Crystal City / Potomac Yard Corridor
Transit Improvements Project

Air Quality Assessment
Technical Memorandum

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Air Quality Assessment

Crystal City / Potomac Yard Corridor Transit Improvements Project

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1.0 INTRODUCTION

This report summarizes the results of the air quality assessment for proposed BRT service along the Crystal City/Potomac Yard (CCPY) Corridor. This analysis was conducted according to the guidelines established by the Environmental Protection Agency (EPA) as required by the National Environmental Policy Act (NEPA).

1.1 Project Description

1.1.1 Project Purpose

The purpose of the CCPY Corridor Transit Improvements Project is to advance the proposed transit improvements for the CCPY Corridor into design and construction utilizing federal grants appropriated for these transit improvements. As required by the Federal Transit Administration (FTA), the potential effects on transportation conditions and social, cultural, and natural environments in the corridor will be evaluated and documented. This process will meet the requirements of the National Environmental Policy Act (NEPA) and other federal and state policies.

1.1.2 Background

The CCPY Corridor is a five-mile long corridor that extends from the Braddock Road Metrorail station in the City of Alexandria to the Pentagon in Arlington County. Metrorail Blue and Yellow lines and Jefferson Davis Highway, a segment of heavily-traveled U.S. Route 1, form the transportation backbone of the corridor. In 2003, the Virginia Department of Rail and Public Transportation (DRPT), Arlington County, and the City of Alexandria completed the CCPY Corridor Transit Alternatives Analysis (AA). In the AA, transit modes, which included bus rapid transit (BRT), light rail transit (LRT), and Metrorail, and alignment options were analyzed. The costs and benefits of each alternative were also assessed.

Following the completion of the AA, DRPT, in collaboration with Arlington County and the City of Alexandria, undertook the CCPY Corridor Interim Transit Improvements Study that formulated implementation strategies targeting the period from 2007 to 2014. As part of the study, an environmental scan and station area planning were conducted. At the conclusion of this study, a high-capacity, branded bus transit service using both mixed traffic operations and exclusive transitways was recommended. This service, while supporting growing transit demand from existing and new developments, would not preclude longer-term transit system improvement options that have been envisioned for the CCPY corridor, including BRT, LRT, and the addition of a Metrorail station.

1.1.4 Environmental Documentation

Both Alexandria and Arlington have secured considerable funding for the design and construction of the planned transit improvements, including several federal grants. In order to utilize the federal grants appropriated for transitways, the project sponsors must undertake environmental analyses to satisfy NEPA. Since the proposed transit improvements are planned largely in existing right-of-way and would require little or no construction, significant environmental effects are not anticipated. Based on consultation with FTA staff, the project sponsors will prepare a Documented Categorical Exclusion as the appropriate NEPA document. The studies will include an Air Quality analysis, a Noise and Vibration analysis, a Traffic analysis, a Historic and Archaeological Analysis, a water resources analysis, and a Phase I

ESA. The studies will document the level of potential impact associated with the project and identify any mitigation measures necessary to reduce or eliminate impacts.

There are a number of activities within this project corridor that are either currently being constructed by others or planned to be constructed by others. Figure 1-1 shows the CCPY planned alignment and areas where construction is underway or planned by others. Construction activities by others include new roadways, bridges, and intersection improvements. Current and proposed projects planned or constructed by others are not evaluated as part of this project, and any potential impacts to known or potential hazardous materials sites are not included in this current study. Evaluations of potential environmental impacts associated with those other improvements are assumed to be part of separate environmental documents being prepared by the agencies sponsoring those improvements.

2.0 SITE DESCRIPTION

2.1 Project Alignment and Planned Improvements

The planned alignment for the CCPY Corridor Transit Improvements Project begins at the Braddock Road Metrorail Station and ends near the Pentagon in Arlington County. The alignment passes through 38 intersections. The planned transit alignment, stops, and location of exclusive right-of-way are shown in Figure 1-1. The planned CCPY Corridor Alignment has been separated into six segments that are identified from south to north. The segments are described below:

Segment A - Alexandria Route 1 South

Segment A begins at the Braddock Road Metrorail Station and heads east on Madison Street to North Fayette Street. The planned alignment turns north on Fayette Street and then east on 1st Street before turning north again on North Henry Street and crossing the realigned Monroe Avenue Bridge. The planned alignment in Segment A runs entirely in mixed traffic on existing roadway.

Segment B - Alexandria Route 1

Segment B runs north along Route 1 from the realigned Monroe Avenue Bridge to East Glebe Road. The planned alignment in Segment B runs entirely in exclusive transit lanes either in a median busway or along the east and west curbsides of Route 1 to East Glebe Road, where it transitions to mixed traffic. [1]

Segment C - Alexandria Potomac Yard

Segment C travels east on East Glebe Road from Route 1 through the planned Potomac Yard Town Center to Potomac Avenue. It then turns north along Potomac Avenue to the Alexandria/Arlington line. The planned alignment in Segment C runs entirely in mixed traffic.

Segment D - Arlington Potomac Yard

Segment D begins at the Alexandria/Arlington border running in mixed traffic north on Potomac Avenue. It transitions to exclusive lanes as it turns west on South Glebe Road, running on the northern side of the roadway in right-of-way donated as part of the planned development of Potomac Yard. The alignment turns north on Jefferson Davis Highway and merges with South Crystal Drive, running on the east side of the roadway to the intersection of South Crystal Drive and 26th Street South.

[1] The 2030 analysis is based upon a median alignment in Segment B as the proposed action. The City of Alexandria has not made a definitive decision about the alignment in Segment B; thus, the 2015 analysis examines the effects of both alignments.

