot be reasonably estimated and therefore they are not considered in the analysis.

The USEPA has developed a database for nonroad engine emission factors as a function of the type and size of the equipment and has provided guidance for developing emission inventories for these engines. The USEPA recommends use of the following formula to calculate hourly emissions from nonroad engine sources:

$$M_i = N \times HP \times LF \times EF_i$$

where:

M_i = mass of emissions of ith pollutants during inventory period (grams/hr);

N = source population (units);

HP = average rated horsepower (hp);

LF = typical load factor (%);

EF_i = average emissions of ith pollutant per unit of use (e.g., grams per horsepower-hour) to be estimated from MOVES2014b modeling.

D.9B.2.4 Clean Air Act General Conformity

Under the General Conformity Rule (GCR), emissions resulting from a Federal action are compared to *de minimis* levels on an annual basis. If the emissions for a nonattainment or maintenance criteria pollutant (or its relevant precursors) do not exceed the *de minimis* levels specified in the GCR, the Federal action is determined to conform for the pollutant under study and no further analysis is necessary. Conversely, if the total direct and indirect emissions are above the de minimis value, a formal general conformity determination is required related to that pollutant.

D.9B.2.4.1 Stationary Source Emissions

Based on the power energy consumption levels estimated for the SCMAGLEV Project, there are two air quality implications to the power operations related to FRA's Federal action:

- The existing power facilities from Potomac Electric Power Company (PEPCO) and Baltimore Gas and Electric (BGE) to be used for providing grid power have the capacities under their current air permit conditions with permitted air emissions already accounted for in the SIP emissions budget. Therefore, they are not considered new emissions.

- If the SCMAGLEV Project requires construction of a new power facility or major modifications to existing facilities from PEPCO or BGE, the CAA Title V air permit requirements through the nonattainment NSR and/or PSD program at the new facility or existing facilities will be applicable.

According to the GCR per 40 CFR 93.153, the portion of a Federal action that includes major or minor new or modified stationary sources that require a permit under the new source review (NSR) program (Section 110(a)(2)(c) and Section 173 of the CAA) or the prevention of significant deterioration (PSD) program (title I, part C of the CAA) is exempt from the rule. Therefore, under either conditions as applicable, FRA concludes that stationary source emissions are exempt from the GCR applicability analysis.

D.9B.2.4.2 Mobile Source Emissions

Based on the GCR, FRA made the following determinations regarding which categories of direct and indirect mobile source emissions should be included in the GCR rule applicability analysis for the SCMAGLEV Project:

- Direct and indirect on-road vehicle emissions within the mesoscale subarea within which detail traffic forecasts are available.
- Direct emissions generated by nonroad equipment used to construct each component of the SCMAGLEV Project.
- Indirect emissions generated during demolition and construction activities from trucks hauling and transporting various construction materials to and from the work site.
- Indirect emissions generated during demolition and construction activities from worker’s commuting vehicles.

FRA performed MOVES14b modeling to predict mobile source emissions factors and, for construction activities, multiplied them with manpower and equipment activity data to determine total emissions from each project construction component such as viaduct, TMF, station, etc. Based on the construction schedule for each construction component, FRA evenly distributed total emissions for each component over the corresponding duration for that component and then determined the overall annual emissions for the SCAMGLEV Project by combining overlapping emissions from each component on an annual basis over the entire construction duration. For the tunnel boring component, it is anticipated that standby generators will be installed and operated under power outage conditions. However, the actual emissions from these generators cannot be reasonably estimated under emergency condition and therefore they are not considered in the analysis.

Appendix D.9C Affected Environment

FRA identified the existing, localized air quality conditions surrounding three identified intersections that were determined in the traffic studies to be affected by the

SCMAGLEV Project. FRA also identified the existing air quality conditions at the mesoscale level along the corridor, including the subarea roadway networks surrounding new stations under Cherry Hill and/or Camden Yards options and within a quarter mile buffer along the entire corridor. These conditions are reflected through the current status of NAAQS attainment and the recent ambient air monitoring data collected and published by Washington, D.C. Department of Energy and Environment (DOEE) and MDE.

The current air quality designations for the cities and counties and Washington, D.C. through which the SCMAGLEV Project is located, are summarized in **Table D.9-5**.

The most recent measured ambient air concentrations within metropolitan areas in Baltimore and in Washington, D.C., illustrated in **Table D.9-6**, present a picture of the recent actual ambient air quality conditions within SCMAGLEV Project Affected Environment in addition to the attainment designation status summarized in **Table D.9-5**. These measurements are mostly consistent with the above attainment designations.

Table D.9-5 Nonattainment and Maintenance Status

County/City	Nonattainment		Maintenance	
	O_3	SO_2	$PM_{2.5}$[1]	CO
Washington, D.C.	X (Marginal)	n/a	X	X
Prince George's	X (Marginal)	n/a	X	X
Montgomery	X (Marginal)	n/a	X	X
Anne Arundel	X (Marginal)	X	X	n/a
Baltimore	X (Marginal)	X	X	n/a
Baltimore City	X (Marginal)	n/a	X	X

Note: An X designates this location as nonattainment or maintenance for the identified pollutants. All areas are in attainment for all other criteria pollutants.

1 Related to the revoked 1997 standard with a maintenance plan still in place.

Source: https://www.epa.gov/green-book

Table D.9-6: Ambient Monitoring Background Concentration Levels

Representative Monitored Ambient Air Quality Data in Washington, D.C. Area

Pollutant	Averaging Time	Year			Standard Primary
		2017	2018	2019	
CO (ppm)	1-hr	2.7	2.1	2.1	35
	8-hr	2.3	1.9	1.6	9
NO_2 (ppb)	1-hr	58	49	49	100
	Annual	15	15	16	53
Ozone (ppm)	8-hr	0.072	0.073	0.075	0.070
SO_2 (ppb)	1-hr	4	5	5	75
$PM_{2.5}$ (µg/m^3)	24-hr	21	23	32	35
	Annual	10.2	9.5	9.1	12
PM_{10} (µg/m^3)	24-hr	44	40	46	150

Representative Monitored Ambient Air Quality Data in Baltimore Area

Pollutant	Averaging Time	Year			Primary Standard
		2017	2018	2019	
CO (ppm)	1-hr	1.4	1.8	2.7	35
	8-hr	1.1	1.3	2.0	9
NO_2 (ppb)	1-hr	49	48	41	100
	Annual	16	16	16	53
Ozone (ppm)	8-hr	0.077	0.075	0.077	0.070
SO_2 (ppb)	1-hr	--	12	11	75
$PM_{2.5}$ (µg/m^3)	24-hr	23	21	31	35
	Annual	8.3	9.6	8.5	12
PM_{10} (µg/m^3)	24-hr	28	33	34	150

Source: https://www.epa.gov/outdoor-air-quality-data

Appendix D.9D Environmental Consequences

Under the No Build Alternative, the SCAMGLEV Project will not be built and, therefore, no impacts related to the construction or operation of a SCMAGLEV system will occur. However, other planned and funded transportation projects will be implemented in the area and could result in air quality effects. Although vehicular traffic may increase on the major roadways within the corridor, the overall vehicular pollutant emissions may be reduced primarily from continuing emission control programs implemented on both Federal and state levels, such as improving engine combustion efficiency, inspection, and maintenance programs. It is, therefore, anticipated that impacts to air quality under the No Build Alternative would be negligible.

D.9D.1 Operational Effects

D.9D.1.1 Microscale Impact

D.9D.1.1.1 CO Impact

FRA conducted a screening analysis for a total of 65 intersections for which 2027 and 2045 traffic level-of-service (LOS) and volume forecasts were estimated for the roadway network surrounding each of the three stations. The worst-cased intersections show a LOS of level D or worse. The overall worst-case primary signalized intersection within each of the three station areas in Washington, D.C. and Baltimore were based on the approach volumes at each intersection, intersection(s) with the highest levels, and land use sensitivity such as the presence of sidewalks, etc. around each congested intersection. These selected worst-case intersections are listed in **Table D.9-7** and illustrated in **Figures D.9-5** and **D.9-6**.

At these three worst-case intersections representing three different geographic areas where the stations are located, FRA conducted CAL3QHC dispersion modeling with the geometric models depicted in **Figures D.9-7 through D.9-9**. Attachment A provides a sample CAL3QHC model output printout.

