# AIR QUALITY ANALYSIS

**Route 257 - Bridgewater Bypass**

**Staunton District**
**(Rockingham, Bridgewater, Mt. Crawford)**

**0257-176-101, P101**

**UPC 17541**

Prepared by:


**Environmental Division**
**Virginia Department of Transportation**


**September 2007**

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## Summary

The Virginia Department of Transportation (VDOT) is conducting a location study for a proposed bypass to the northeast of the Town of Bridgewater. The bypass would generally extend from Route 257 to Route 42 and have two to four lanes, with curb and gutter.

Build scenarios for the proposed bypass were assessed for potential air quality impacts and conformity with applicable air quality regulations and requirements. The assessment indicates that the project would meet all applicable air quality analysis and conformity requirements. As such, it will not cause or contribute to a violation of national ambient air quality standards (NAAQS) as established by the US Environmental Protection Agency (US EPA).

Additionally, best available information indicates that, nationwide, regional levels of air toxics are expected to decrease in the future due to fleet turnover and the continued implementation of more stringent emission and fuel quality regulations. Nevertheless, it is possible that some localized areas may show an increase in emissions and ambient levels of these pollutants due to locally increased traffic levels associated with the project.

This project lies in an area that is currently in attainment with all of the NAAQS. General care should be observed to minimize emissions of volatile organic compounds (VOC) and nitrogen oxides (NOx). VDOT must adhere to these measures to ensure that air quality is not impacted by project construction. The following Virginia Department of Environmental Quality (DEQ) air pollution regulations must be adhered to during the construction of this project: *9 VAC 5-50-60 et seq., Fugitive Dust precautions*; and *9 VAC 5-40-5600 et seq., Open Burning precautions*.

Emissions may be produced in the construction of this project from heavy equipment and vehicle travel to and from the site, as well as from fugitive sources. Construction emissions are short term or temporary in nature. In order to mitigate these emissions, all construction activities are to be performed in accordance with VDOT *Road and Bridge Specifications*.

## Project Description & Traffic Forecasts

A bypass to the northeast of the Town of Bridgewater is being studied. The bypass would generally extend from Route 257 to Route 42 and have two to four lanes, with curb and gutter.

Modeling was conducted to generate demand estimates for average daily traffic (ADT) and AM and PM peak hour traffic for a base year (2005), interim year (2018) and design year (2030). Separate forecasts were generated for Preliminary Candidate Alternatives A and B. The peak forecast average daily traffic (ADT) volume in the design year is approximately 36,500, forecast for the segment of Route 42 at which Alternative B would connect. Excerpts from the traffic forecasts are provided in Attachment A[1].

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[1] Spreadsheets by Stuart Tyler, Parsons Transportation Group Inc. of Virginia to Nick Nies, VDOT Environmental, attached to email dated September 7, 2007.

## Regulatory Requirements

An overview of regulatory requirements and guidance is provided below.

*NEPA and Conformity Requirements & Guidance*

Air quality analyses requirements are addressed both by NEPA (including recently issued federal guidance for the assessment of Mobile Source Air Toxics, or MSATs) and federal transportation conformity regulations. Applicable requirements and updates are summarized below.

On August 4, 2004, the Federal Highway Administration (FHWA) and VDOT completed a "Project Level Air Quality Studies Agreement"[2] ("Agreement") addressing requirements for NEPA project-level air quality analyses. Under this Agreement, project-level air quality (hot-spot) analyses are conducted for carbon monoxide (CO) for projects that meet traffic and related criteria as specified in the agreement. Projects that qualify for programmatic categorical exclusions (PCEs) under NEPA are exempted from analysis under the first criterion in the Agreement. Other key criteria as specified in the Agreement include:

2. *(i) Level of Service (LOS) is "C" or better for all intersections/interchanges in the project area or intersections/interchanges directly affected by the project*
3. *Any project which meets the following volume requirements:*
   - *(i) The design year 24-hour forecasted traffic does not exceed 30,000 vehicles per day if one or more intersections/interchanges has LOS "D" or worse;*
   - *(ii) The design year 24-hour forecasted traffic on any roadway in the project area or any roadway directly affected by the project does not exceed 42,500 vehicles per day;*

On October 28, 2004, FHWA provided related project-level analysis guidance[3] to VDOT to address the process for updating existing air quality studies. The specified process applies, for example, to projects for which requisite air quality studies have already been completed (and related approvals obtained) but the project has been delayed in implementation or changes are made to assumptions (such as design year and associated traffic projections) relating to its design or implementation.