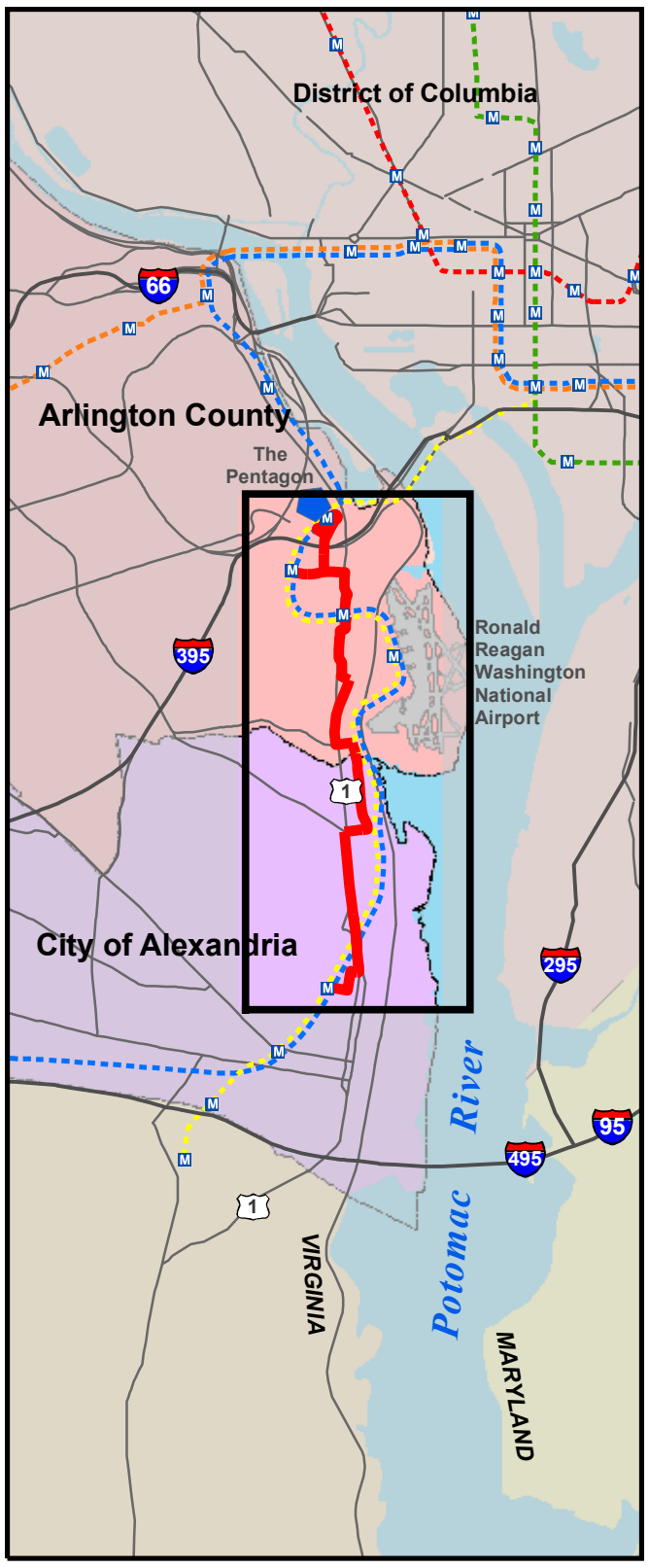


Figure 1-1
Planned Alignment

Legend

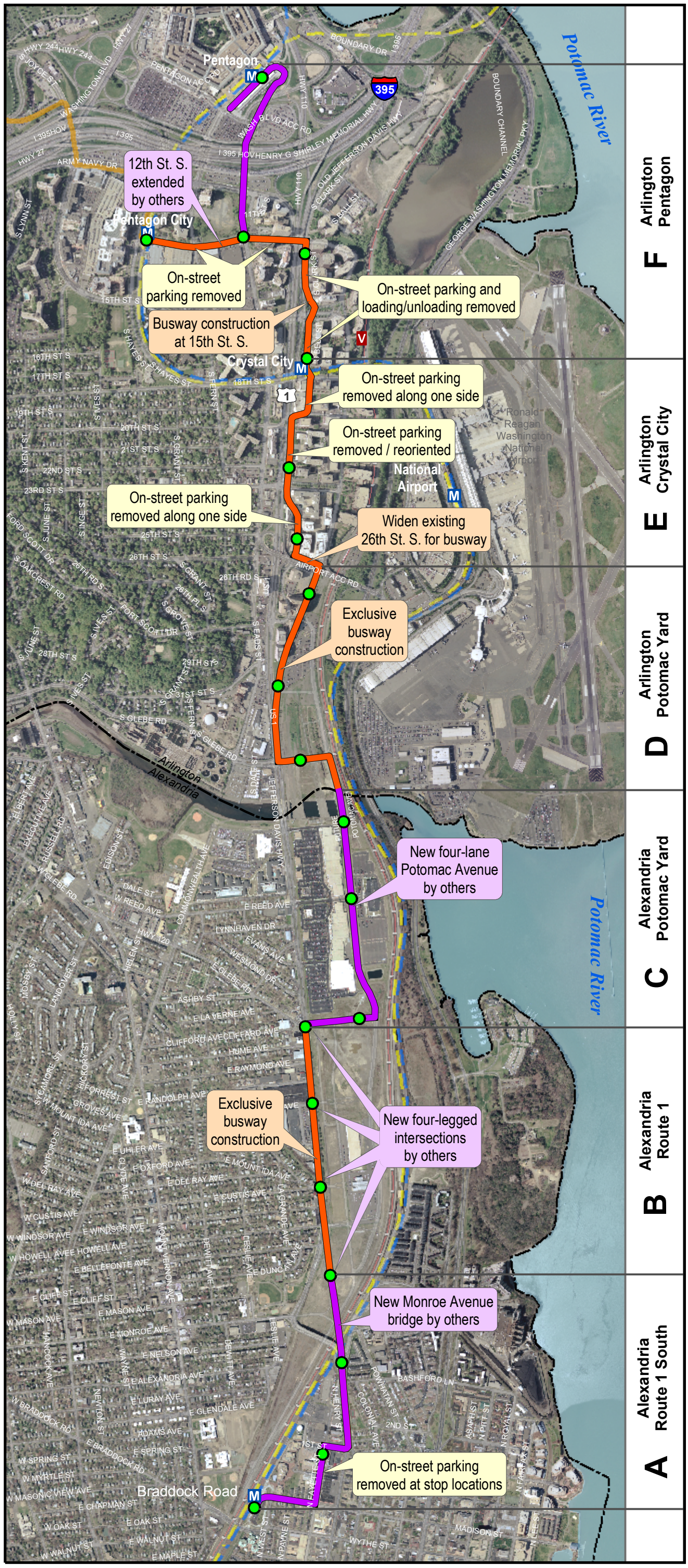
- VRE Station
- Metro Station
- Blue Metro Line
- Yellow Metro Line
- VRE Railroad
- Proposed Station Stop
- Columbia Pike Transit (Proposed)

Planned Alignment

- Mixed Traffic ROW
- Dedicated ROW
- Improvement Associated with CC/PY Project
- Improvement by Others
- Affected Parking

N

0 0.3 0.6 Miles



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Segment E- Arlington Crystal City

Segment E begins at 26th Street South and South Crystal Drive running west before turning north on South Clark Street to 20th Street South. At 20th Street South, the planned alignment turns east and then north on South Bell Street to the Crystal City Metrorail Station at 18th Street South. This segment runs entirely in exclusive curbside lanes.

Segment F - Arlington Pentagon

Segment F begins at the Crystal City Metrorail Station and travels north on South Bell/South Clark Street before turning west on 12th Street. At South Eads Street, the alignment splits into two branches serving the Pentagon and Pentagon City. The first branch turns north on South Eads Street to the Pentagon Transit Center. The second branch continues west on 12th Street South to the Pentagon City Metrorail Station. The planned alignment in Segment F runs in exclusive curbside lanes until the intersection of 12th Street and South Eads Street, where it transitions to running in mixed traffic.

2.2 Study Area

The study area for the air quality assessment included all intersections that were affected by the project. These intersection sites were further refined to four locations based on a screening assessment to select only those sites with the worst level of service. For the purposes of this analysis, construction activities assumed to have invasive or subsurface work would include the installation/upgrading of station stops and the installation of new roadways. All other project work is assumed to be completed at grade. As described in Section 5.4, short-term construction impacts on ambient air quality can result although mitigation measures are available to eliminate their onset.

2.3 Current Use of Adjoining Properties

Conditions along the corridor are very urban with a mix of commercial and residential land uses. Most of the corridor has been disturbed over the years to make way for the various developments that exist. Very little natural environment exists with the exception of designated recreation areas, landscaped areas, and along Four Mile Run and the Potomac River.

The density and mix of uses varies within the corridor. The existing development in southern half of the corridor is residential in character, with commercial uses along Route 1, Mount Vernon Avenue, and around the Braddock Road Metrorail station. There is also active redevelopment of several sites for residential and retail uses at the edge of Old Town Alexandria. The central portion of the corridor is occupied by Potomac Yard, a 368-acre former rail yard that is being redeveloped with a mix of office, residential, and retail uses. Build-out of Potomac Yard over the next 10 years will result in approximately 4.4 million square feet of new office space, 3,000 new residential units, 1,200 new hotel rooms, and 270,000 square feet of new retail space.

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

3.0 METHODOLOGY

The modeling methodologies used for the air quality assessment, including descriptions of the pollutants of concern, are described in the following section.

3.1 Pollutants of Concern

The pollutants that are most important for a transit air quality impact analysis are those that can be traced principally to motor vehicles and electrical power plants. In the study area, however, ambient concentrations of carbon monoxide (CO) and ozone (O_3) are predominantly influenced by motor vehicle activity. Emissions of hydrocarbons (HC), nitrogen oxides (NO_x) and particulate matter smaller than 10 and 2.5 microns (respectively, PM10/2.5) come from both mobile and stationary sources while emissions of sulfur oxides (SO_x) and lead (Pb) are associated mainly with various stationary sources. The air quality assessment focused on emission sources that could be traced directly to the Project, which included primarily motor vehicles. Since electricity for the street cars would be purchased from the electrical grid, the source and the magnitude of the emitted pollutants are difficult to quantify and would depend greatly on characteristics of the production plant (e.g., percent efficiency, fuel type, etc.). These stationary emissions are typically insignificant compared with the emissions due to motor vehicles.

CO is the primary pollutant used to indicate the potential for adverse air quality impacts from motor vehicles in general, and at roadway intersections in particular. This is because motor vehicles produce most of the ambient CO, and emission rates of CO from vehicles are relatively high compared to emissions of other pollutants. The federal ambient air quality standards are set up in such a way that, should adverse impacts occur, the CO standard would most likely be exceeded first. Accordingly, CO is the main pollutant of concern for the air quality analysis.

Similarly, because ozone is a regional pollutant that is formed in the presence of volatile organic compounds (VOC) and NO_x, it is not possible to evaluate ozone directly. Ozone is typically assessed through its precursors. However, because the CO standard would be exceeded first before either nitrogen dioxide (NO_2) or VOC, only CO is included in the modeling analysis. As a result, concentrations of ozone are typically measured directly in the atmosphere rather than through modeling predictions.

3.2 Modeling Methodology

In accordance with EPA guidance, the analysis methodology consisted of an intersection assessment and a dispersion modeling analysis for computing CO concentrations at candidate intersections along the corridor. The intersection screening methods were based on EPA criteria in the *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*[2]. The study area for air quality is the intersections modeled.

<u>Intersection Screening</u>

Motor vehicles emit CO at the highest rates when they are operating at low speeds or idling. For this reason, the potential for adverse air quality impacts is greatest at intersections where traffic is most congested. An initial screening of 14 traffic intersections in the traffic study area was performed that identified intersections where traffic volumes would be likely to increase due to the project. For all intersections included in the traffic study, the level of service (LOS) ratings were ranked from worst ('F') to best ('A') to correspond with increasing vehicle delay and

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

congestion. Based on the results of this initial intersection screening, the following four intersections were selected for analysis:

1. Army Drive and South Eads Street, Arlington in Segment F;
2. South Clark Street and 23rd Street South, Arlington in Segment E;
3. 33rd Street/Crystal Drive and Jefferson Davis Highway, Arlington (future only) in Segment D; and
4. Route 1 and Potomac Avenue, Alexandria in Segment B (future only).