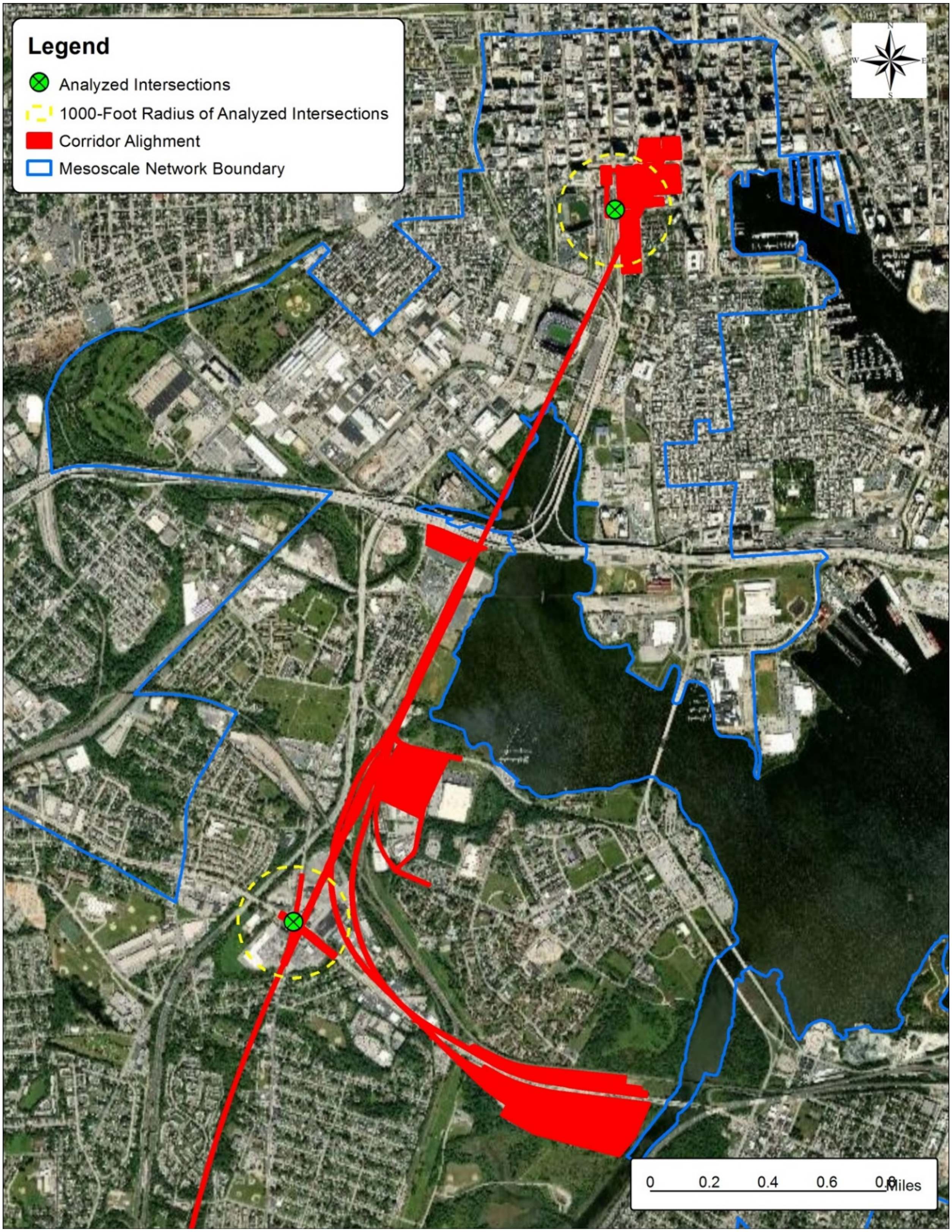
According to the traffic forecasts, traffic patterns on a local level around stations and maintenance facilities would not be meaningfully different among Build Alternatives. The predicted highest CO concentrations are well below the NAAQS for CO as illustrated in **Table D.9-7**. As the studies were conducted at the worst-case intersections identified, FRA anticipates that CO concentration levels at other intersections in the vicinity of the SCMAGLEV Project will be lower than or will remain the same as these modeled intersections and will also be well below the NAAQS for CO. Consequently, FRA concluded that potential air quality impacts on a local level will not be considered negative under each Build Alternative.

Table D.9-7: Worst-Case CO Intersections and Predicted CO Concentration

Intersection	CO Concentration (ppm)			
	2027		2045	
	1-hour	8-hour	1-hour	8-hour
New York Ave. NW @ 7th St. NW/ Massachusetts Ave. NW @ 7th St. NW Combined	4.6	3.4	3.0	2.2
Howard Street @ Conway Street	4.5	3.3	3.8	2.8
Annapolis Road @ Patapsco	4.6	3.3	3.8	2.8
NAAQS	*35*	*9*	*35*	*9*

Source: AECOM, July 2020

Figure D.9-5: Baltimore Area Hot Spots



Source: AECOM, July 2020

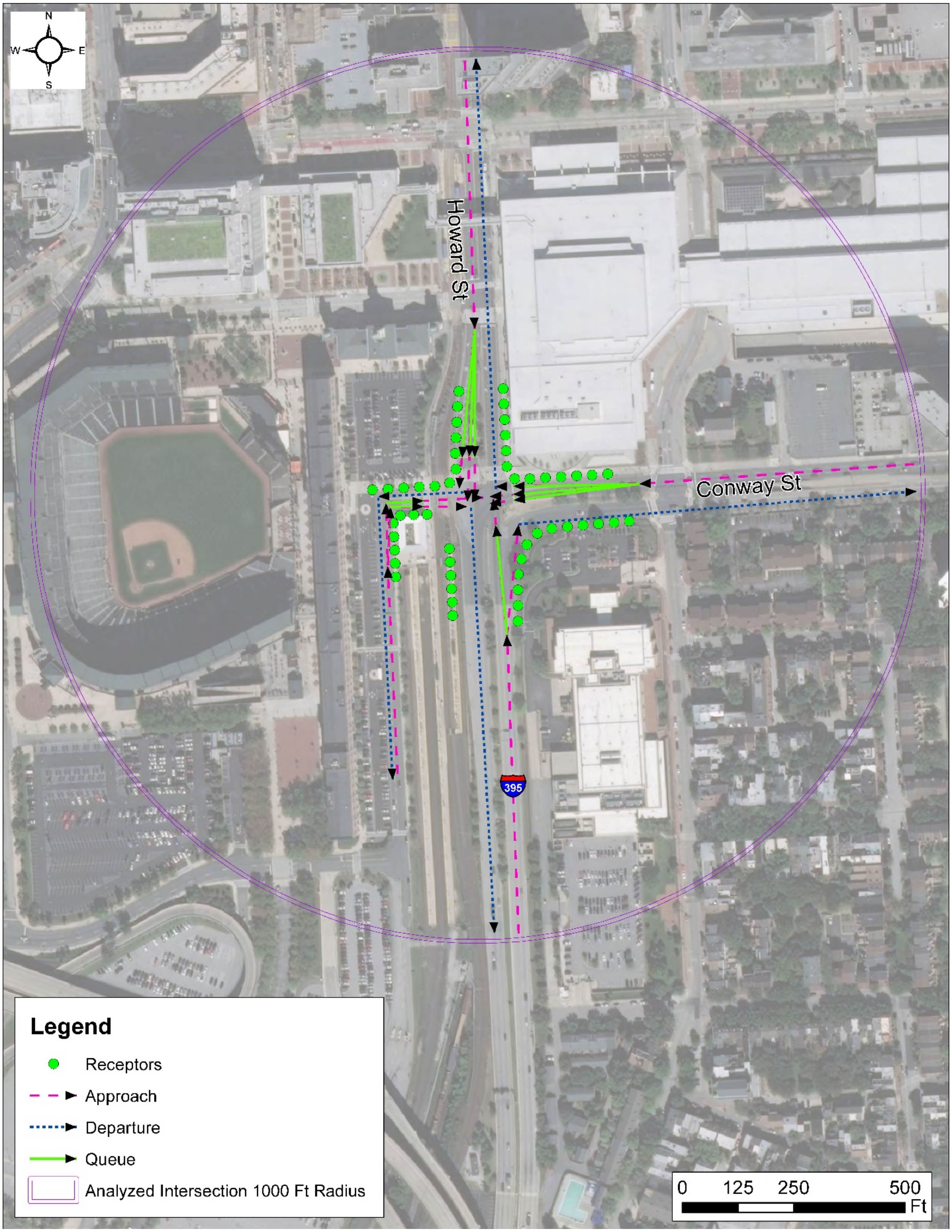
Figure D.9-6: Washington, D.C. Area Hot Spot