On February 3, 2006, FHWA and EPA issued joint guidance[4] for the assessment of MSATs in the NEPA process for highways. The MSATs guidance includes specific criteria for determining which projects are to be considered exempt from MSAT analysis requirements, which may require a qualitative analysis, and which should undergo a quantitative assessment. Projects considered exempt under section 40 CFR 93.126 of the federal conformity rule are also specifically designated as exempt from MSATs analysis requirements. The priority MSATs identified in the guidance are benzene, formaldehyde, acetaldehyde, diesel particulate

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2 Documented in a letter agreement dated August 4, 2004 from FHWA to VDOT.

3 "Procedures for Updating Air Studies When New Planning Assumptions Become Available", letter dated October 28, 2004 from FHWA to VDOT.

4 "Interim Guidance on Air Toxic Analysis in NEPA Documents", dated 2/3/06, jointly issued by EPA and FHWA. A copy may be found online at: http://www.fhwa.dot.gov/environment/airtoxic/020306guidmem.htm.

matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene; however, the guidance also indicates that this list is subject to change.

The federal conformity rule (40 CFR Parts 51 and 93) requires air quality conformity determinations for transportation plans, programs and projects in "non-attainment or maintenance areas for transportation-related criteria pollutants for which the area is designated nonattainment or has a maintenance plan" (40 CFR 93.102(b)). Regional conformity analysis requirements apply for plans and programs; hot-spot analysis requirements apply for projects.

Non-attainment and maintenance areas are ones that do not meet or have not met National Ambient Air Quality Standards (NAAQS), which are established by the US EPA. Transportation-related criteria pollutants as specified in the conformity rule (40 CFR 93.102(b)) include ozone ($O_3$), carbon monoxide (CO), nitrogen dioxide ($NO_2$), and particulate matter less than 10 and 2.5 microns in diameter ($PM_{10}$ and $PM_{2.5}$, respectively). Precursors to these pollutants are also specified in the rule. Currently applicable NAAQS are listed in Table 1 below.

The federal conformity rule requires a currently conforming transportation plan and program at the time of project approval (40 CFR 93.114) and for the project to be from a conforming plan and program (40 CFR 93.115). Conditions for this purpose are specified. For example, if the project is of a type or one that is not required to be specifically identified, the project must be consistent with the policies and purpose of the transportation plan and not interfere with other projects specifically included in the transportation plan (40 CFR 93.115(b)). Additionally, the design concept and scope of the project as specified in the program at the time of the regional conformity determination should be adequate to determine its contribution to regional emissions, and any mitigation measures associated with the project should have written commitments from the project sponsor and/or operator (40 CFR 93.1115(c)).

Project level (hot-spot) air quality conformity analysis requirements apply only for FHWA (and Federal Transit Administration, or FTA) projects and only for ones located in air quality non-attainment and/or maintenance areas for CO, $PM_{10}$ and/or $PM_{2.5}$ (40 CFR 93.116(a))[5]. FHWA and FTA projects are defined in the federal conformity rule and are generally considered ones for which federal funding or approvals are proposed or required (40 CFR 93.100).

The federal conformity rule requires that the "FHWA/FTA project must not cause or contribute to any new localized CO, PM10, and/or PM2.5 violations or increase the frequency or severity of any existing CO, PM10, and/or PM2.5 violations in CO, PM10, and PM2.5 nonattainment and maintenance areas" (40 CFR 93.116(a)). Other general requirements for hot-spot analyses for CO and particulate are listed in Section 93.116 of the conformity rule.

5 Hot-spot analyses for CO may still be required to meet NEPA requirements if certain project-related criteria specified in the 2004 FHWA-VDOT Agreement are met, as noted previously.

