AIR QUALITY ANALYSIS: Technical Report

Interstate 95 Widening (Fourth Lane, Both Directions)

Northern Virginia District Wide

0095-96A-104, B658, B659, B660, B661, B662, B663, B664, B665, B666, B667, BRDGS, C501, P102, R201

PPMS 57017

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Introduction

The Commonwealth of Virginia plans to widen Interstate 95 to four lanes in both directions from Route 123 at Occoquan in Prince William County to Route 7100 (Fairfax County Parkway) in Fairfax County. The length of the project is approximately eight miles. Federal funding is involved, thus compliance with the National Environmental Policy Act (NEPA) is required. Part of the NEPA compliance is to determine the potential operational impacts on air quality from the changes in the roadway and conformity with any State Implementation Plan (SIP) for any criteria pollutant in a nonattainment or maintenance area. This project is located in a Particulate Matter $(PM)_{2.5}$ nonattainment area.

Alternatives under Consideration

The No Build Alternative assumes other currently programmed, committed, and funded roadway projects in the VDOT Six Year Plan and the Statewide Transportation Improvement Program will be implemented. The project analyzed herein would not be built. There are several other projects in the Six Year Plan that affect the project area, namely widening I-95 High Occupancy Vehicle (HOV) lanes from two to three lanes from Quantico to I-495; and widening US Route 1 from four to six lanes between the Stafford County line and VA Route 235.

The Build Alternative assumes the construction of a fourth lane to I-95 North and South, and other currently programmed, committed, and funded roadway projects in the VDOT Six Year Plan and the Statewide Transportation Improvement Program will be implemented as well.

Existing Conditions

The worst case interchange analyzed from an emission standpoint in this document is located in Fairfax County. The temperature ranges from an average daily minimum of 24 degrees Fahrenheit (°F) in January to an average daily maximum of 87 °F in July. The annual precipitation is approximately 45 inches per year.

Regulatory Standards/Criteria

Section 176(c) of the Clean Air Act (CAA)

The CAA, under Section 176(c), provides a framework for ensuring that transportation projects conform to the appropriate state or federal implementation plan for achieving the National Ambient Air Quality Standards (NAAQS). Before any agency or department of the federal government engages in, supports in any way, provides financial assistance for, licenses, permits, or approves any activity, that agency has an affirmative responsibility to ensure that such actions conform to the applicable implementation plan. Conformity to an air quality implementation plan is defined in the CAA, as amended in 1990, as meaning conformity with the plan's purpose in eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of these standards. Federal actions must not cause or contribute to any new violation of any standard, increase the frequency or severity of any existing violation, or delay timely attainment of any standard or required interim milestone. If the proposed action does not conform to the SIP, it cannot be approved.

Transportation Conformity Rule

EPA promulgated the Transportation Conformity Rule concerning the applicability, procedures, and criteria that transportation agencies must use in analyzing and determining conformity of transportation projects. The Transportation Conformity Rule applies to federally funded transportation projects in areas that have violated one or more of the NAAQS (nonattainment/maintenance areas). The Transportation Conformity Rule sets forth the requirements for determining conformity, which include applicability of the rule and the methodology to be used to perform the analysis, including air dispersion modeling, if necessary.

Current SIP

In 1979, EPA required each state to prepare a SIP, which describes how the state will achieve compliance with the NAAQS. A SIP is a compilation of goals, strategies, schedules, and enforcement actions that will lead the state into compliance with all federal air quality standards. Every change in compliance schedule or plan must be incorporated into the SIP. The CAA Amendments of 1990 established new deadlines for achievement of the NAAQS depending on the severity of nonattainment.

Definition of Resource

Air quality is defined by ambient air concentrations of specific pollutants determined by the U.S. Environmental Protection Agency (EPA) to be of concern with respect to the health and welfare of the general public. The subject pollutants are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM_{10} and $PM_{2.5}$), and lead (Pb). EPA established National Ambient Air Quality Standards (NAAQS) for these pollutants (Table 1).