Source: AECOM, July 2020

Figure D.9-7: Baltimore Area Hot Spot Model Setup – Cherry Hill Station

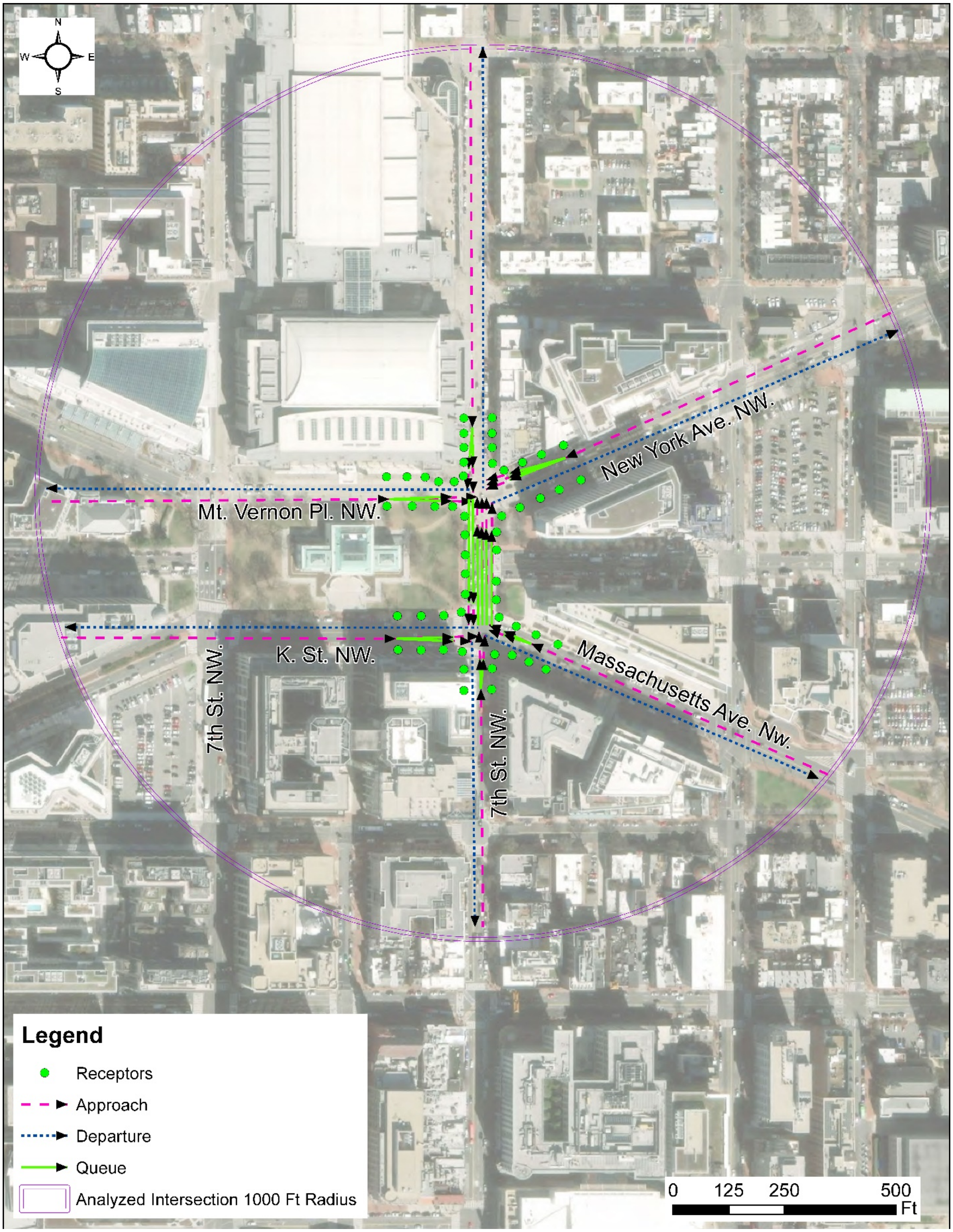
Source: AECOM, July 2020

Figure D.9-8: Baltimore Area Hot Spot Model Setup – Camden Yards Station



Source: AECOM, July 2020

Figure D.9-9: Washington, D.C. Area Hot Spot Model Setup



Source: AECOM, July 2020

D.9D.1.1.2 $PM_{2.5}$ Impact

As described in the methodology section, per the FHWA guidance, the SCAMGLEV Project is not considered to have potential for air quality concern with respect to potential PM impacts since each Build Alternative would not increase diesel vehicle traffic on roadways and fall into any Project categories with potential air quality concern. Therefore, potential localized $PM_{2.5}$ impacts would not be significant.

D.9D.1.1.3 MSAT Impact

FHWA's *Interim Guidance* (December 6, 2012 and October 18, 2016) establishes a three-tiered approach to determine the level of MSAT analysis required by a project-level study. Each tier or level is reviewed below. Project requirements are assessed in relation to the *Guidance* following this review.

Exempt Projects or Projects with No Meaningful Potential MSAT Effects

The types of projects included in this category are:

- Projects qualifying as a categorical exclusion under 23 CFR 771.117(c);
- Projects exempt under the Clean Air Act conformity rule under 40 CFR 93.126; or
- Other projects with no meaningful impacts on traffic volumes or vehicle mix

Additionally, the guidance indicates that "for projects with no negligible traffic impacts, regardless of the class of NEPA environmental document, no MSAT analysis is required." It is further noted in the guidance that "the types of projects categorically excluded under 23 CFR 771.117(d) or exempt from conformity rule under 40 CFR 93.127 do not warrant an automatic exemption from an MSAT analysis, but they usually will have no meaningful impact."

Projects in this category do not require either a qualitative or a quantitative analysis for MSATS, although documentation of the project category is required.

Projects with Low Potential MSAT Effects

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

Projects in this category are to be addressed with a qualitative analysis.

Projects with Higher Potential MSAT Effects

The types of projects in this category must:

- Create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location; or
- Create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000, or greater, by the design year; and
- Be proposed to be located in proximity to populated areas or in rural areas, in proximity to concentrations of vulnerable populations (i.e., schools, nursing homes, hospitals).

Projects in this category would be more rigorously assessed for impacts.

Based on these descriptions, the proposed action can be categorized as a *Project with Low Potential MSAT Effects*, requiring a qualitative analysis.

Qualitative MSAT Analysis

The roadways with potential to be impacted by the proposed action would be those arterial roadways around the proposed stations and maintenance facilities. According to the traffic forecasts under the future horizon years of 2027 and 2045, the Annual Average Daily Traffic (AADT) along those affected roads (e.g., New York Avenue, etc.) would be well below 140,000, the threshold with higher potential MSAT effect. Additionally, diesel truck percentages are generally low, and the truck percentage would not change under the proposed action within the affected roadway network. The proposed action, therefore, falls into the second category, i.e., those with "*Low Potential MSAT Effects*", as noted above,

For this EIS, the amount of MSAT emitted would be proportional to the vehicle miles traveled (VMT), assuming that other variables such as fleet mix are the same for each Build Alternative. The VMT estimated for the Build Alternatives is slightly higher than that for the No Build Alternative in Washington, D.C. area, because the proposed station attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the action alternative within the Washington, D.C. area around the proposed station. Because the estimated VMT under each of the Build Alternatives are nearly the same, varying by less than two (2) percent during 2045 design year, it is expected there would be no appreciable difference in overall MSAT emissions among the various Build Alternatives. Also, regardless of the Build Alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs. FHWA estimated that even if VMT increases by 45 percent from 2010 to 2050 as forecast, a combined reduction of 91 percent in the total annual emissions for the priority MSAT is projected for the same time period. As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to control MSATs.

For this EIS, the amount of MSAT emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each Build Alternative. The VMTs estimated and presented in below Section 4.1.2 for the Cherry Hill and Camden Yards station alternatives show slightly higher than those for the No Build Alternative particularly in the Baltimore area, because the proposed station attracts rerouted trips from elsewhere in the transportation network. These increases in VMT would lead to higher MSAT emissions within the Baltimore area around the proposed station. Because the estimated VMT under each station alternative are nearly the same, it is expected there would be no appreciable difference in overall MSAT emissions among the various Build Alternatives. Also, regardless of the Build Alternative chosen, emissions will likely be lower than present levels in the design year as a result of USEPA's national control programs. USEPA projected that such programs would reduce annual MSAT emissions by over 90 percent from 2010 to 2050 per the *Updated Interim Guidance on MSAT Analysis in NEPA Document*[1]. As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards are necessary to control MSATs.

Because of the specific characteristics of the proposed action (i.e., some new trips might be generated around proposed stations), there would be localized areas where VMT would increase as discussed previously. Therefore, it is possible that localized increases in MSAT emissions would occur. The localized increases in MSAT emissions would likely be most pronounced near the traffic routes with new trips. However, these potential increases would be substantially reduced in the future due to implementation of USEPA's vehicle and fuel regulations. Since the magnitude of the USEPA-projected reductions is so great (even after accounting for VMT growth), MSAT emissions in the Project Study Area would be lower in the future as compared to the present condition in virtually all locations resulting in no significant MSAT impacts.

Using EPA's MOVES2014a model, FHWA estimates that even if VMT increases by 45 percent from 2010 to 2050 as forecast, a combined reduction of 91 percent in the total annual emissions for the priority MSAT is projected for the same time period. As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to control MSATs.