## Table 1: National Ambient Air Quality Standards*

| Pollutant | Primary Stds. | Averaging Times | Secondary Stds. |
|---|---|---|---|
| Carbon Monoxide | 9 ppm (10 mg/m$^3$) | 8-hour[1] | None |
| | 35 ppm (40 mg/m$^3$) | 1-hour[1] | None |
| Lead | 1.5 µg/m$^3$ | Quarterly Average | Same as Primary |
| Nitrogen Dioxide | 0.053 ppm (100 µg/m$^3$) | Annual (Arithmetic Mean) | Same as Primary |
| Particulate Matter ($PM_{10}$) | Revoked[2] | Annual[2] (Arith. Mean) | |
| | 150 µg/m$^3$ | 24-hour[3] | |
| Particulate Matter ($PM_{2.5}$) | 15.0 µg/m$^3$ | Annual[4] (Arith. Mean) | Same as Primary |
| | 35 µg/m$^3$ | 24-hour[5] | |
| Ozone | 0.08 ppm | 8-hour[6] | Same as Primary |
| | 0.12 ppm | 1-hour[7] (Applies only in limited areas) | Same as Primary |
| Sulfur Oxides | 0.03 ppm | Annual (Arith. Mean) | ------- |
| | 0.14 ppm | 24-hour[1] | ------- |
| | ------- | 3-hour[1] | 0.5 ppm (1300 µg/m$^3$) |

(1) Not to be exceeded more than once per year.

(2) Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the agency revoked the annual $PM_{10}$ standard in 2006 (effective December 17, 2006).

(3) Not to be exceeded more than once per year on average over 3 years.

(4) To attain this standard, 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 µg/m$^3$.

(5) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m$^3$ (effective December 17, 2006).

(6) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(7) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1, as determined by appendix H.
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

* *Source: Table including footnotes listed above are as excerpted from US Environmental Protection Agency (US EPA) web site (http://www.epa.gov/air/criteria.html, accessed April 20, 2007).*

Additional Notes:

(i) EPA introductory text for the table presented above: "The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m3), and micrograms per cubic meter of air (µg/m3)."

(ii) A revision to the eight-hour ozone standard is expected to be promulgated by EPA in 2007, to be effective in 2008. Designations of areas in nonattainment for the revised standard would follow.

(iii) $PM_{2.5}$ standards are as specified in the Final Rule published in the Federal Register on October 17, 2006 (FR Volume 71, No. 200, pp.61144—61233) and made effective December 18, 2006. The previous (1997) 24-hour standard of 65 µg/m3 applies for conformity analyses and determinations for areas previously designated as in nonattainment for that standard, as indicated in the EPA guidance memorandum issued April 16, 2007 for "Transportation Conformity and the Revised 24-Hour PM2.5 Standard". The EPA guidance memo also indicates that "[t]ransportation conformity for the 2006 24-hour PM2.5 standard does not apply until one year after the effective date of nonattainment designations that consider that standard…". As of the date of preparation of this report, no areas in Virginia have been designated in nonattainment for the new standard.

Section 93.123 of the conformity rule specifies procedures for the preparation of hot-spot analyses for both CO and particulate. The VDOT-FHWA Agreement noted above responds to the federal requirements for CO analyses and provides additional or more specific procedures or criteria for their preparation.

*Project Specific Conditions & Analysis Requirements*

The area is which the project is located is in attainment for all of the NAAQS. As such, regional conformity requirements are not applicable for this project.

Traffic volume criteria as specified in the 2004 FHWA-VDOT Agreement addressing air quality analysis for NEPA are not satisfied for this project, as the maximum average daily traffic (ADT) among all of the alternatives considered would exceed 30,000. A worst-case analysis for CO was therefore conducted and a summary of that analysis is provided below.

MSATs are addressed in this update in accordance with the recently issued (2006) federal guidance noted previously. Given relatively low projected traffic volumes, the project is of a type that would be expected to have minimal impact on MSAT emissions.

### Carbon Monoxide

Modeling for CO was conducted using inputs and procedures implemented following US EPA and FHWA general guidance[6,7,8] as well as Department guidance for local (consultant) implementation[9]. Emissions and ambient concentrations were modeled, respectively, using standard US EPA models MOBILE6.2 and CAL3QHC as incorporated into or employed by interface software developed and released by the FHWA. The interface software streamlines the file preparation and modeling process and provides a ready means to test worst-case (pre-screening) scenarios for project level analyses. The interface software package used for the emission modeling was "EMIT"[10] as updated by the FHWA in March 2007. The corresponding interface software package applied for dispersion modeling of intersections was "Cal3Interface"[11], released by the FHWA in December 2006. More information on these models may be obtained from the FHWA web site[12].