Table 1: Federal Ambient Air Quality Standards[1, 2]

Pollutant	Averaging Time	Federal	
		Primary	Secondary
Ozone (O_3) [3]	8-hour	0.08 ppm (157 µg/m³)	0.08 ppm (157 µg/m³)
Coarse Particulate Matter (PM_{10})	24-hour	150 µg/m³	150 µg/m³
	Annual Mean	50 µg/m³	50 µg/m³
	Annual GM	–	–
Fine Particulate Matter ($PM_{2.5}$)	24-hour	65 µg/m³	35 µg/m³
	Annual Mean	15 µg/m³	15 µg/m³
Carbon Monoxide (CO)	1-hour	35 ppm (40 mg/m³)	–
	8-hour	9 ppm (10 mg/m³)	–

Table 1: Federal Ambient Air Quality Standards[1, 2]

Pollutant	Averaging Time	Federal	
		Primary	Secondary
Nitrogen Dioxide (NO_2)	1-hour	–	–
	Annual Mean	0.053 ppm (100 mg/m^3)	0.053 ppm (100 mg/m^3)
Lead (Pb)	30-day	–	–
	Calendar Quarter	1.5 µg/m^3	1.5 µg/m^3
Sulfur Dioxide (SO_2)	1-hour	–	–
	3-hour	–	0.5 ppm (1,300 µg/m^3)
	24-hour	0.14 ppm (365 µg/m^3)	–
	Annual AM	0.03 ppm (80 µg/m^3)	–

GM – Geometric Mean
ppm – parts per million
mg/m^3 – milligrams per cubic meter
µg/m^3 – micrograms per cubic meter

[1]National standards (other than O_3, PM_{10}, and those based on annual periods) are not to be exceeded more than once per year. The ozone standard is based on a 3-year average of the fourth highest 8-hour concentration in each year. For PM, the 24-hour standard is based on 99 percent (PM_{10}) or 98 percent ($PM_{2.5}$) of the daily concentrations, averaged over 3 years.

[2]Equivalent units given in parenthesis are based upon reference conditions of 25 degrees Celsius (°C) and 760 millimeters (mm) mercury.

[3]Environmental Protection Agency (EPA)-promulgated new federal 8-hour O_3 and $PM_{2.5}$ standards on July 18, 1997.

Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. The major factors affecting pollutant dispersion are wind speed and direction, atmospheric stability, temperature, the presence or absence of inversions, and the topographic and geographic features of the region. Air quality standards in Virginia are enforced by the Federal Clean Air Act (CAA) (1970), which established maximum pollutant levels and requires the preparation of a State Implementation Plan (SIP) to outline enforcement and attainment strategies. Currently, only CO, O_3, $PMB_{2.5}$ and PM_{10} are required to be addressed in project-level, or hot-spot, analyses to be included in the NEPA document. The Air, Noise and Energy Section (ANE) of the Environmental Division, Central Office is responsible for administering the project air evaluation process. These procedures apply to all the Virginia Department of Transportation (VDOT) projects except proposed highway tunnel projects. Significant changes to the project scope, design or schedule may require additional hotspot modeling to ensure the continuing validity of this air quality analysis.

Particulate Matter Analysis

On January 5, 2005, the EPA designated areas within the country as nonattainment for fine particulate matter, called $PM_{2.5}$. This designation became effective on April 5, 2005, 90 days after EPA's published action in the *Federal Register*. Transportation projects that are proposed after April 5, 2006 (i.e., after the one-year grace period provided by the Clean Air Act) must demonstrate compliance with the conformity rule for the $PM_{2.5}$. In addition, designated $PM_{2.5}$ nonattainment areas must have in place both a long range transportation plan and transportation improvement program (TIP) that complies with the conformity rule, and federally supported projects must also demonstrate conformity. For $PM_{2.5}$, project-level conformity may also require an assessment of localized emission impacts, known as a hot-spot analysis, for certain projects. On March 10, 2006, EPA published a final rule that establishes the transportation conformity criteria and procedures for determining which transportation projects must be analyzed for local air quality impacts in Particulate Matter ($PM_{2.5}$ and PM_{10}) nonattainment and maintenance areas (71 FR 12468). These rule amendments require the assessment of localized air quality impacts of federally-funded or approved transportation projects in $PM_{2.5}$ or PM_{10} nonattainment and maintenance areas deemed to be *projects of air quality concern*[1]. Fairfax County falls within the $PM_{2.5}$ nonattainment area, and this project is a project of air quality concern. As such, the project is required to meet Transportation Conformity requirements found in 40 CFR Part 93. Although the NEPA document has been completed, phases that require FHWA authorization still remain. As discussed in "Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in PM2.5 Nonattainment and Maintenance Areas" issued by EPA and FHWA on March 29, 2006[2], if a project still requires a FHWA approval or authorization, a project-level conformity determination is required prior to the first such action on or after April 5, 2006, even if the project has already completed the NEPA process, or for multi-phase projects, even if other phases of the project have already been constructed.