Modeling Analysis

At each of the intersections selected for detailed air quality modeling, maximum one-hour and eight-hour CO concentrations were predicted at several receptor locations in the vicinity of the intersection where the maximum concentrations would be expected and where the public would have reasonable access. The traffic data used in the air quality analysis were based on traffic volumes and growth projections included in the *CCPY Transportation Effects Technical Memorandum*.

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

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

Maximum one- and eight-hour CO concentrations were estimated using EPA's CAL3QHC Version 2.0 dispersion model[3]. Specific modeling inputs were selected in accordance with MWCOG guidance. Consistent with EPA's 1992 guidelines, eight-hour CO concentrations were estimated by multiplying the modeled one-hour results by a persistence (scale) factor of 0.7 based on local monitored data at two sites including (1) South 18th Street and Hayes Street and (2) 517 North Saint Asaph Street. Total CO concentrations were derived by adding to the modeled maximum concentrations a background level to account for sources of CO other than the traffic at the intersection being modeled. Background levels of 2.5 parts per million (ppm) for one hour and 1.6 ppm for eight hours were applied to all modeled concentrations. These background concentrations, which are based on ambient data from the two closest monitoring sites (S. 18th Street and N. St. Asaph Street), were held constant for all analysis years and project alternatives.

3.3 Ambient Air Quality Standards

Under the authority of the Clean Air Act, EPA established a set of *National Ambient Air Quality Standards* (NAAQS) for various "criteria" air pollutants listed in Table 3-1[4]. Presently, there are NAAQS for six criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM) of diameter 10 microns or less (PM10) and 2.5 microns or less (PM2.5), and lead (Pb). Compliance with these standards must be achieved by any project to be constructed in the Commonwealth of Virginia.

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

[4] 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.

Table 3-1: National and Virginia Ambient Air Quality Standards

Pollutant	Standard Type	Averaging Period	Standard Value[a]
Carbon Monoxide (CO)	Primary and Secondary[b] Primary and Secondary	8-Hour average 1-Hour average	9 ppm (10 mg/m^3)[c] 35 ppm (40 mg/m^3)
Nitrogen Dioxide (NO_2)	Primary and Secondary	Annual arithmetic mean	0.053 ppm (100 µg/m^3)[c]
Ozone (O_3)	Primary and Secondary	1-Hour average 8-Hour average	0.12 ppm (235 µg/m^3)[d] 0.08 ppm (155 µg/m^3)
Particulate Matter (PM10)	Primary and Secondary	Annual arithmetic mean 24-Hour average	50 µg/m^3 [e] 150 µg/m^3
Particulate Matter (PM2.5)	Primary and Secondary	Annual arithmetic mean 24-Hour average	15 µg/m^3 65 µg/m^3
Lead (Pb)	Primary and Secondary	Quarterly mean	1.5 µg/m^3
Sulfur Dioxide (SO_2)	Primary Primary Secondary	Annual arithmetic mean 24-Hour average[f] 3-Hour average	0.03 ppm (80 µg/m^3) 0.14 ppm (365 µg/m^3) 0.5 ppm (1300 µg/m^3)

a Short-term standards (1 to 24 hours) are not to be exceeded more than once per calendar year.

b Former national secondary standards for carbon monoxide have been repealed.

c Pollutant concentrations are reported in parts per million (ppm), milligrams per cubic meter (mg/m^3), or micrograms per cubic meter (µg/m^3).

d Maximum daily 1-hour (8-hour) average. The ozone standard is attained when the expected number of days with maximum hourly (8-hourly) average concentrations above the value of the standard, averaged over a three year period, is less than or equal to one.

e For each particle size, the annual PM standard is met when the three-year average of the annual mean concentration is less than or equal to the value of the standard. The 24-hour PM10 (PM2.5) standard is met when the three-year average of the annual 99th (98th) percentile values of the daily average concentrations is less than or equal to the value of the standard.

f National standards are block averages rather than moving averages.

Note: CO, NO_2, O_3, and PM are transportation related pollutants

Source: 40 CFR 50, National Primary and Secondary Ambient Air Quality Standards.

3.4 Conformity

The Clean Air Act also requires EPA to specify geographic areas of the country that have measured pollutant concentrations exceeding the levels prescribed by the air quality standards (non-attainment areas). It classifies non-attainment areas and specifies compliance deadlines for these areas. The Crystal City/Potomac Yards Project Corridor is located in the Commonwealth of Virginia, which is located in the EPA defined Metropolitan Washington, D.C.-MD-VA non-attainment area for 8-hour ozone and PM2.5. This ozone non-attainment area must demonstrate attainment with the 8-hour ozone standard by 2010.

The Commonwealth of Virginia, including the CCPY Project Corridor, is in attainment for CO. However, the Commonwealth is considered a maintenance area due to past violations. Thus the SIP requirements do not apply to CO with respect to the project. The Commonwealth of Virginia is also in attainment for NO_2, PM10, Pb, and SO_2.

Under the Clean Air Act, it is the responsibility of federal agencies, such as FTA, to ensure that a proposed project conforms to the SIP. Because the study area is located in an ozone non-attainment area, a conformity determination is required under Section 176(C) of the Clean Air Act.

A project conforms to the SIP if it comes from a conforming metropolitan transportation plan. The transportation plan for the region is the Constrained Long-Range Plan (CLRP) prepared by the MWCOG Transportation Planning Board. The Crystal City/Potomac Yards Project is included in an approved conforming Transportation Improvement Program (TIP), for the Fiscal year 2007 element. The TIP is part of the CLRP, a plan that has been found by MWCOG to conform to the relevant SIPs (i.e., those of Virginia, Maryland, and D.C.). EPA, FHWA, and FTA have concurred in that conformity determination for the CLRP. Therefore, the CCPY Project conforms to the SIP.

4.0 EXISTING CONDITIONS

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

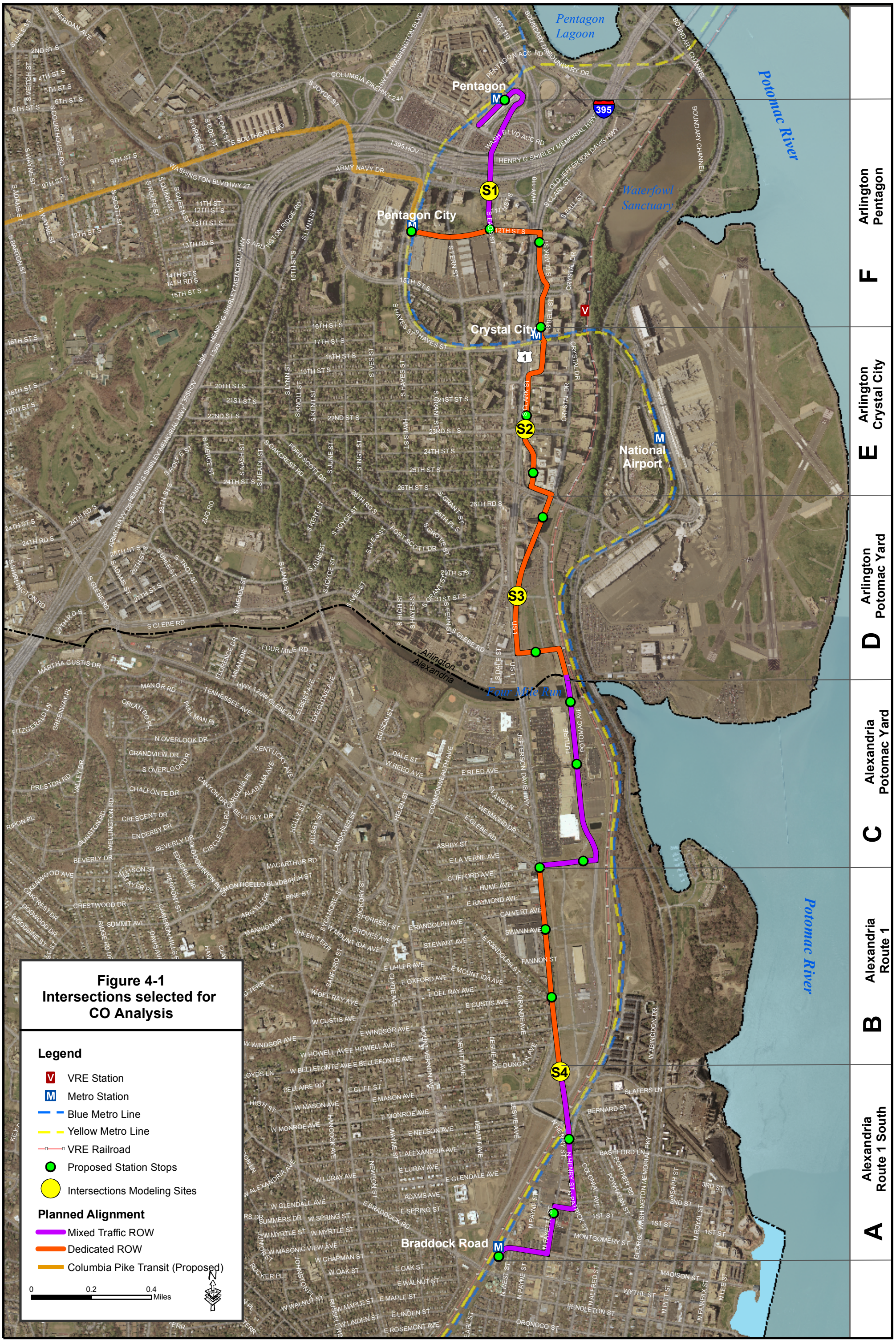
This section summarizes measured ambient air quality data for the region including the study area. The VDEQ maintains a state wide network of monitoring stations that routinely measure pollutant concentrations in the ambient air. These stations provide data to assess compliance with the NAAQS and to evaluate the effectiveness of pollution control strategies. The relevant monitored pollutants are ozone, NO_2, CO, PM, and SO_2. **Table 4-1** presents the maximum measured concentrations for these pollutants measured at representative monitoring stations (shown in **Figure 4-1**) nearest to the study area, as reported by the VDEQ for the most recent year for which data are available (2005).