Compliance with 40 CFR 1502.22(B)

The following information is provided in compliance with 40 CFR 1502.22(b).

Unavailable Information for Project-Specific MSAT Impact Analysis

This MSAT analysis includes a basic quantitative analysis of the likely MSAT emission impacts of this project. However, available technical tools do not make it possible to predict the health impacts of the projected emission changes. Acknowledging this limitation, the following discussion is included in accordance with the Council of

[1] https://www.fhwa.dot.gov/ environMent/air_quality/air_toxics/policy_and_guidance/msat/page01.cfm

Environmental Quality's regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSAT emissions from a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling to estimate ambient concentrations, exposure modeling to estimate human exposure to the estimated concentrations, and a final determination of health impacts based on the estimated exposure. Each of these theoretical steps is subject to practical technical or scientific limitations shortcomings that do not allow for a more complete determination of project-related MSAT health impacts. These limitations are briefly described in the following paragraphs.

- **Dispersion**. The tools to predict how MSAT disperse are limited. The USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the National Ambient Air Quality Standards. The performance of the dispersion models is better for optimum concentrations that can occur at some time at some location within a geographic area. It is difficult to accurately predict exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The National Cooperative Highway Research Program is conducting research on best practices in applying models and other technical methods in the analysis of MSAT. This work will also focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the general public. Along with these general limitations of dispersion models, FHWA is also faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.
- **Exposure Levels and Health Effects**. Even if emission levels and concentrations of MSAT could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is challenging to accurately calculate annual concentrations of MSAT near roadways and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between the Build Alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the

results of such assessments would not be useful to decision makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSAT

Research into the health impacts of MSAT is ongoing. For different emission types, there is a variety of studies showing either that some toxics are statistically associated with adverse health outcomes identified through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been the focus of a number of USEPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. Although not intended for use as a measure of or a benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or state level.

The USEPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The USEPA's Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database can be accessed at http://www.epa.gov/iris. The following toxicity information for the seven prioritized MSAT was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from USEPA's IRIS database and represents the agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures:

- Benzene is characterized as a known human carcinogen.
- 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 is a probable human carcinogen based on limited evidence in humans and sufficient evidence in animals.
- 1,3-butadiene is characterized as carcinogenic to humans by inhalation.
- DPM is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust, as reviewed in this document, is the combination of DPM and diesel exhaust organic gases. DPM 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. Exposure relationships have not been developed from these studies.
- USEPA has classified naphthalene as a possible human carcinogen. Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and

neurological damage. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina.

- Polycyclic Aromatic Hydrocarbons are a group of over 100 different chemicals that can be formed during the incomplete burning of oil and gas.

There have been other studies that address MSAT health impacts near roadways. The Health Effects Institute, a non-profit organization funded by USEPA, FHWA, and industry stakeholders, has undertaken a series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes – particularly respiratory problems. Much of this research is not specific to MSAT; instead, it surveys the full spectrum of both criteria and other pollutants. FHWA cannot evaluate the validity of these studies, but more importantly, these studies do not provide information that would be useful to alleviate the uncertainties listed above or to perform a more comprehensive evaluation of the health impacts specific to a project like the proposed action.

Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of Impacts based upon Theoretical Approaches or Research Methods Generally Accepted in the Scientific Community

Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level. Although available tools do allow a reasonable prediction of relative emissions changes between Build Alternatives for larger projects as performed for the project, the MSAT concentrations or exposures to the amount of MSAT emissions from the proposed action evaluated in this report cannot be predicted with enough accuracy to be useful in estimating health impacts. Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether this project would have "significant adverse impacts on the human environment."

In this EIS, FHWA provides a qualitative assessment and acknowledges that the project may result in increased exposure to MSAT emissions at certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

Although technical shortcomings and uncertain science with respect to health effects prevent meaningful or reliable estimates of the MSAT emissions and effects associated with this proposed action, it is possible to qualitatively assess the levels of future MSAT emissions under the proposed action. The qualitative assessment is derived in part from a study conducted by FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*[2].

Emissions would likely be lower than at present in the design year (2045), as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent from 2000 to 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the Project Study Area are likely to be lower in the future in virtually all locations.

However, for this project, there may be localized areas where VMT would increase and, therefore, MSATs would increase as well. Current tools and science are not adequate to quantify these increases. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

D.9D.1.2 Mesoscale Impact

FRA predicted project-level mesoscale emissions for criteria pollutants and GHG emissions in terms of CO_2 for both No Build and Build Alternatives under Cherry Hill and Camden Yards Station options and provided a comparison of mesoscale pollutant emission levels within the affected roadway network within the boundary defined for traffic impact analysis as depicted in **Figure D.9-4**.

FRA utilized the MOVES2014b model with input parameters established by BMC and MWCOG that are applicable for their respective regional air conformity demonstration. These parameters were used to estimate emission factors for both criteria pollutants and GHG in terms of CO_2. The average daily VMT within this mesoscale roadway network (AECOM, 2020) along the corridor between Washington, D.C. and Baltimore were multiplied by MOVES2014b-predicted emission factors to predict daily mesoscale emission levels, thus providing a comparison of mesoscale pollutant emission levels to the No Build Alternative for both 2027 and 2045.

The predicted increases in mesoscale corridor emissions are primarily attributed to the increases in new trips or VMT around new stations particularly within the Baltimore area according to the traffic forecasts. The VMT forecasts within both Washington, D.C. and Baltimore regions and emissions summaries are presented in **Tables D.9-8 and D.9-9**. It should be noted that these mesoscale emissions will occur within the same traffic impact analysis area that includes roadways within approximately quarter mile buffer areas along the corridor and does not reflect the change in emissions over all affected roadways in the region. Based on the regional VMT forecasts provided in Ridership

[2] www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm

Data Request (BWRR, May 6, 2020), the SCMAGLEV Project will likely reduce overall regional VMT in a range of 9 to 12 percent during 2027 and 2045 under Cherry Hill and Camden Yards Station options. Therefore, the SCMAGLEV Project will likely result in an overall regional mobile source emissions reduction as a result of significant overall reduction of vehicle miles travelled over the entire regional affected environment while the corridor wide emissions within the selected mesoscale network will slightly increase along the corridor subarea particularly around station areas. The slight mesoscale subarea emissions increase particularly around new stations would be expected to result in a benefit of reducing overall regional emissions substantially as more commuters shift from personal vehicle within the region to SCMAGLEV.

Table D.9-8: Mesoscale Daily Vehicle Mile Traveled – Cherry Hill Station Option

Year 2027

Region	2027	VMT (Mile)	Net Difference	% Change
			No-Build to Build	No-Build to Build
BMC	No Build	4,663,438	96,431	-
	Build	4,759,868		
MWCOG	No Build	3,315,725	-28,558	-
	Build	3,287,167		
BMC+MWCOG	No Build	7,979,162	67,873	0.85%
	Build	8,047,035		

Year 2045

Region	2045	VMT (Mile)	Net Difference	% Change
			No-Build to Build	No-Build to Build
BMC	No Build	5,072,098	110,849	-
	Build	5,182,947		
MWCOG	No Build	3,458,183	18,220	-
	Build	3,476,403		
BMC+MWCOG	No Build	8,530,281	129,069	1.51%
	Build	8,659,350		

Source: AECOM, July 2020

FRA predicted a slight emission increase summarized in **Tables D.9-10 and D.9-11** for each pollutant within the mesoscale network under the Build Alternatives as compared to the No Build Alternative primarily as a result of new trips around the new stations within the roadway network immediately adjacent to the corridor. The estimated daily emissions in tons per day (tpd) are shown in **Tables D.9-10 and D.9-11** for Build Alternatives under Cherry Hill and Camden Yards Station options, respectively. It should be noted that such slight increases in emissions were predicted within a subarea that is immediately adjacent to the corridor within which the emissions burden can be feasibly estimated using the most recent planning tool, MOVES, in association with detail VMT forecasts in terms of road type, vehicle type, speed bin, county area, etc. This subarea is much smaller than the entire SCMAGLEV Project Affected Environment.

Attachment B provides mesoscale analysis sample worksheets.