Section 176(c) of the Clean Air Act and the federal conformity rule require that transportation plans and programs conform to the intent of the state air quality SIP through a regional emissions analysis in $PM_{2.5}$ nonattainment areas. The National Capital Region 2005 Constrained Range Transportation Plan (CLRP) and the 2006-2011 Metropolitan Transportation Improvement Program (TIP) have been determined to conform to the intent of the SIP. The CLRP is a comprehensive plan of transportation projects and strategies that the Transportation Planning Board realistically anticipates can be implemented over the next 30 years. The TIP is a 6-year program that describes the time-frame for federal funds to be obligated to state and local projects. The U.S. Department of Transportation made a PM2.5 conformity determination on the CLRP and the TIP on February 21, 2006; thus, there is a currently conforming transportation plan and TIP in accordance with 40 CFR 93.114. The current conformity determination is consistent with the final conformity rule found in 40 CFR Parts 51 and 93.

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1 Criteria for identifying *projects of air quality concern* is described in 40 CRF 93.123(b)(1), as amended.

2 *Transportation Conformity Guidance for Qualitative Hotspot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas.* EPA420-B-06-902. March 29, 2006.

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. $PM_{2.5}$ refers to particulates that are 2.5 microns or less in diameter, roughly 1/28th the diameter of a human hair. $PM_{2.5}$ results from fuel combustion (e.g., from motor vehicles, power generation, and industrial facilities), residential fireplaces and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing for example;
- Decreased lung function;
- Aggravated asthma;
- Development of chronic bronchitis;
- Irregular heartbeat;
- Nonfatal heart attacks; and
- Premature death in people with heart or lung disease.

(Source: http://www.epa.gov/air/particlepollution/health.html)

Qualitative hotspot analysis is required for projects of air quality concern until such time as EPA releases its future quantitative modeling guidance and announces that quantitative $PM_{2.5}$ hotspot analyses are required under 40 CFR 93.123.(b)(4). EPA requires hotspot findings to be based on directly emitted $PM_{2.5}$, since secondary particles take several hours to form in the atmosphere, giving emissions time to disperse beyond the immediate area of concern. EPA has established the following list of criteria to assist in determining whether a project is of air quality concern. This project meets one or more of the criteria for the reasons listed, and thus is considered a project of air quality concern.

i) New or expanded highway projects that have a significant number of or significant increase in diesel vehicles, such as a roadway with 125,000 ADT and 8% diesel traffic.

This project exceeds this criterion. The highest design volume on any affected roadway for this project is 250,000 with 16% diesel traffic.

ii) Projects affecting intersections that operate at LOS D, E, or F with a significant number of diesel trucks or that will change to LOS D, E or F as a result of the increased traffic volumes from a significant number of diesel vehicles related to the project.

No LOS information was available, however, there will be no significant increase in diesel vehicle traffic as a result of this project, but there is an existing level of significant diesel traffic.

iii) New bus and rail terminals and transfer points with a significant number of diesel vehicles congregating at a single location, or

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

This project does not affect bus or rail terminals.

v) Projects in or affecting locations which are identified in an applicable $PM_{2.5}$ implementation plan as potential or existing areas of violation.

This project is not in such an area.