Table 4-1: 2005 Monitored Ambient Air Quality in the Region

Pollutant	Monitor Location	Averaging Period	Maximum Concentration	Second Maximum Concentration
Carbon Monoxide (CO)	South 18th and Hayes Street, Arlington – Segment F	1 Hour 8 Hours	2.4 ppm 1.8 ppm	2.3 ppm 1.6 ppm
	Alexandria Health Center 517 N. Saint Asaph Street – Segment A	1 Hour 8 Hours	2.3 ppm 1.7 ppm	2.3 ppm 1.6 ppm
Nitrogen Dioxide (NO_2)	South 18th and Hayes Street, Arlington – Segment F	Annual	0. 021 ppm	Not applicable
	Alexandria Health Center 517 N. Saint Asaph Street – Segment A	Annual	0.024 ppm	Not applicable
Ozone (O_3)	South 18th and Hayes Street, Arlington – Segment F	1 Hour 8 Hours	0.114 ppm 0.094 ppm	0.106 ppm 0.009 ppm
	Alexandria Health Center 517 N. Saint Asaph Street – Segment A	1 Hour 8 Hours	0.107 ppm 0.089 ppm	0.104 ppm 0.086 ppm
Particulate Matter (PM10)	34th.and Dix Streets, NE Washington, DC	24 Hours Annual	53 $\mu g/m^3$ 28 $\mu g/m^3$	47 $\mu g/m^3$ Not applicable
Particulate Matter (PM2.5)	South 18th and Hayes Street, Arlington – Segment F	24 Hours Annual	40 $\mu g/m^3$ 15.3 $\mu g/m^3$	37 $\mu g/m^3$ Not applicable
Sulfur Dioxide	Alexandria Health Center 517 N. Saint Asaph Street – Segment A	3 Hours 24 Hours Annual	0.077 ppm 0.02 ppm 0.005 ppm	0.067 ppm 0.019 ppm Not applicable

Source: Virginia Department of Environmental Quality, as reported to U.S. Environmental Protection Agency AIRData website (http://www.epa.gov/air/data/geosel.html).

As shown in Table 4-1, the highest eight-hour ozone concentration in 2005 from among the representative monitoring stations was 0.094 parts per million (ppm) measured at the South 18th and Hayes Street station. This level is below the eight-hour ozone standard of 0.08 ppm. No other pollutant concentrations exceeded their respective standards in 2005. Additionally, the only PM2.5 concentration measured in 2005 was 15.3 micrograms per cubic meter ($\mu g/m^3$) also measured at the South 18th and Hayes Street station. This level is, however, still above the annual PM2.5 standard of 15 $\mu g/m^3$. No other pollutant concentrations exceeded their respective standards in 2005. The Washington metropolitan region is in attainment for the other pollutants listed.



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5.0 IMPACT ASSESSMENT

Maximum predicted one- and-eight hour CO concentrations at the four selected intersections are shown in Table 5-1. These concentrations were predicted for the existing conditions in 2005 and the future conditions in 2015 and 2030 to indicate air quality trends at the intersections over time. All predicted concentrations include background levels of 2.5 parts per million (ppm) for one hour and 1.6 ppm for eight hours to account for sources of CO other than the traffic at the modeling sites. All predicted concentrations are below the applicable Federal CO Standards.

5.1 Existing Condition

Under the 2005 Existing Condition, the maximum one-hour CO concentration in the project study area was predicted to be 4.2 ppm and occurred at Site 2, South Clarke Street and 23rd Street South in Arlington. The maximum predicted eight-hour CO concentration was 2.8 ppm and occurred at the same intersection. Predicted CO concentrations at the other intersection (Army Drive and South Eads Street) ranged from 4.1 ppm for the one-hour period to 2.7 ppm for the eight-hour period.

Table 5-1: Predicted Maximum CO Concentrations at Select Intersections (ppm)

Intersection Site		Averaging	2005	2015		2030	
ID	Description	Period	Existing	No Build	Build[1]	No Build	Build
S1	Army Drive and South Eads Street, Arlington – Segment F	1-Hour	4.1	3.4	3.4	3.3	3.3
		8-Hour	2.7	2.2	2.2	2.2	2.2
S2	S. Clark Street and 23rd Street South, Arlington – Segment E	1-Hour	4.2	3.5	3.5	3.2	3.2
		8-Hour	2.8	2.3	2.3	2.1	2.1
S3	33rd Street/Crystal Drive and Route 1, Arlington – Segment D	1-Hour	N/A[2]	3.6	3.6	3.4	3.5
		8-Hour	N/A	2.4	2.4	2.2	2.3
S4	Route 1 and Potomac Avenue, Alexandria (future) – Segment B	1-Hour	N/A	4.1	4.1	3.8	3.9
		8-Hour	N/A	2.7	2.7	2.5	2.6

1 The results for the Build Alternative are predicted to be the same for both the Curbside and the Median Alternatives.

2 N/A means not applicable. The intersection Sites 3 and 4 (South Clarke-23rd Street and Route 1-Potomac Avenue, respectively), which are currently under construction, are not applicable under the Existing Condition.

Source: DMJM Harris, October 2006.

5.2 No Build Condition

For the 2015 No Build Condition, the maximum one-hour CO concentration in the project study area was predicted to be 4.1 ppm and occurred at Site 4, Route 1 and Potomac Avenue in Alexandria. The maximum predicted eight-hour CO concentration was 2.7 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the remaining three intersections ranged from 3.4 ppm to 3.6 ppm. Predicted eight-hour CO concentrations at the remaining intersections ranged from 2.2 ppm to 2.4 ppm.

For the 2030 No Build Condition, the maximum one-hour CO concentration in the project study area was predicted to be 3.8 ppm and occurred at Site 4, Route 1 and Potomac Avenue in Alexandria. The maximum predicted eight-hour CO concentration was 2.5 ppm and occurred the remaining intersections ranged from 2.1 ppm to 2.3 ppm. All predicted CO concentrations for the 2015 and 2030 No Build Conditions are less than the NAAQS of 35 ppm for one hour and 9 ppm for eight hours.

The maximum one- and eight-hour CO levels for the 2015 No Build Alternative are also lower than the corresponding levels for the 2005 Existing Conditions. This decrease in CO concentrations is mainly due to the decrease in the exhaust emission factors from 2005 to 2015, as older and more polluting vehicles in the nation's fleet are replaced with new vehicles which have lower emission rates, as prescribed in the *Federal Motor Vehicles Emission Control Program* (FMVECP) mandated in the Clean Air Act. This reduction in the vehicle emission rates more than offsets the increase in traffic volumes from 2005 to 2015.

5.3 Build Alternatives

For the 2015 Build Alternatives, the maximum one-hour CO concentration in the project study area was predicted to be 4.1 ppm and occurred at Site 4, located at Route 1 and Potomac Avenue in Alexandria. The maximum predicted eight-hour CO concentration was 2.7 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the remaining three intersections ranged from 3.4 ppm to 3.6 ppm. Predicted eight-hour CO concentrations at the remaining intersections ranged from 2.2 ppm to 2.4 ppm.

For the 2030 Build Alternatives, the maximum one-hour CO concentration in the project study area was predicted to be 3.9 ppm and occurred at Site 4, located at Route 1 and Potomac Avenue in Alexandria. The maximum predicted eight-hour CO concentration was 2.6 ppm and occurred at the same intersection. Predicted one-hour CO concentrations at the remaining two intersections ranged from 3.2 ppm to 3.5 ppm. Predicted eight-hour CO concentrations at the remaining intersections ranged from 2.1 ppm to 2.3 ppm. All predicted CO concentrations for the 2030 Center-Running Conditions are less than the NAAQS of 35 ppm for one hour and 9 ppm for eight hours.

5.4 Construction

Construction activities can result in short-term impacts on ambient air quality. These potential impacts include direct emissions from construction equipment and trucks, increased emissions from motor vehicles on the streets due to disruption of traffic flow, and fugitive dust emissions. These impacts would be temporary, and would affect only the immediate vicinity of the construction sites and their access routes. Emissions from project-related construction equipment and trucks would be much less than the total emissions from other industrial and transportation sources in the region, and therefore, are expected to be insignificant with respect to compliance with the NAAQS.