Table D.9-9: Mesoscale Daily Vehicle Mile Traveled – Camden Yards Station Option

Year 2027

Region	2027	VMT (Mile)	Net Difference No-Build to Build	% Change No-Build to Build
BMC	No Build	4,663,438	82,178	-
	Build	4,745,616		
MWCOG	No Build	3,315,725	-44,900	-
	Build	3,270,825		
BMC+MWCOG	No Build	7,979,162	37,278	0.47%
	Build	8,016,441		

Year 2045

Region	2045	VMT (Mile)	Net Difference No-Build to Build	% Change No-Build to Build
BMC	No Build	5,072,098	54,825	-
	Build	5,126,923		
MWCOG	No Build	3,458,183	-4,471	-
	Build	3,453,712		
BMC+MWCOG	No Build	8,530,281	50,354	0.59%
	Build	8,580,635		

Source: AECOM, July 2020

Table D.9-10: Mesoscale Daily Emissions (tons per day) – Cherry Hill Station Option

Year 2027

Pollutant	BMC 2027		MWCOG 2027		BMC + MWGOC 2027		Net Difference	% Change
	No-Build	Build	No-Build	Build	No-Build	Build	No-Build to Build	No-Build to Build
VOC	0.37	0.38	0.37	0.37	0.74	0.75	0.0049	0.66%
NOx	3.76	3.84	2.95	2.93	6.71	6.77	0.0509	0.76%
CO	12.94	13.20	9.24	9.16	22.18	22.36	0.1808	0.82%
PM2.5	0.12	0.12	0.08	0.08	0.20	0.20	0.0018	0.89%
PM10	0.44	0.45	0.29	0.29	0.73	0.73	0.0074	1.02%
SO2	0.01	0.01	0.01	0.01	0.02	0.02	0.0002	0.90%
CO2	4012.64	4095.07	2663.36	2640.42	6676.01	6735.49	59.4853	0.89%

Year 2045

Pollutant	BMC 2045		MWCOG 2045		BMC + MWCOG 2045		Net Difference	% Change
	No-Build	Build	No-Build	Build	No-Build	Build	No-Build to Build	No-Build to Build
VOC	0.31	0.32	0.20	0.21	0.52	0.52	0.0087	1.69%
NOx	3.30	3.37	1.98	1.99	5.28	5.36	0.0802	1.52%
CO	11.09	11.32	6.88	6.92	17.97	18.24	0.2697	1.50%
PM2.5	0.09	0.09	0.05	0.05	0.14	0.14	0.0025	1.77%
PM10	0.44	0.45	0.26	0.27	0.70	0.72	0.0131	1.86%
SO2	0.01	0.01	0.01	0.01	0.02	0.02	0.0003	1.59%
CO2	4130.35	4220.23	2524.82	2538.04	6655.17	6758.28	103.1077	1.55%

Source: AECOM, July 2020

Table D.9-11:4 Mesoscale Daily Emissions (tons per day) – Camden Yards Station Option

Year 2027

Pollutant	BMC 2027		MWCOG 2027		BMC + MWGOC 2027		Net Difference	% Change
	No-Build	Build	No-Build	Build	No-Build	Build	No-Build to Build	No-Build to Build
VOC	0.37	0.38	0.37	0.36	0.74	0.74	0.0015	0.20%
NOx	3.76	3.83	2.95	2.91	6.71	6.74	0.0258	0.38%
CO	12.94	13.16	9.24	9.12	22.18	22.28	0.0982	0.44%
PM2.5	0.12	0.12	0.08	0.08	0.20	0.20	0.0009	0.46%
PM10	0.44	0.45	0.29	0.28	0.73	0.73	0.0039	0.53%
SO2	0.01	0.01	0.01	0.01	0.02	0.02	0.0001	0.52%
CO2	4012.64	4082.84	2663.36	2627.47	6676.01	6710.31	34.3013	0.51%

Year 2045

Pollutant	BMC 2045		MWCOG 2045		BMC + MWCOG 2045		Net Difference	% Change
	No-Build	Build	No-Build	Build	No-Build	Build	No-Build to Build	No-Build to Build
VOC	0.31	0.32	0.20	0.20	0.52	0.52	0.0033	0.64%
NOx	3.30	3.33	1.98	1.98	5.28	5.32	0.0326	0.62%
CO	11.09	11.21	6.88	6.87	17.97	18.08	0.1069	0.59%
PM2.5	0.09	0.09	0.05	0.05	0.14	0.14	0.0010	0.68%
PM10	0.44	0.44	0.26	0.26	0.70	0.71	0.0050	0.71%
SO2	0.01	0.01	0.01	0.01	0.02	0.02	0.0001	0.64%
CO2	4130.35	4174.95	2524.82	2521.73	6655.17	6696.69	41.5163	0.62%

Source: AECOM, July 2020

D.9D.1.3 General Conformity Rule Applicability

For those nonattainment or maintenance pollutants as listed in **Table D.9-5**, only NOx, VOC and SO_2 are the pollutants considered as part of this general conformity applicability determination. For maintenance pollutant CO, the 20-year maintenance periods were over on December 15, 2015 and March 16, 2016 for the Baltimore and the Washington, D.C. areas, respectively. Therefore, a project occurring after the maintenance period is over a specific maintenance pollutant does not require a conformity applicability determination such as for CO for the Proposed Action. For $PM_{2.5}$, EPA revoked the 1997 $PM_{2.5}$ NAAQS and the area is in attainment for the 2006 $PM_{2.5}$ NAAQS, therefore GCR is not applicable for $PM_{2.5}$ emissions. Per the CAA general conformity rule requirements, FRA predicted mesoscale nonattainment pollutant operational emissions for 2027 and 2045 as summarized in **Table D.9-12** for both Cherry Hill and Camron Yard Station Alternatives. The predicted annual operational emissions are below the applicable de minimis levels for each respective pollutant. FRA has, therefore, concluded that no general conformity determination is required, and no significant operational air quality impacts will result from the implementation of a Build Alternative.

Table D.9-12: Mesoscale Operational Emissions (tons per Year)

Pollutant	2027 Cherry Hill Alternatives	2027 Camden Yards Alternatives	2045 Cherry Hill Alternatives	2045 Camden Yards Alternatives	GCR *de minimis* Threshold	Exceed *de minimis* Threshold?
VOC	1.79	0.55	3.18	1.20	50	No
NOx	18.58	9.42	29.27	11.90	100	No
SO_2	0.07	0.04	0.11	0.04	100	No

Source: AECOM, July 2020

D.9D.2 Construction Effects

Per the general conformity rule requirement applicable to FRA Federal action, FRA performed a rule applicability analysis by predicting construction period emissions on an annual basis and then compared with the applicable de minimis levels.

D.9D.2.1 Proposed Construction Activities Resource Data Estimates

FRA performed a construction estimate to identify equipment, material and manpower requirements for the construction associated with SCMAGLEV Project. This memo documents the assumptions made in developing the list of major construction items, the equipment necessary to complete construction, and construction productivity. Equipment, material and manpower estimates are included in the attached spreadsheet; this memo serves to document calculations and assumptions made in the development of the estimates.

The construction activity estimate is based on conceptual designs and simplifying assumptions in order to arrive at a rough order-of-magnitude estimate of equipment, material and manpower estimates as they relate to emissions from construction-related activity. In particular, a significant simplifying assumption is that the use of tunnel boring machines (TMB) for construction of extensive tunnel segments will be powered by electricity obtained from the grid at appropriate locations along the corridor. Accordingly, excavation of the tunnel itself and delivery of spoils (muck) to shaft sites is not considered to generate emissions through operation of equipment underground; however, trucking for removal of muck and delivery of materials to construct the tunnel lining and train support systems is a source of emissions. The scope and nature of such assumptions are detailed as appropriate below. The primary elements of the construction are estimated on a prototype basis (e.g., per mile of tunnel or mile of elevated guideway), as there are several options under consideration for route alignment and location of support facilities, which in combination alter the total quantities. The various Build Alternatives and the major-item quantities associates with these Build Alternatives are summarized in a matrix as shown in **Table D.9-13**.

Table D.9-13: Build Alternative Matrix

Alignment	Baltimore Station Location	TMF Location	Shafts	Viaduct Miles	Tunnel Miles	Total Mileage
J	Camden Yards	BARC	8	10.06	29.11	39.17
J1	Camden Yards	BARC	9	6.04	33.16	39.2
J	Camden Yards	MD-198	8	11.86	29.11	40.97
J1	Camden Yards	MD-198	9	7.97	33.16	41.13
J	Cherry Hill	BARC	8	10.7	26.86	37.56
J1	Cherry Hill	BARC	9	6.68	30.9	37.58
J	Cherry Hill	MD-198	8	12.5	26.86	39.36
J1	Cherry Hill	MD-198	9	8.6	30.9	39.5

Source: AECOM, July 2020

FRA considered the following major components for purposes of developing the estimate as to construction crew and equipment requirements and productivity based on data presented in

- "2003 RSMeans Facilities Construction Cost Data", R.S. Means Co., Inc., 2002
- "2011 RSMeans Facilities Construction Cost Data", R.S. Means Co., Inc., 2010