In summary, based on these criteria, it is determined that the widening of I-95 to 8 lanes is a project of air quality concern, and as such, a qualitative hot-spot analysis of $PM_{2.5}$ is required to assess whether the project would cause or contribute to any new localized $PM_{2.5}$ violations, or increase the frequency or severity of any existing violations, or delay attainment of the $PM_{2.5}$ NAAQS (see Table 1).

The Conformity Rule requires $PM_{2.5}$ hotspot analyses to include road dust emissions only if such emissions have been found significant by EPA or the state air agency prior to the $PM_{2.5}$ SIP or as part of an adequate $PM_{2.5}$ SIP motor vehicle emissions budget (40 CFR 93.102(b)(3)). Emissions resulting from construction of the project are not required to be considered in the hotspot analysis if such emissions are considered temporary according to 40 CFR 92.123(c)(5). Road dust emissions have not been found to be a significant problem by EPA or the Virginia Department of Environmental Quality, and thus are not considered in this analysis.

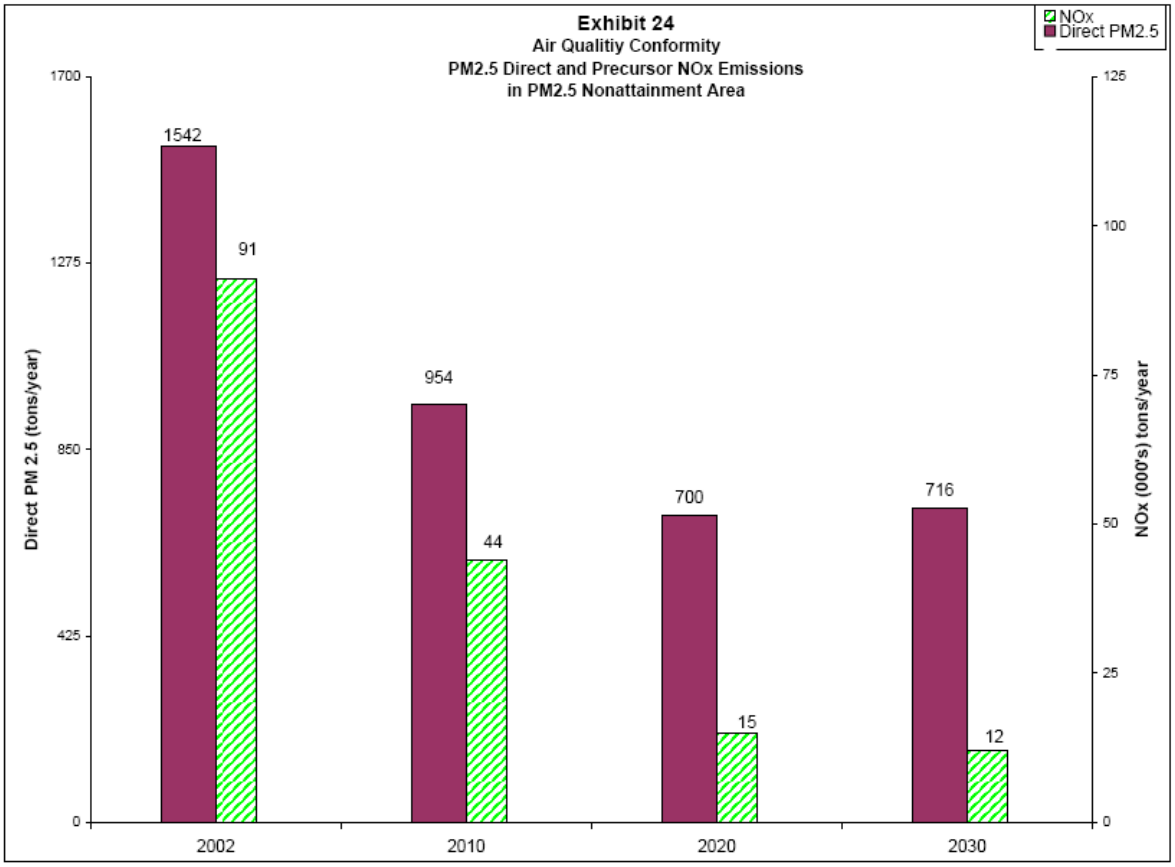
Construction emissions do not need to be addressed in a PM hot-spot analysis if such emissions are considered temporary as defined in 40 CFR 93.123(c)(5) (i.e. emissions which only occur during the emissions phase and last less than 5 years). For the project analyzed herein, construction emissions are considered temporary and therefore not included in the analysis.