Project construction activities may include roadway realignment, pavement removal, station stop construction, and other miscellaneous activities. Roadway traffic disruption due to lane closures, detours, and construction vehicles accessing the sites can cause congestion, which can increase motor vehicle exhaust emissions. Fugitive dust emissions could occur during demolition, ground excavation, material handling and storage, movement of equipment at the site, and transport of material to and from the site. Fugitive dust would most likely be a problem during periods of intense activity and would be accentuated by windy and/or dry weather conditions.

5.5 Mitigation

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

With respect to localized air quality impacts, the modeled one-hour and eight-hour CO concentrations were compared to the NAAQS. In order to demonstrate compliance with the ambient CO standards, predicted CO concentrations must not equal or exceed the NAAQS. Based on the analyses presented above, there would be no adverse air quality impacts associated with the operation of this project. Therefore, no mitigation measures are required for operation of this project.

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

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

6.0 CONCLUSION

The project is not predicted to cause or exacerbate a violation of the applicable NAAQS, and with respect to regional emissions and conformity, the project has been shown to conform to the SIP. No mitigation measures are necessary with respect to compliance with the transportation conformity requirements.

Construction activities have potential to produce short-term, localized air quality impacts. These potential impacts can be minimized with appropriate mitigation measures.

The results of the air quality impact assessment are summarized by segment of the project corridor in Table 6-1. As shown in Table 6-1, none of the project noise or vibration levels are predicted to exceed the FTA impact criteria anywhere along the project corridor.

Table 6-1: Summary of Air Quality Impacts by Project Corridor Segment

Corridor Segment		Impacts	
No.	**Description**	**1-Hour**	**8-Hour**
A	Alexandria Route 1 South	0	0
B	Alexandria Route 1	0	0
C	Alexandria Potomac Yard	0	0
D	Arlington Potomac Yard	0	0
E	Arlington Crystal City	0	0
F	Arlington Pentagon	0	0

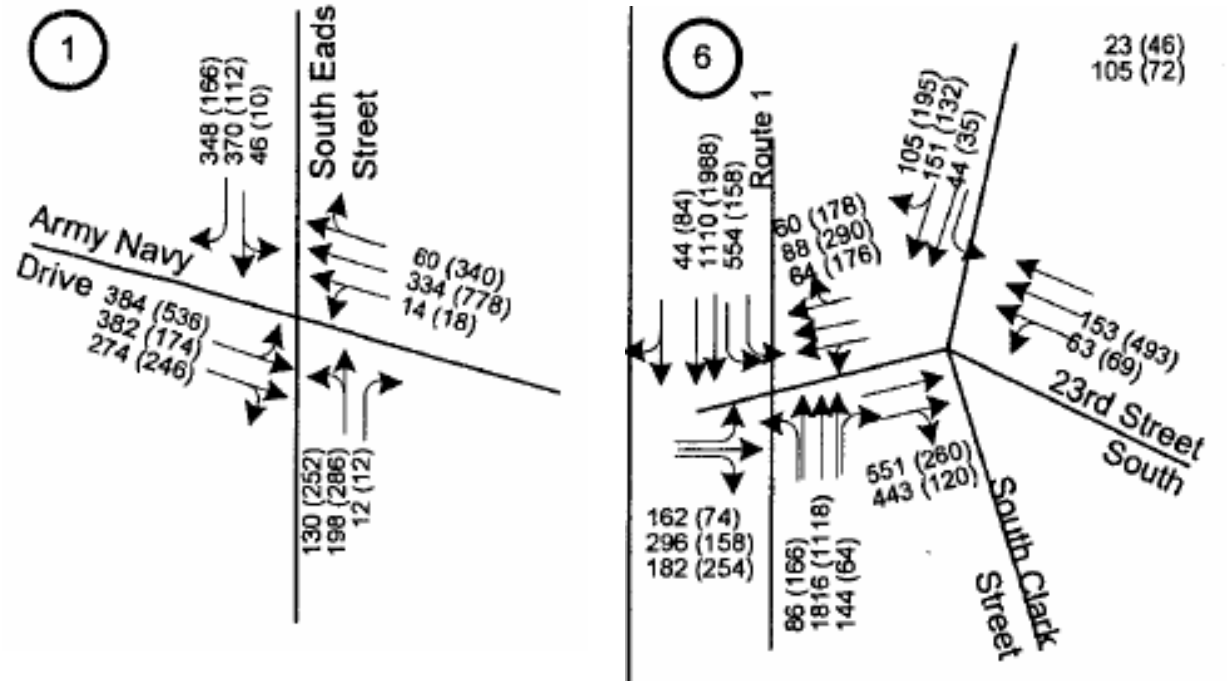
Source: DMJM Harris, October 2006.

APPENDICES

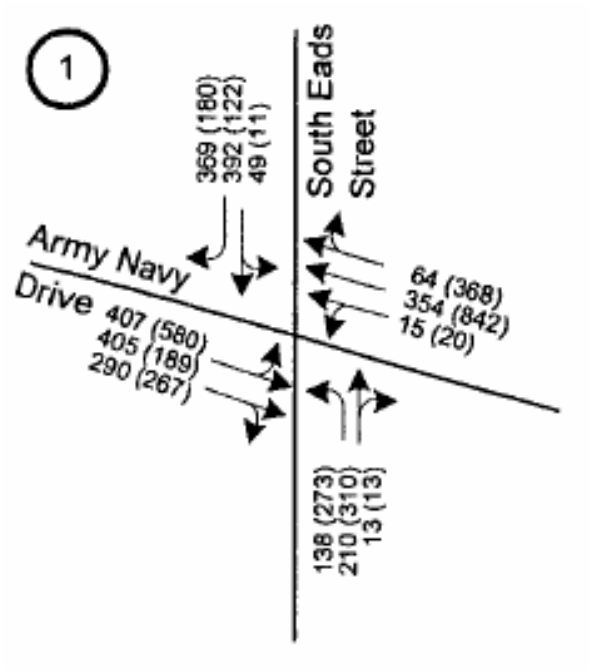
APPENDIX A

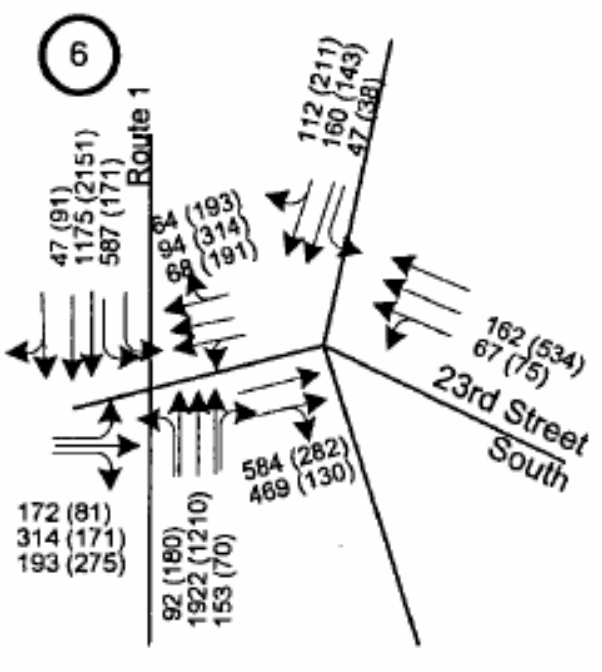
Peak-Hour Turning Movements

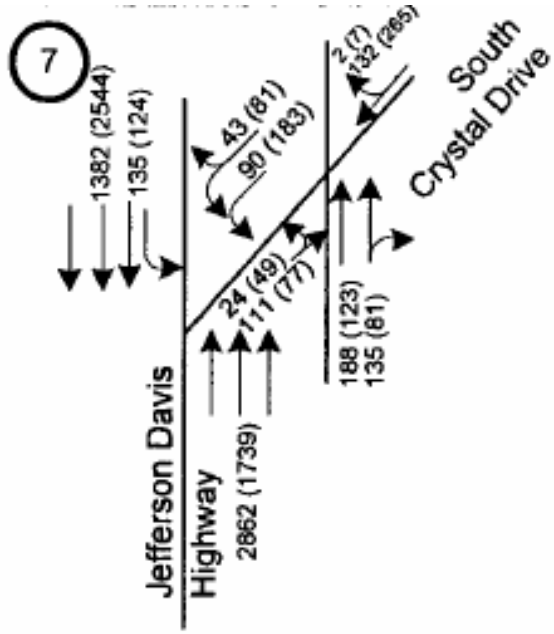
2005 Existing Condition Peak Hour Turning Movements