D.9D.2.1.1 Tunnels

The tunnels are assumed to be excavated by TBM, which will excavate the alignment and transport muck via electrical-powered conveyors to specific locations (portals or access shaft locations) for trucking to disposal locations. Tunnel bores will be approximately 45 feet in diameter, and TBM will place precast liner segments as an integral part of the construction process. Precast liners are assumed to be 1-foot thick; based on a 45-ft tunnel diameter, the circumference of the tunnel is 141 feet and the net in-place weight of the tunnel liner is 10.2 tons per liner foot of tunnel for a concrete unit weight of 145 pounds per cubic foot (pcf); reinforcement and other steel content is considered negligible for purposes of this estimate. An additional 9.8 tons per linear foot of precast concrete is expected to be placed to form the guideway, plenum and other internal tunnel infrastructure, for a total in-place weight of approximately 20 tons of materials per liner foot of tunnel to be delivered. On a per-mile basis for the tunnel, the following net quantities of trucking for muck removal and material delivery are required:

- Hauling of muck – 524,840 tons of material (assumed in-situ weight of 125 pcf) required; assuming a net load of 24 tons per truck loaded out, 21,870 truck trips are required. Assuming a disposal facility within 20 miles, the round-trip truck mileage for muck disposal is 874,800 miles/linear mile of tunnel.
- Delivery of precast liners/appurtenances – 105,600 tons of material; assuming a net load of 24 tons per truck, 4,400 truck trips are required. Assuming materials are laded to delivery trucks within 20 miles, the round-trip truck mileage for material delivery is 176,000 miles/linear mile of tunnel.

Although construction equipment in the tunnel will be electrically powered, assume four crane crews are required to support loading in of material at access points, and also that 25 workers are present in the tunnel itself (for purposes of estimating manhours), and that the tunnel productivity rate is 100 feet per working day (e.g., 52.8 days per mile of completed tunneling)

Construction of access shafts will be by conventional fuel-powered construction equipment. It is assumed that shafts will be of slurry-wall construction. Shaft sizes were specified in the SCAMGLEV Project documents and vary, in some cases considerably, from shaft to shaft; for estimating purposes, however, the average shaft volume of 420,000 cubic yards (CY) is assumed. A total of eight or nine shafts are assumed, depending on the route alignment.

- Shaft excavations – Total excavation volume is 420,000 CY; total weight of soil to be loaded out is 708,750 tons per shaft (assumed in-situ weight of 125 pcf). Assuming a net load of 24 tons per truck loaded out, 29,531 truck trips are required. Assuming a disposal facility within 20 miles, the round-trip truck mileage for muck disposal is 1,181,250 miles per shaft.
- Slurry walls – Based on a 3-foot wall thickness, the total wall volume is 20,600 CY. Total concrete weight is 41,715 tons per shaft. Assuming a net load of 12 tons of transit mix concrete delivered per truck, 3,476 truck trips are required. Assuming materials are laded to delivery trucks within 20 miles, the round-trip truck mileage for cast-in-place concrete delivery at shafts is 139,050 miles per shaft.

It is assumed that truck mileages and equipment use requirements for placement of finishes in shafts (generally, tunnel support equipment including ventilation, electrical gear, stairways, etc.) is comparatively minor to the overall tunneling and shaft construction, and is not considered further for purposes of this conceptual estimate.

D.9D.2.1.2 Elevated Guideway

The guideways are to be generally of precast concrete construction. Cast-in-place construction would be limited to installation of drilled shafts and pile caps. Piers and guideways will be precast, with piers at an average interval of 120 feet. The elevated guideway right-of-way is estimated at 65 feet in width. Approximate typical dimensions and corresponding weights for various components are as follows (assumed 150 pcf unit weight for concrete):

D.9D.2.1.3 Piers

- Foundations.
- Vertical member – 10-ft square precast column, assume 40-ft average height – 300 tons per pier.
- Hammerhead pier dimension – average width 23 feet, height 10 feet, thickness 10 feet – average weight 195 tons.

D.9D.2.1.4 Guideways

- Based on scaling from cross-sections, assume approximately 225 square feet (SF) of concrete in cross section, or 27,000 cubic feet (CF) per span; net weight is 2,025 tons per span.
- In addition, assume clearing, grubbing and grading of full 65-ft wide right-of-way beneath.
- It is assumed that each segment requires 10 days of a 40-ton crane plus support crew for erection purposes, but that all other onsite work is minimal as the guideway will be delivered precast with most components preinstalled.

At transition points, portions of the guideway will be constructed on built-up fill; however, these built-up fill segments are of limited length overall and for estimate purposes are assumed to be constructed in the same manner as the elevated guideway. It can be assumed that built-up fill segments can be constructed using fill excavated from cut-and-cover segments and the assumption that the excavated material from the cut-and-cover segments is being disposed of off-site therefore overestimates effort for movement of this material and is therefore a conservative assumption.

D.9D.2.1.5 Aboveground Station

The Cherry Hill station, if selected as the Baltimore City terminal station, will be above-grade station with express tracks for eventual non-stop thru service to points north and local trackways for service at the station. It is assumed that the local trackways are in the form of localized diversions from the mainline, of sufficient length only to provide sufficient acceleration/deceleration distance for local service to slow down and regain speed for purposes of stopping at the station, without impacting other service on the mainline. For purposes of this estimate, it is nominally assumed that this acceleration/deceleration distance is one mile per track on each side of the station; however, it is further assumed that structure for the onward service northbound beyond Cherry Hill is not included at this time, and only two miles of additional acceleration/deceleration four-track guideway would be constructed south of the station (i.e., one mile of acceleration/deceleration trackway for each of the two local tracks before rejoining the main alignment towards Washington, D.C.). It is further assumed that one additional mile of two-track guideway is assumed as a conservative estimate of the effort to construct four-track guideway over this same length (i.e., in reality a four-track guideway can be constructed more efficiently than two two-track guideways). It is also assumed that the guideways through the station itself would be constructed in a manner typical of the mainline guideway, and that the station itself may be modeled as a typical “institutional” type building built around the guideways. The size of the Cherry Hill station is not specified; it is assumed to have a floor area 150,000 gross SF for purposes of this estimate.

D.9D.2.1.6 Underground Stations

The Mount Vernon Square, BWI Airport and Camden Yards station (if selected as the Baltimore City terminal station) are all underground stations with four tracks of service. Unlike the Cherry Hill station option, it is assumed that all four tracks platform at these stations, and as such a long run-in/run-out for the additional tracks to account for acceleration/deceleration to/from mainline speed is not required; accordingly, for purposes of this estimate separate accounting of tunneling for run-in/run-out length is ignored. It is assumed that the station alignments are one-half mile each for purposes of this estimate (provides space not only for the platforms, but the ancillary areas at each station outside of the passenger areas). The BWI station would have a surface structure component as part of the overall underground station, but for purposes of conservatism in terms of construction effort an entirely underground station is assumed. Though specifics vary by station, in general terms it is assumed that there will be 100 feet of excavation and structural work across a 125-ft wide alignment, not including the actual tunnel construction itself (which further extends these structures downward and are assumed to be constructed per the mainline prototypical tunnel item).

Construction of station shafts will be by conventional fuel-powered construction equipment. It is assumed that shafts will be of slurry-wall construction, with a shaft size of 1,000-ft by 125-ft and a depth of 100 feet; concrete slurry walls will be 3-ft in thickness around the perimeter of the shafts.

- Shaft excavations – Total excavation volume is 12,500,000 cubic feet per station; total weight of soil to be loaded out is 781,250 tons per station (assumed in-situ weight of 125 pcf). Assuming a net load of 24 tons per truck loaded out, 32,552 truck trips are required. Assuming a disposal facility within 20 miles, the round-trip truck mileage for muck disposal is 1,302,000 miles per shaft.
- Slurry walls – Based on a 3-foot wall thickness, the total wall volume is 675,000 cubic feet. Total concrete weight is 50,625 tons per station. Assuming a net load of 12 tons of transit mix concrete delivered per truck, 4,219 truck trips are required. Assuming materials are loaded to delivery trucks within 20 miles, the round-trip truck mileage for cast-in-place concrete delivery at shafts is 168,750 miles per shaft.

It is assumed that station fit-out can be approximated using the same effort necessary for the above-ground station at Cherry Hill (i.e., using an institutional structure prototype), to the extent significant structural work inside the station shell is still needed to construct the station finishes, and are in addition to the construction effort related directly to the excavation of the station shell. For estimating purposes, a constructed structural floor area of 150,000 SF per station is assumed (to account for ticketing hall, waiting areas, facilities, platform space, etc.).