As clarified in the preamble to the July 1, 2004 revision to the transportation conformity rule (64 FR 40056), the conformity rule requires that project-level analyses consider the year of expected peak emissions from the project. For $PM_{2.5}$, this is expected to be a near-term year, such as the year the project opens, because emission rates from diesel vehicles are predicted to substantially decline between the opening year (2007) and the design year (2030) and these decreases will more than offset any increase in projected traffic volumes. The decline in emissions in future years are due in part to improvements in tailpipe emissions, national vehicle emissions control programs and the mandated use of ultra-low sulfur diesel-fuel. As shown in Figure 1, the regional $PM_{2.5}$ emissions as projected in the conformity analysis for the FY2007-2012 TIP and 2006 CLRP are much higher in current years than in future years. These projections are a good indicator of the overall emissions trends in the region, and it is therefore expected that 2007 would be the year of peak emissions from the project and other emissions sources that affect the project area.

The study area contains a mix of residential, industrial and commercial land uses. Several state and regional parks, a marina, the Fort Belvior military base, as well as

various neighborhoods are in proximity to the project. The meteorological conditions at these sites as well as along the entire project area can be generally characterized as variable and temperate. Light winds generally tend to disperse $PM_{2.5}$ emissions at these sites. In addition, temperature, humidity, and rainfall do not seem to influence the level of $PM_{2.5}$ at the sites.

Figure 1: $PM_{2.5}$ Emission Trends



Source: Metropolitan Washington Council of Governments (MWCOG), Air Quality Conformity Determination of 2006 CLRP and FY2007-2012 TIP, October 18, 2006.

Overall traffic and truck data have been analyzed to assess which area(s) affected by the project are most likely to have the highest emissions burden. Truck percentages for those roadways impacted by the project were taken from the VDOT report "2005 Daily Traffic Volume Estimates Including Vehicle Classifications Estimates – Jurisdiction Report 29". 2007 AADT for the Build scenario for the roadways were derived using the 2005 AADTs and grown at an annual rate of 2.17% for interstates and 2.16% for arterials. These growth rates were provided by VDOT's Transportation and Mobility Planning Division. Since the project is not changing the overall character of the area, it is not expected that the project will change in the current vehicle mix within the area. As such, the truck percentages present in 2005 were applied to 2007 vehicular volume estimates to obtain 2007 truck volumes. A summary of the traffic characteristics within the project area is provided in Table 2. The interchange of I-95 and Route 7100 (Fairfax County Parkway) has the highest overall vehicular volume and the highest truck volumes of all

the phases analyzed. Although Lorton Road (Route 642) has higher truck percentages than Fairfax County Parkway, the corresponding daily truck traffic volumes are lower. Following the methodologies provided in the March 2006 guidance, it was determined that the I-95 and Fairfax County Parkway interchange would be analyzed as the worst case site of the project. Conditions at this interchange were used in the qualitative comparison approach, where monitored $PM_{2.5}$ levels within the study area, roadway volumes, and emission projections for the opening year of the project were assessed to determine if the project has the potential to cause or exacerbate a violation of the $PM_{2.5}$ NAAQS.