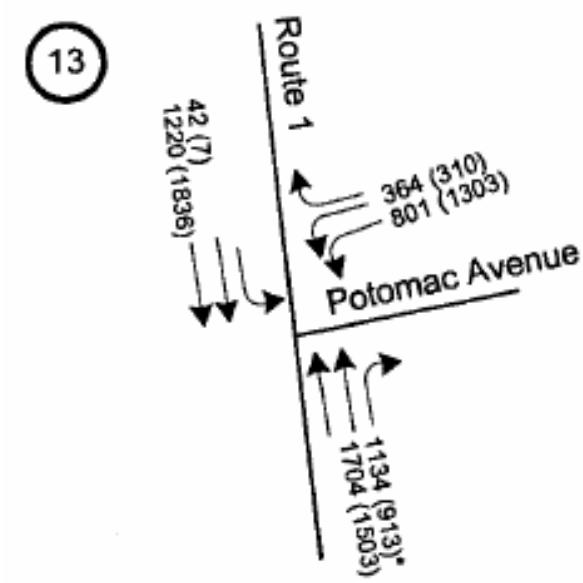


2015 No Build Condition Peak Hour Turning Movements

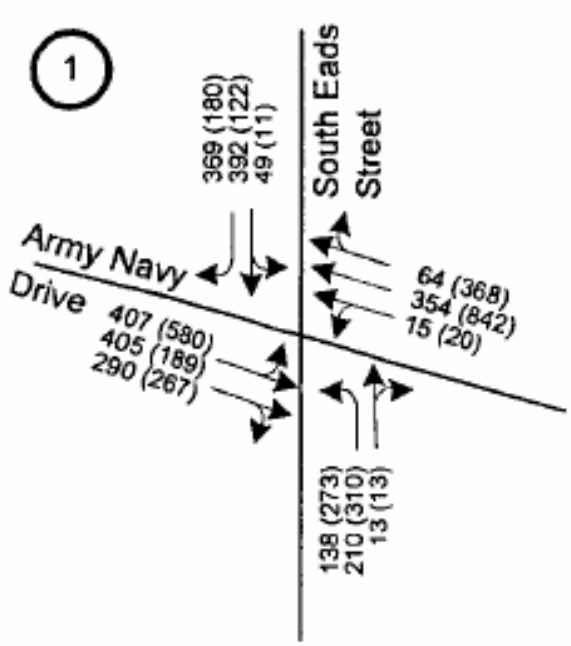


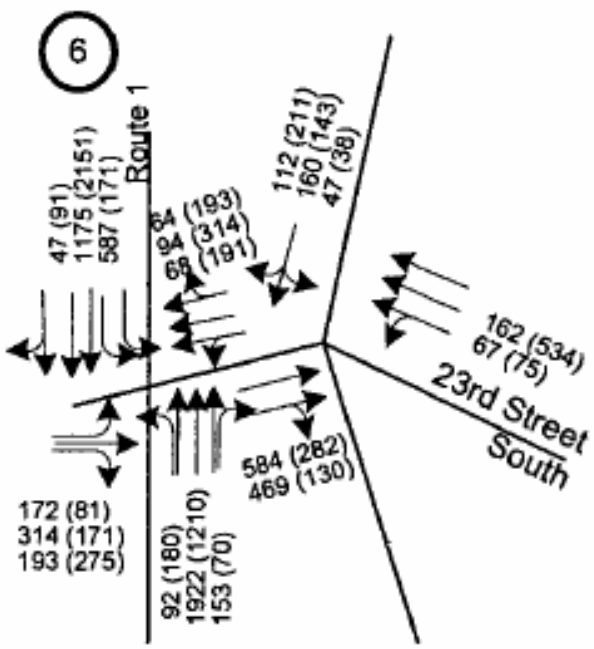


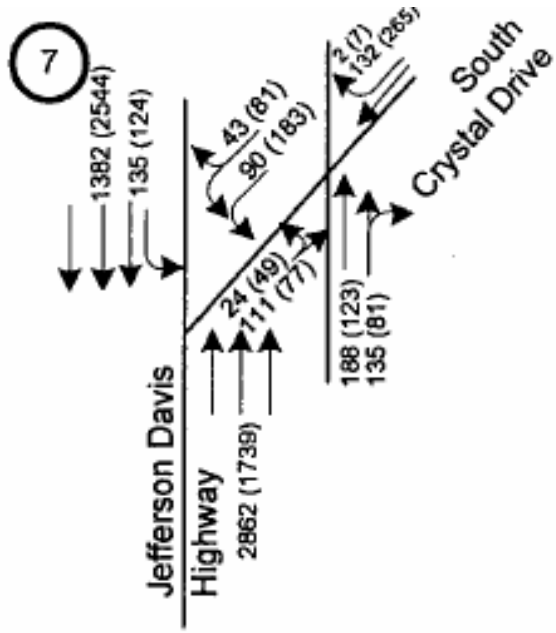


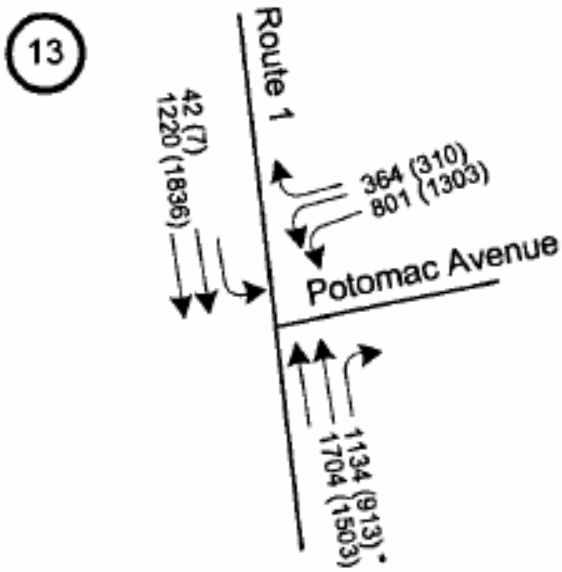


2015 Build Alternative Peak Hour Turning Movements

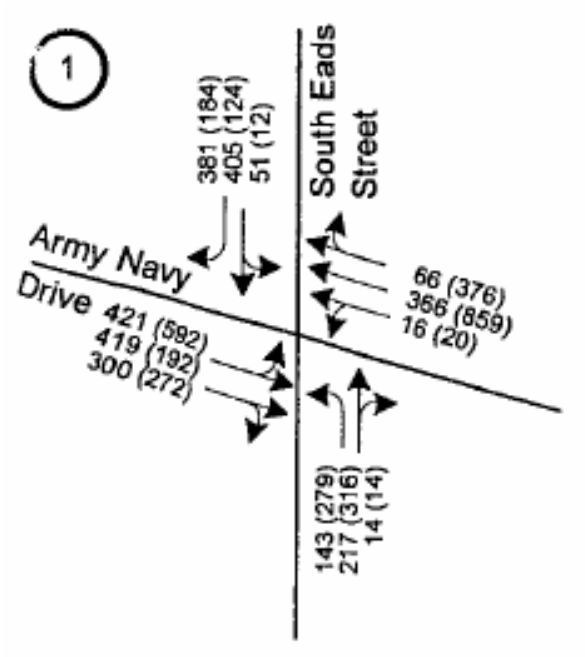


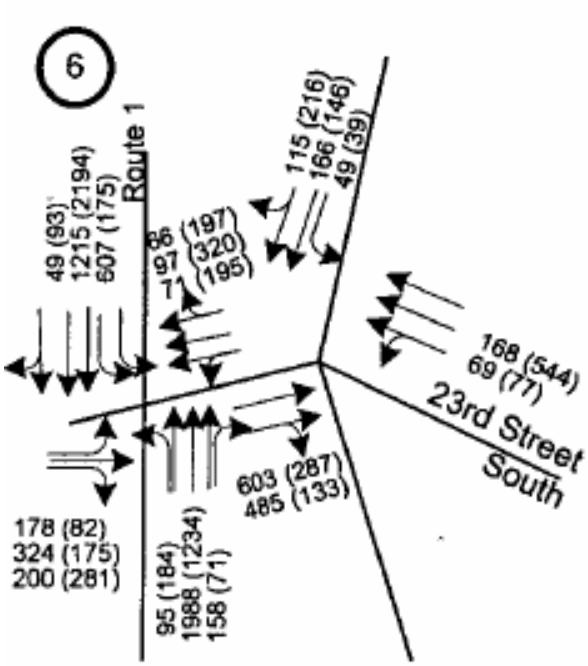


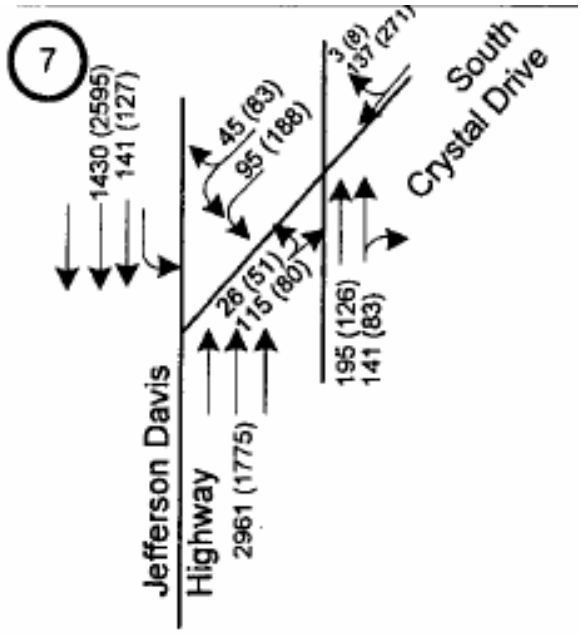


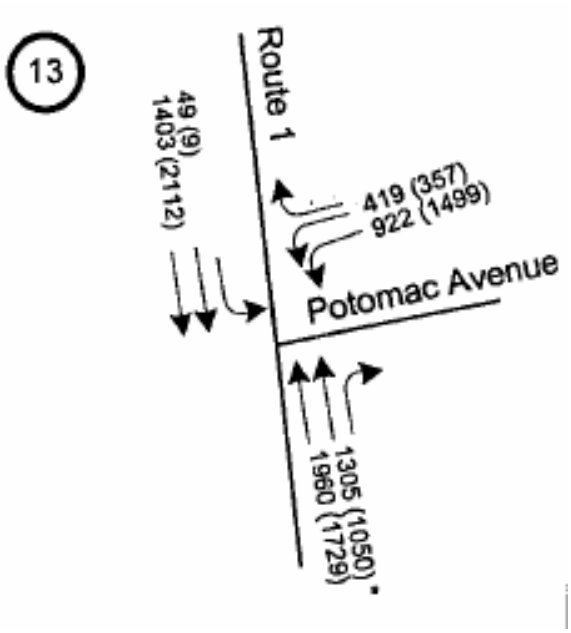


2030 No Build Condition Peak Hour Turning Movements

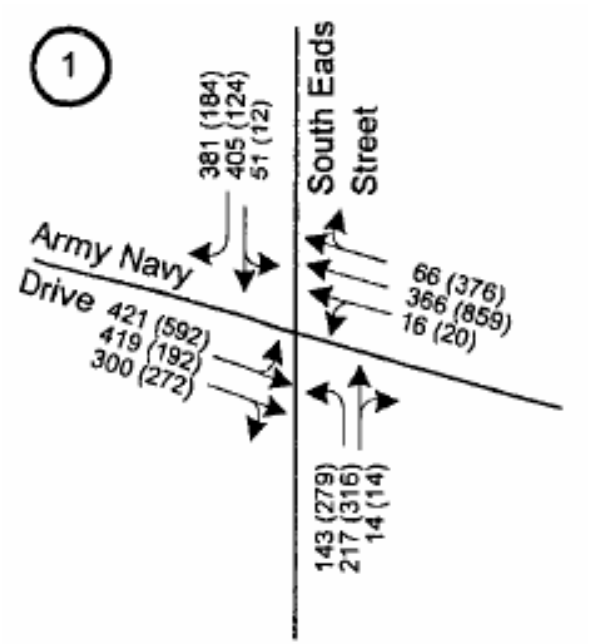


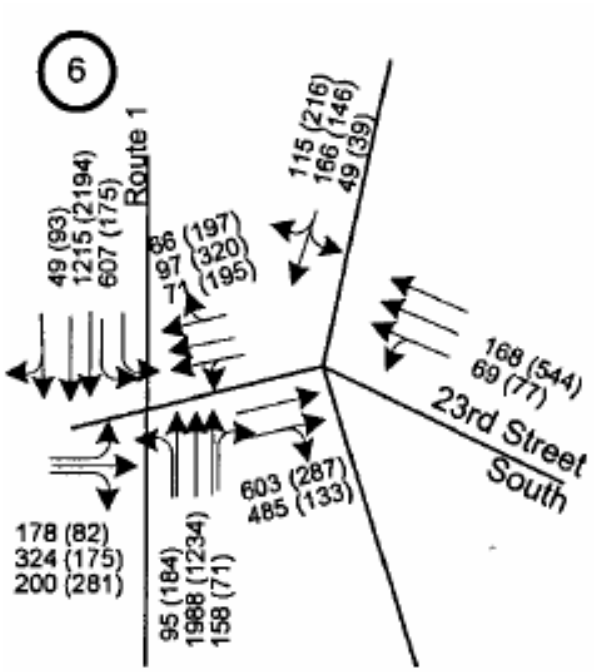


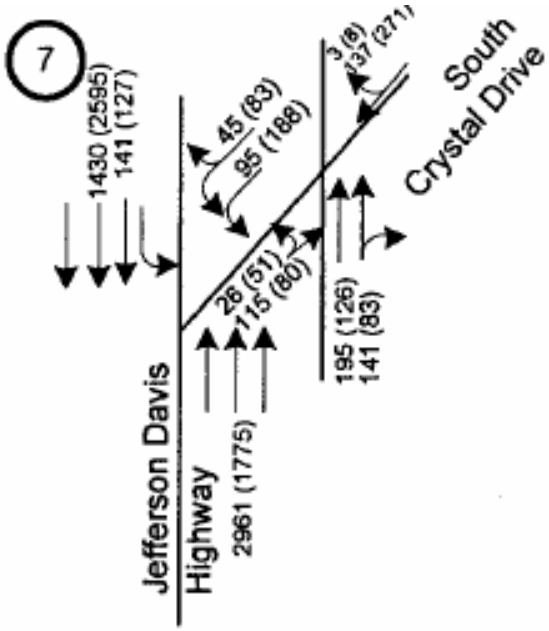


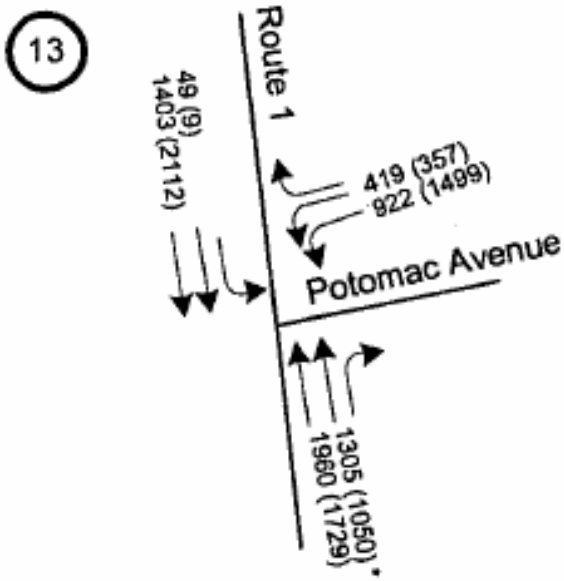


2030 Build Alternative Peak Hour Turning Movements









APPENDIX B
Intersection Data

Table B-1: Intersection Approach Speeds (in miles per hour)

Intersection	Existing 2005				2015 No Build				2015 Build				2030 No Build				2030 Build			
Description	**NB**	**SB**	**EB**	**WB**	**NB**	**SB**	**EB**	**WB**	**NB**	**SB**	**EB**	**WB**	**NB**	**SB**	**EB**	**WB**	**NB**	**SB**	**EB**	**WB**
Army Drive and S. Eads St.	26	12	15	31	28	17	25	28	27	18	24	29	28	17	24	28	27	22	23	28
	21	23	24	25	26	27	23	30	27	23	23	30	26	24	23	30	25	22	24	30
S. Clark St. and 23rd St. South	-	22	28	20	-	22	-	21	23	22	-	19	-	22	-	20	23	22	-	19
	-	24	23	23	-	23	-	15	23	23	-	18	-	22	-	21	23	23	-	17
33rd St./Crystal Dr. and Jefferson Davis Highway	-	-	-	-	32	-	30	30	31	**21**	30	23	32	-	30	24	31	**21**	29	25
	-	-	-	-	30	-	29	12	30	**21**	29	18	28	-	30	18	29	**20**	28	19
Route 1 and Potomac Ave.	-	-	-	-	28	26	-	26	25	32	-	27	31	29	-	27	28	32	-	27
	-	-	-	-	31	29	-	26	27	32	-	26	29	28	-	27	25	31	-	26