D.9D.2.1.7 Trainset Maintenance Facility

For the Trainset Maintenance Facility (TMF), it is likewise assumed that the facility itself can be reasonably estimated using an institutional-type building prototype. The actual location, and thus configuration, of the TMF is still under consideration. For purposes of this estimate, it is assumed to have a 170-acre footprint, of which roughly 32 acres (1,393,920 SF) is assumed to be occupied by institutional-type prototype buildings in which the various TMF functions (new vehicle assembly, maintenance, inspection, administration, etc.) are located, another 8 acres (348,480 SF) is occupied by an institution-type building that is part of a maintenance of way facility that will be included within the TMF, 7 acres are precast concrete guideways to function as yard space (for conservatism, it is assumed foundation elements are still required though when installed at-grade, pile foundations can likely be omitted), approximately 50 acres of paved surface serves as general-use yard space, 5 acres is used for a power substation, and 6 acres is used for parking lots. The remainder of the lot (approximately 62 acres) are landscape to serve as stormwater management, buffer, and/or provide future expansion capacity. In addition, it is assumed that 5 additional miles of 2-track elevated guideway will connect the TMF to the main line and/or provide other ancillary connections within the TMF.

Maintenance of Way Facility

A standalone maintenance of way facility (in addition to the one integrated into the TMF) may also be constructed, depending on the specific Build Alternative. For purposes of this estimate, it is assumed to have a 12-acre footprint, of which roughly 8 acres (348,480 SF) is occupied by an institution-type and the remaining 4 acres are assumed to be paved areas for general yard use purposes. In addition to the maintenance of way facilities themselves, there is also additional guideway construction required for a ramp to access the right of way from the maintenance of way facility – these distances vary depending upon alignment selection and the TMF/maintenance of way site selections, are accounted for in the guideway length estimates provided as part of the DEIS, and are not estimated separately.

Prototype Items

General Clearing and Grading

On a per acre basis, for basic removal and grading:

- Clear and grub, cut & chip light trees

- Grade subgrade for base course, roadways

Roadway Construction

On a per acre basis, pavement for the new parking area/work yard, etc. would involve:

- Base Course
- Pavement

In addition to parking areas, a total of 2 miles of roadway alignments will relocated as part of the work; although the locations vary slightly depending on the route alignment selected, the total is approximately the same for either alignment. For estimating purposes, it is assumed that 2 miles of new 25-ft wide roadway (264,000 SF total, or 6.1 acres) is constructed for all the Build Alternatives. General clearing and grading components are added to the estimate for the roadway components (i.e., those outside the other construction areas for which grading is already accounted for).

Institutional Structures

For construction of the new permanent structures (stations, etc.), a typical institutional-type building is assumed at a typical size and then scaled to the sizes appropriate for each application. A 150-ft by 275-ft building (41,250 SF) single-story building is assumed as the base structure.

- Foundation – Assume a reinforced slab foundation, with pile-supported grade beams running along the exterior edges of the slab to support the masonry and steel-frame exterior walls.
- Superstructure - For the building superstructure and interior fit-out, for purposes of developing this estimate it is assumed that the building will have exterior dimensions of 150 ft. by 275 ft. A framing system using 25-ft framing bays in both directions (therefore, a 7 x 12 column plan, or 6 x 11 framing bay plan around the perimeter) and open-web long-span joists are used to create a clear span building.
- Interior Fit-out including installation of mechanical system, utility system, interior assembly, etc.

Parking Structures

Parking is to be provided at all stations. Sizes are provided only in terms of spots; no specific number of spots is provided for the BWI stop, but 1,200 spots are assumed for purposes of this estimate. Nominally some facilities may be underground, but no site specifics are provided, so for these facilities it is assumed that the underground garage would be constructed within the station shell excavation envelope. Structural components are assumed otherwise similar for above or belowground parking re loads, etc. For the underground structures, foundations are assumed not required, but are retained in the prototype for purposes of conservatism.

1) Site Prep & Foundation – Due to high, concentrated loads, assume a pile foundation beneath each column, with columns connected by grade beams. Based on project drawings, a total of 90 columns are estimated; assume 5,000 LF of grade beam (based on scaling from project drawings)
2) For framing purposes, assume three levels are required
3) Utility installations including:
   a. Electrical
   b. Lighting
   c. Communications
   d. Sprinkler system
   e. Two elevators

D.9D.2.2 Construction Activity Emissions Estimates

FRA predicted emission factors from USEPA's MOVES 2014b emission factor model associated with the available Washington, D.C. and Baltimore area model database for nonroad engines. The quantity and type of equipment necessary was determined based on the activities necessary to implement SCMAGLEV Project described previously. FRA assumed that equipment would be mostly diesel-powered and each truck or commuting vehicle round trip would be 20 miles during construction. FRA predicted truck and commuter vehicle running emission factors for NOx, VOC, and SO_2 as applicable for SCMAGLEV Project using the MOVES 2014b model. Attachment C provides construction emission factors estimated using MOVES 2014b.

FRA predicted construction period nonattainment and maintenance pollutant emissions associated with each project component and then evenly distributed them over the respective construction schedule on an annual basis. The breakdown of predicted tons per year for each applicable pollutant under the worst-case condition amongst all 12 Build Alternatives are summarized in **Table D.9-14** for each construction element and each Build Alternative defined based on different project element combinations. Attachment C shows a sample calculation of TMF construction emissions. **Table D.9-15** summarizes the annual construction emissions under each Build Alternative over the entire construction period including the last finishing year producing no emissions.

D.9D.2.3 General Conformity Rule Applicability

As shown in **Table D.9-15** as well the worst-case annual construction emissions summarized in **Table D.9-16**, FRA found that the predicted annual construction emissions for NOx, VOC, and SO_2 would not exceed the applicable *de minimis* thresholds and concluded that no formal general conformity determination is required.

Table D.9-14: Total Construction Emissions for Each Build Alternative

Build Alternative	Construction Element	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
J-01	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.30	13.11	11.44	0.74	1.25	0.04	6,719.4
	Tunnel	9.20	76.42	34.98	4.76	11.11	0.19	45,427.5
	Total	17.77	152.54	101.18	9.34	20.07	0.39	85,061.5
J-02	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.11	11.23	9.80	0.64	1.07	0.03	5,751.8
	Tunnel	9.20	76.42	34.98	4.76	11.11	0.19	45,427.5
	Total	17.59	150.65	99.53	9.23	19.89	0.39	84,093.9
J-03	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.11	11.23	9.80	0.64	1.07	0.03	5,751.8
	Tunnel	9.20	76.42	34.98	4.76	11.11	0.19	45,427.5
	Total	17.59	150.65	99.53	9.23	19.89	0.39	84,093.9
J-04	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3

Build Alternative	Construction Element	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.23	12.44	10.86	0.71	1.19	0.04	6,375.4
	Tunnel	9.97	82.82	37.90	5.16	12.04	0.21	49,232.9
	Total	19.27	166.76	106.19	10.18	21.77	0.42	91,371.2
J-05	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.04	10.55	9.21	0.60	1.01	0.03	5,407.8
	Tunnel	9.97	82.82	37.90	5.16	12.04	0.21	49,232.9
	Total	19.08	164.87	104.54	10.08	21.59	0.42	90,403.6
J-06	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	3.57	31.11	14.04	1.94	4.31	0.09	19,021.9
	Viaduct	1.04	10.55	9.21	0.60	1.01	0.03	5,407.8
	Tunnel	9.97	82.82	37.90	5.16	12.04	0.21	49,232.9
	Total	19.08	164.87	104.54	10.08	21.59	0.42	90,403.6
J1-01	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3

Build Alternative	Construction Element	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.89	9.02	7.87	0.51	0.86	0.03	4,623.0
	Tunnel	10.58	87.92	40.24	5.47	12.78	0.22	52,260.2
	Total	19.20	163.83	104.62	10.06	21.89	0.42	92,175.5
J1-02	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.69	7.01	6.12	0.40	0.67	0.02	3,590.9
	Tunnel	10.58	87.92	40.24	5.47	12.78	0.22	52,260.2
	Total	19.00	161.81	102.86	9.95	21.70	0.41	91,143.4
J1-03	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Cherry Hill)	2.12	19.56	17.13	1.13	2.00	0.04	7,138.1
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.69	7.01	6.12	0.40	0.67	0.02	3,590.9
	Tunnel	10.58	87.92	40.24	5.47	12.78	0.22	52,260.2
	Total	19.00	161.81	102.86	9.95	21.70	0.41	91,143.4
J1-04	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.83	8.36	7.30	0.47	0.80	0.03	4,284.3

Build Alternative	Construction Element	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
	Tunnel	11.36	94.35	43.18	5.87	13.71	0.24	56,082.5
	Total	20.70	178.09	109.65	10.91	23.59	0.45	98,507.5
J1-05	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.63	6.34	5.53	0.36	0.60	0.02	3,246.8
	Tunnel	11.36	94.35	43.18	5.87	13.71	0.24	56,082.5
	Total	20.50	176.06	107.89	10.80	23.40	0.44	97,470.0
J1-06	TMF	1.44	11.43	20.57	0.71	1.28	0.04	6,199.3
	Maintenance of Way Facility	0.13	0.83	2.98	0.05	0.12	0.00	530.8
	Road Replacement	0.01	0.06	0.04	0.01	0.01	0.00	24.3
	Station (Camden Yard)	2.91	28.05	19.80	1.61	2.83	0.05	9,986.5
	Shaft	4.01	35.00	15.79	2.18	4.85	0.10	21,399.7
	Viaduct	0.63	6.34	5.53	0.36	0.60	0.02	3,246.8
	Tunnel	11.36	94.35	43.18	5.87	13.71	0.24	56,082.5
	Total	20.50	176.06	107.89	10.80	23.40	0.44	97,470.0