Table 2: Summary of Traffic Characteristics of Affected Roadways

Roadway	2007 Combined AADT	Percent Trucks	Daily Truck Volumes
I-95 (south of Rte 123)	189,985	9%	17,099
I-95 (from Rte 123 to US 1)	210,862	9%	18,978
I-95 (from US 1 to Rte 642)	204,599	9%	18,414
I-95 (from Rte 642 to Rte 7100)	**211,906**	**9%**	**19,072**
I-95 (north of Rte 7100)	**218,169**	**9%**	**19,635**
Rte 123 approaching I-95	20,877	3%	626
Rte 123 departing I-95	30,272	2%	605
US 1 approaching I-95	38,623	2%	772
US 1 departing I-95	41,755	2%	835
Rte 642 approaching I-95	4,802	12%	576
Rte 642 departing I-95	13,570	12%	1,628
Rte 7100 approaching I-95	**36,535**	**3%**	**1,096**
Rte 7100 departing I-95	**65,764**	**3%**	**1,973**

Below, Table 3 provides a summary of the air quality monitoring data for the years 2003, 2004 and 2005. 2006 was not included as data is still being collected. To attain the National Ambient Air Quality Standards set forth by EPA, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$ for the Annual Standard; and the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 $\mu g/m^3$ for the 24-hour standard. As indicated in Table 3, the three year averages of the annual mean and the 98^{th} percentile for the monitoring site are currently below the NAAQS for $PM_{2.5}$ (annual and 24-hour) although exceedances have been recorded (i.e. Arlington monitor, 2005). As discussed above, despite a small number of isolated past exceedances, the region as a whole is experiencing and expected to continue experiencing downward trends in $PM_{2.5}$ values.

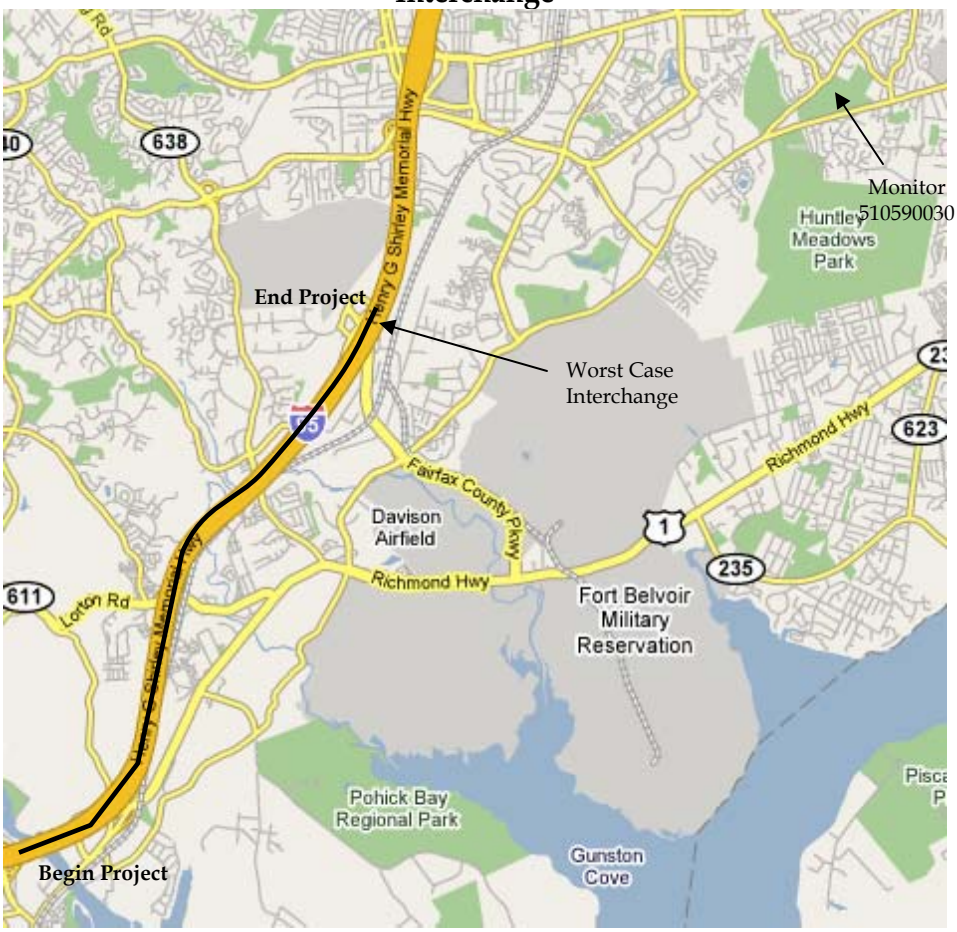
Table 3: Monitor Values and Averages in Northern Virginia for 2003-2005 (µg/m³)