Source: DMJM Harris, October 2006.

Table B-2: Intersection Cycle and Approach Delay Times (in Seconds)

Intersection	Turning	2005	2015		2030	
Description	**Movement**	**Existing**	**No Build**	**Build**	**No Build**	**Build**
Army Navy Drive and S. Eads Street	***Cycle Time***	*105*	*105*	*105*	*120*	*120*
	Army Navy Dr EB Left & Through	47.5	58.5	58.5	73.5	73.5
	Army Navy Dr WB Left & Through	71.5	73.5	73.5	88.5	88.5
	South Eads St NB left & Through	62.5	52	52	52	52
	South Eads St SB Left & Through	62.5	52	52	52	52
	Cycle Time	*140*	*140*	*140*	*160*	*160*
South Clarke Street and 23rd Street	S. Clark St SB Left, Through & Right	116	116	113	136	123
	S. Clark St WB Left & Through	110	110	110	130	138
	S. Clark St SB Dedicated Bus Lane	-	-	87	-	85
	Route 1 SB left	124	128	128	137	137
	Route 1 SB through and right	85	83	83	76	76
	Route 1 NB left	124	128	128	133	133
	Route 1 NB through	85	83	83	72	72
	Route 1 NB right	85	83	128	72	72
	Route 1 EB left	111	111	111	111	111
	Route 1 EB through	111	111	111	111	111
	Route 1 EB right	94	94	94	94	94
	Cycle Time		*140*	*140*	*80*	*80*
Crystal Drive and 33rd Street	Crystal Dr NB	-	26	26	27	27
	33rd St EB	-	104	104	45	45
	33rd St WB	-	104	104	45	45
	Crystal Dr NB Dedicated bus lane	-	-	26	-	27
	Crystal Dr SB Dedicated bus lane	-	-	26	-	27
	Route 1- NB through	-	26	26	27	27
	Route 1 - SB left	-	127	127	70	70
	Route 1- SB through	-	26	26	28	28
	Cycle Time		*128*	*128*	*150*	*150*
Route 1 and Potomac Avenue	Route 1 SB Left	-	116	116	138	138
	Route 1 SB Through	-	58	58	49	59
	Route 1 NB Through & Right	-	73	73	64	74
	Potomac Ave WB Left & Right	-	76	76	107	107
	Route 1 SB Dedicated bus Lane	-	-	53	-	54

Source: DMJM Harris, October 2006.