Source: AECOM, July 2020

Table D.9-15: Annual Construction Emissions for Each Build Alternative

Build Alternative	Construction Year	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
J-01	1	1.96	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.35	37.87	23.19	2.32	4.98	0.10	21,576.0
	3	4.12	35.16	22.37	2.15	4.69	0.09	19,702.7
	4	4.12	35.16	22.37	2.15	4.69	0.09	19,702.7
	5	2.15	18.05	12.73	1.11	2.42	0.04	9,891.6
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6

Build Alternative	Construction Year	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J-02	1	1.96	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.29	37.24	22.64	2.28	4.92	0.10	21,253.5
	3	4.06	34.53	21.83	2.11	4.63	0.09	19,380.1
	4	4.06	34.53	21.83	2.11	4.63	0.09	19,380.1
	5	2.15	18.05	12.73	1.11	2.42	0.04	9,891.6
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J-03	1	1.96	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.29	37.24	22.64	2.28	4.92	0.10	21,253.5
	3	4.06	34.53	21.83	2.11	4.63	0.09	19,380.1
	4	4.06	34.53	21.83	2.11	4.63	0.09	19,380.1
	5	2.15	18.05	12.73	1.11	2.42	0.04	9,891.6
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J-04	1	1.96	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.59	40.13	23.93	2.46	5.25	0.10	22,570.3
	3	4.49	38.48	23.60	2.35	5.12	0.10	21,331.2
	4	4.49	38.48	23.60	2.35	5.12	0.10	21,331.2
	5	2.41	20.53	13.66	1.26	2.71	0.05	11,000.6
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J-05	1	1.96	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.53	39.50	23.38	2.42	5.19	0.10	22,247.8
	3	4.42	37.85	23.05	2.32	5.06	0.09	21,008.7
	4	4.42	37.85	23.05	2.32	5.06	0.09	21,008.7
	5	2.41	20.53	13.66	1.26	2.71	0.05	11,000.6
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0

Build Alternative	Construction Year	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
J-06	1	2.18	16.93	9.49	1.06	2.31	0.05	10,254.9
	2	4.53	39.50	23.38	2.42	5.19	0.10	22,247.8
	3	4.42	37.85	23.05	2.32	5.06	0.09	21,008.7
	4	4.42	37.85	23.05	2.32	5.06	0.09	21,008.7
	5	2.41	20.53	13.66	1.26	2.71	0.05	11,000.6
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-01	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8
	2	4.67	40.37	23.76	2.48	5.39	0.11	23,204.9
	3	4.45	37.63	22.94	2.31	5.11	0.10	21,281.4
	4	4.45	37.63	22.94	2.31	5.11	0.10	21,281.4
	5	2.38	19.97	13.61	1.23	2.70	0.05	11,030.4
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-02	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8
	2	4.61	39.70	23.17	2.45	5.33	0.10	22,860.8
	3	4.38	36.95	22.35	2.27	5.05	0.09	20,937.4
	4	4.38	36.95	22.35	2.27	5.05	0.09	20,937.4
	5	2.38	19.97	13.61	1.23	2.70	0.05	11,030.4
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-03	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8
	2	4.61	39.70	23.17	2.45	5.33	0.10	22,860.8
	3	4.38	36.95	22.35	2.27	5.05	0.09	20,937.4
	4	4.38	36.95	22.35	2.27	5.05	0.09	20,937.4
	5	2.38	19.97	13.61	1.23	2.70	0.05	11,030.4
	6	0.60	5.19	6.52	0.31	0.55	0.01	2,247.9
	7	0.47	4.17	4.50	0.24	0.44	0.01	1,685.6
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-04	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8

Build Alternative	Construction Year	Pollutant (tons)						
		VOC	NOx	CO	PM2.5	PM10	SO2	CO2
	2	4.91	42.64	24.50	2.62	5.67	0.11	24,203.8
	3	4.81	40.96	24.17	2.51	5.54	0.10	22,917.4
	4	4.81	40.96	24.17	2.51	5.54	0.10	22,917.4
	5	2.64	22.45	14.54	1.38	2.99	0.05	12,142.2
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-05	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8
	2	4.84	41.96	23.91	2.58	5.60	0.11	23,857.9
	3	4.75	40.29	23.58	2.47	5.48	0.10	22,571.5
	4	4.75	40.29	23.58	2.47	5.48	0.10	22,571.5
	5	2.64	22.45	14.54	1.38	2.99	0.05	12,142.2
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
J1-06	1	2.18	18.87	10.36	1.18	2.58	0.05	11,443.8
	2	4.84	41.96	23.91	2.58	5.60	0.11	23,857.9
	3	4.75	40.29	23.58	2.47	5.48	0.10	22,571.5
	4	4.75	40.29	23.58	2.47	5.48	0.10	22,571.5
	5	2.64	22.45	14.54	1.38	2.99	0.05	12,142.2
	6	0.73	6.61	6.96	0.39	0.69	0.01	2,722.7
	7	0.60	5.59	4.95	0.33	0.57	0.01	2,160.4
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.0
GCR De minimis Threshold		50	100	100	N/A	N/A	100	N/A
Exceed De minimis Threshold		No	No	N/A	N/A	N/A	No	N/A

Source: AECOM, July 2020

Table D.9-16: Worst-case Construction Emissions for All Build Alternatives (tons per Year)

Year	VOC	NOx	SO_2
2022	2.2	18.9	0.05
2023	4.9	42.6	0.11

Year	VOC	NOx	SO_2
2024	4.8	41.0	0.10
2025	4.8	41.0	0.10
2026	2.6	22.5	0.01
2027	0.7	6.6	0.01
2028	0.6	5.6	0.01
GCR *de minimis* Threshold	50	100	100
Exceed *de minimis* Threshold	No	No	No

Source: AECOM, July 2020

D.9D.3 General Conformity Rule Applicability for Overlapping Emissions

Since the build year is 2027, FRA further combined construction and operational emissions starting from 2027 and beyond as shown in **Table D.9-17**. The predicted worst-case annual construction and operational emissions combined are below the applicable de minimis levels for each respective pollutant during each construction and operation year.

FRA has, therefore, concluded that no formal conformity determination is required for the SCMAGLEV Project, and no significant air quality impact will result from the implementation of each Build Alternative during construction period as well as the period when construction and operation activities would overlap.

Table D.9-17: Worst-case Combined Construction and Operational Emissions for All Build Alternatives (tons per Year)

Year	VOC	NOx	SO_2
2022	2.2	18.9	0.05
2023	4.9	42.6	0.11
2024	4.8	41.0	0.10
2025	4.8	41.0	0.10
2026	2.6	22.5	0.01
2027	2.5	25.2	0.08
2028	2.4	24.2	0.08
2045	3.2	29.3	0.1
GCR *de minimis* Threshold	50	100	100
Exceed *de minimis* Threshold	No	No	No

Source: AECOM, July 2020

D.9D.4 Avoidance, Minimization & Potential Mitigation Strategies

To mitigate the temporary air quality impacts during construction period, to extent practicable, FRA would consider and implement various control measures including:

- Dust Control - a dust control plan including a watering program would be required as part of contract specifications. The plan would include measures such as:
  - All trucks hauling loose material would be equipped with tight-fitting tailgates and their loads securely covered prior to leaving the construction site.
  - Water sprays would be used for all demolition, excavation, and transfer of soils to ensure that materials would be dampened as necessary to avoid the suspension of dust into the air.
- Idling Restriction - all stationary vehicles on roadways adjacent to the construction site would be prohibited from idling with the exception of vehicles that are using their engines to operate a loading, unloading, or processing device (e.g., concrete-mixing trucks) or otherwise required for the proper operation of the engine.
- Clean Fuel – ultra low sulfur diesel fuel would be used for diesel engines.
- Best Available Tailpipe (BAT) Reduction Technologies - nonroad diesel engines and controlled truck fleets (i.e., truck fleets under long-term contract with the project) including but not limited to concrete mixing and pumping trucks would utilize the BAT for further reducing particulate emissions. Diesel particulate filters (DPFs) have been identified as being the tailpipe technology currently proven to have the highest reduction capability and could be installed by the original equipment manufacturer or retrofitted.

Appendix D.9E References

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