Monitor Information		2003		2004		2005		3 Year Averages	
Site ID	County	98th Percentile	Annual Mean	98th Percentile	Annual Mean	98th Percentile	Annual Mean	98th Percentile	Annual Mean
510130020	Arlington	39	14.1	36	14.5	34	15.3	36	14.6
510590030	**Fairfax**	**33**	**13.2**	**35**	**13.9**	**36**	**13.7**	**35**	**13.6**
510591005	Fairfax	37	13.2	34	13.7	35	14.4	35	13.8
510595001	Fairfax	33	13.6	34	14	35	14.8	34	14.1
511071005	Loudoun	35	13.1	34	14.1	38	14.6	36	13.9

Source: US EPA, Office of Air Quality Planning and Standards, Information Transfer and Program Integration Information Transfer Group. AirData (http://www.epa.gov/air/data/monvals.html).

The closest monitor to the worst case interchange for this project is at Lee Park on Telegraph Road in Fairfax County (Site ID 510590030). The monitor is located approximately 5 miles northeast of the I-95/Fairfax County Parkway Interchange (Figure 2). As demonstrated in Table 3, this monitor is in attainment with the NAAQS for $PM_{2.5}$. The 3 year averages which are used to demonstrate attainment are measured at 35 µg/m³ for the 98th Percentile and 13.6 µg/m³ for the Annual Mean.

Figure 2: Location of Air Quality Monitor in Fairfax County Closest to Worst Case Interchange



For future scenarios, $PM_{2.5}$ annual emissions associated directly to on-road mobile sources are expected to decrease by 56% in 2010 from a 2002 baseline according to a recent report by the Regional Transportation Planning Board[3]. Emissions estimates using EPA's approved emissions estimation tool, MOBILE6.2, show that $PM_{2.5}$ emissions rates from vehicles will drop by almost 50% between 2010 and 2030. In the MWCOG $PM_{2.5}$ conformity assessment, regional emissions of direct $PM_{2.5}$ from on-road mobile sources are shown to continue to decline through 2030. Additionally, the increase in VMT as a result of the project is consistent with the increases in VMT in the metropolitan area generally, where no increases in $PM_{2.5}$ emissions or concentrations have been reported. Furthermore, according to EPA, the 2007 heavy-duty engine standards will result in the introduction of new, highly effective control technologies for heavy-duty engines. Particulate matter emission levels are expected to be 90% lower on a per vehicle basis than 2000 standard levels due to the 2007 diesel engine and fuel program.[4]

In summary, air quality information supplied by the air quality monitor within the nonattainment area located nearest to the project area did not record any current violations in the past three years and averages were well below the annual and 24-hour $PM_{2.5}$ standards. This monitor has not recorded any exceedances to date for the year 2006. Also, $PM_{2.5}$ emissions are expected to be reduced in the project area, as demonstrated by projected reductions in the regional emissions analysis conducted by the MWCOG, as well as by national projections by EPA reflecting impacts of national emissions control programs, such as the 2007 Heavy-Duty Diesel Rule. As discussed in the March 2006 guidance, any increase in emissions due to traffic changes associated with the project, will be offset by decrease in emissions from the transportation facility due to decreasing on-road vehicle emission trends, as well as decreasing background concentrations.

Therefore, the project has been shown to meet all regional and hot-spot conformity requirements as set forth in 40 CFR Part 93 for $PM_{2.5.}$ It is determined that the project will not cause or contribute to a new violation of the $PM_{2.5}$ NAAQS, or increase the frequency or severity of a violation.

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3 *Fine Particles ($PM_{2.5}$) Standards Air Quality Assessment*. National Capital Regional Transportation Planning Board, Metropolitan Washington Council of Governments. December 21, 2005.

4 Heavy-duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements – Final Rule. ("2007 Heavy Duty Highway Final Rule"). Signed December 21, 2000.