Intersection Geometries and Receptor Locations

Figure B-1: Army Navy Drive and South Eads Street in Arlington (Intersection 1)

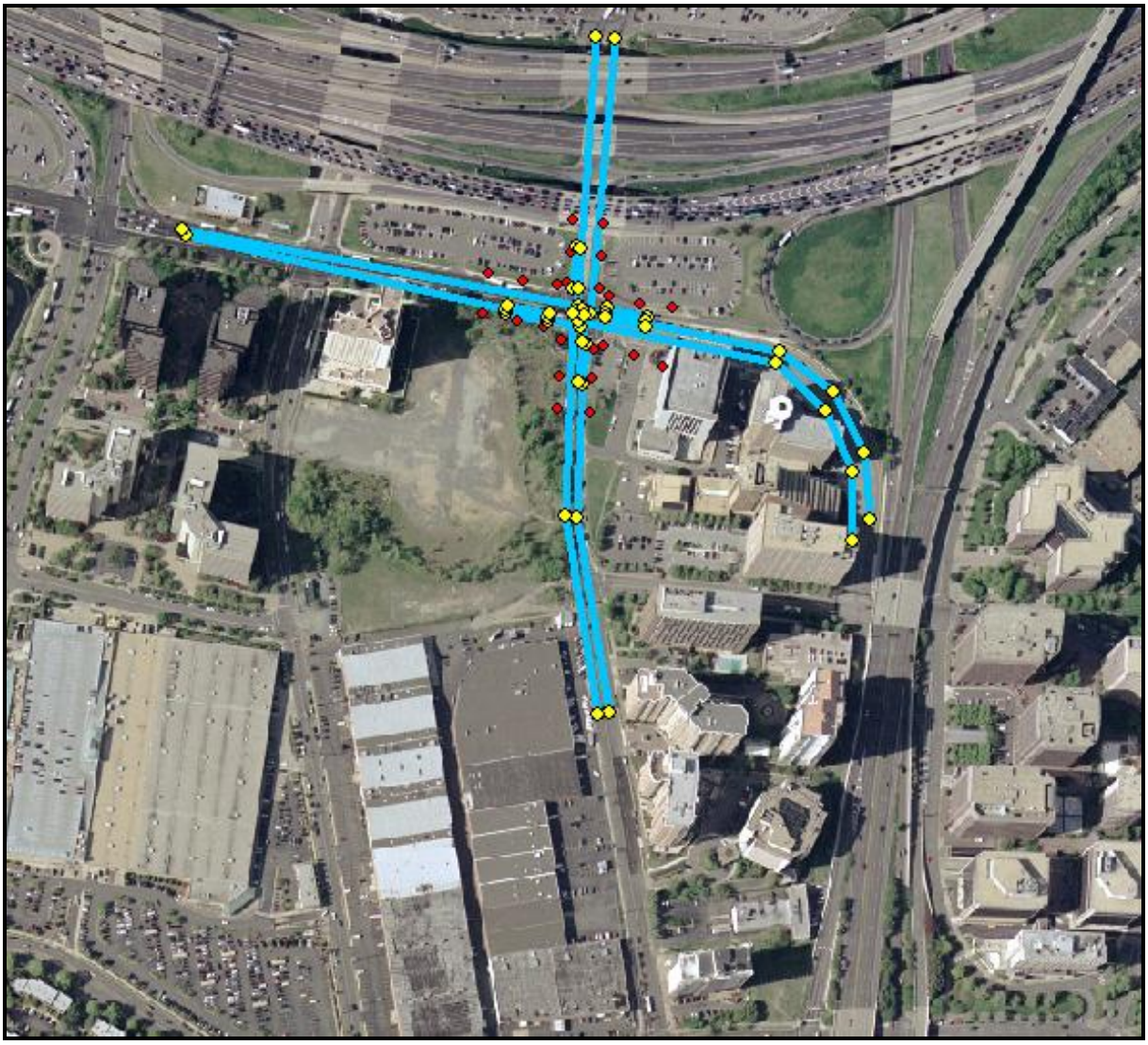


Figure B-2: South Clark Street and 23rd Street South in Arlington (Intersection 2)

Figure B-3: Future 33rd Street/Crystal Drive and Route 1 in Arlington (Intersection 3)

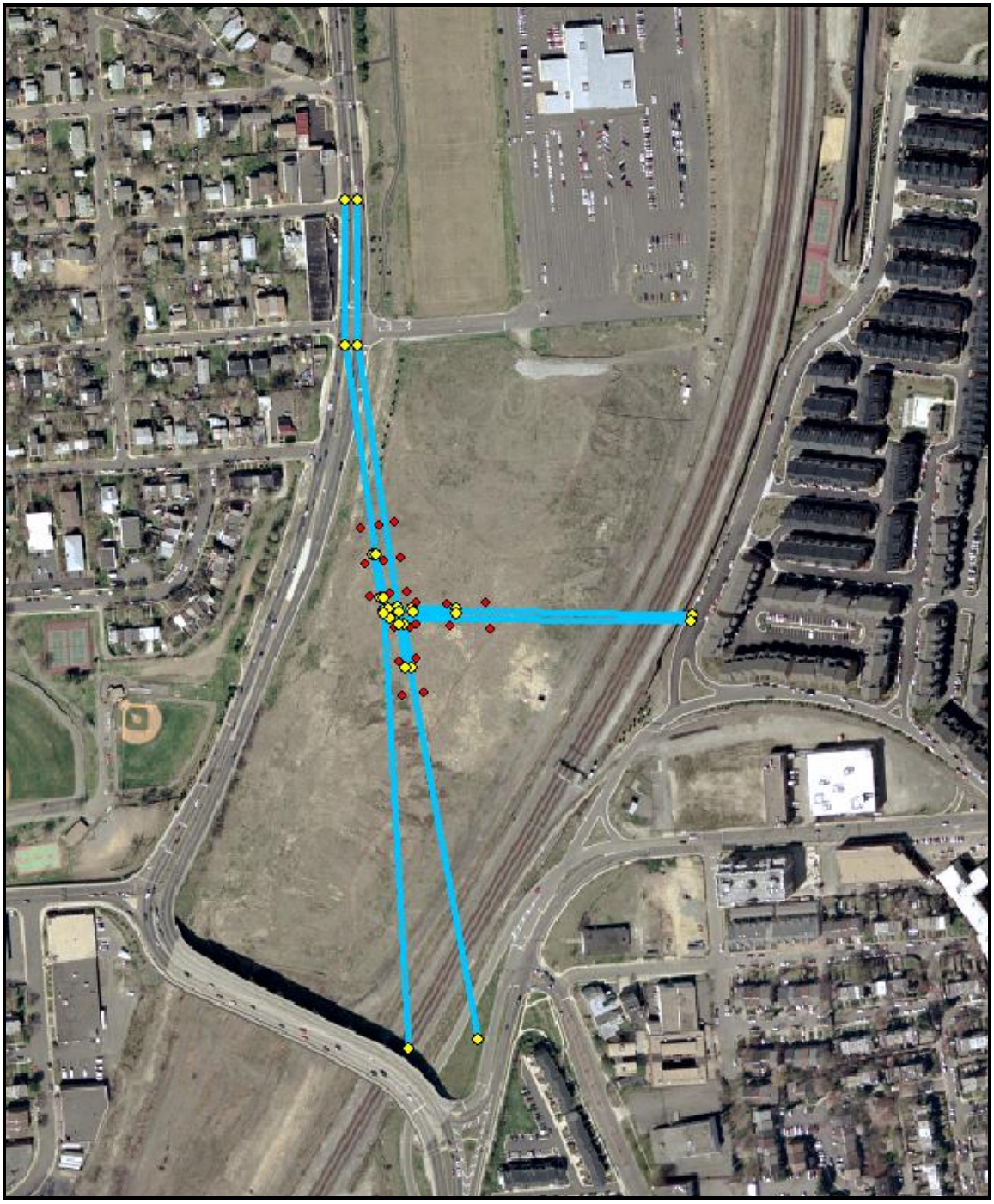



Figure B-4: Future Route 1 and Potomac Avenue Alexandria (Intersection 4)