Following federal guidance for use of the Cal3Interface model, a worst-case analysis was applied. Traffic forecasts were generated for each of Alternative A and B, with forecast volumes

6 "Guidelines for Modeling Carbon Monoxide from Roadway Intersections", EPA-454/R-92-005, US EPA, 1992

7 "User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections", EPA-454/R-92-006 (Revised), EPA, September 1995

8 "Discussion Paper. Appropriate Level of Highway Air Quality Analysis for a CE, EA/FONSI, and EIS", FHWA, March 1986

9 "Consultant Guide. Air Quality Conformity Project-Level Analysis", VDOT Environmental Division, Air Section, June 2007

10 See "The Easy Mobile Inventory Tool – EMIT", Michael Claggett, Ph.D. (Principal Author and Model Designer), Air Quality Modeling Specialist, Federal Highway Administration Resource Center, 604 West San Mateo Road, Santa Fe, New Mexico 87505, and Jeffrey Houk, Air Quality Modeling Specialist, Federal Highway Administration Resource Center, 12300 West Dakota Avenue, Suite 340, Lakewood, Colorado 80228, dated November 2, 2006.

11 See "CAL3Interface – A Graphical User Interface for the CALINE3 and CAL3QHC Highway Air Quality Models", Michael Claggett, Ph.D., FHWA Resource Center, 12300 West Dakota Avenue, Suite 340, Lakewood, Colorado 80228, ca 2006.

12 See http://www.fhwa.dot.gov/index.html.

provided by roadway segment including segments at or near each major intersection, which is where vehicles queues will occur. The forecasts indicated maximum traffic volumes would be expected at or near the intersection of Alternative B and John Wayland Highway (Route 42). The analysis therefore focused on the immediate area of this intersection, as this will be the location of expected maximum concentrations of CO.

Input data applied for the emission factor modeling using the EMIT interface are summarized in Table 2 below. Input data were applied as specified in the VDOT Consultant Guide, and generally included local (Rockingham) vehicle registration data for 2005, fuel quality (sulfur, and Reid Vapor Pressure or RVP), and other data. Temperature data were selected as specified in the Consultant Guide and represents an average minimum monthly temperature for January. Other data such as absolute humidity were kept at EPA defaults.

Table 2: Key EMIT Interface Software (MOBILE6.2) Input Data

| Parameter | Data |
|---|---|
| Evaluation Month | January |
| Min/Max Temperature (Fahrenheit) | 30/30 |
| Gasoline Reid Vapor Pressure (RVP((psi) | 13.5 |
| Gasoline Sulfur | Conventional East |
| Vehicle Registration by Vehicle Class | Data for Rockingham County |

Emission factors as generated using the EMIT interface (for the MOBILE6.2 model) are listed in Table 3 below. The factors were developed for both the roadway operating speed (approximately 47 mph for Route 42, and 55 mph for Alternative B) and idle conditions. For reference, Attachment A presents the traffic forecasts.

Table 3: Emission Factors Generated with EMIT Interface Software (MOBILE6.2)

| Operating Condition | Base Year (2005) | Interim Year (2018) | Design Year (2030) |
|---|---|---|---|
| Idle (grams/vehicle-hour) | na | 81.332 | 70.197 |
| Operating Speed – 47 mph (grams/mile) | 16.346 | 8.448 | 7.292 |
| Operating Speed – 55 mph (grams/mile) | na | 9.349 | 7.983 |

Input data for the dispersion modeling are listed in Table 4 below and were selected as the Cal3Interface software defaults (for a worst-case analysis) unless otherwise noted. As documented in the VDOT Consultant Guide referenced previously, DEQ reviewed available monitoring data and established ambient background concentrations to be used for CO modeling of 6 parts per million (ppm) for the one hour standard and 3 ppm for the eight hour standard. The option of having the model locate the worst-case wind direction for each receptor was employed to ensure that the maximum possible CO concentration was predicted. The roadways are modeled as at-grade with a source height of zero. Default signal timing is used for the forecast years.

Table 4: Key Cal3Interface (CAL3QHC) Worst-Case Analysis Inputs*

| Parameter | Data |
|---|---|
| Surface Roughness Coefficient, cm | 108 |
| Background CO Concentration, ppm** | |
| - One-hour | 6 |
| - Eight-Hour | 3 |
| Wind Speed, meters per second | 1 |
| Stability Class | 4 (D – Neutral) |
| Mixing Height, meters | 1000 |
| Receptor Height, meters (ft) | 1.8 (5.9) |
| Persistence Factor | 0.7 |

* Cal3Interface Defaults unless otherwise specified.
** As developed by the DEQ and specified in the VDOT Consultant Guide (2006).

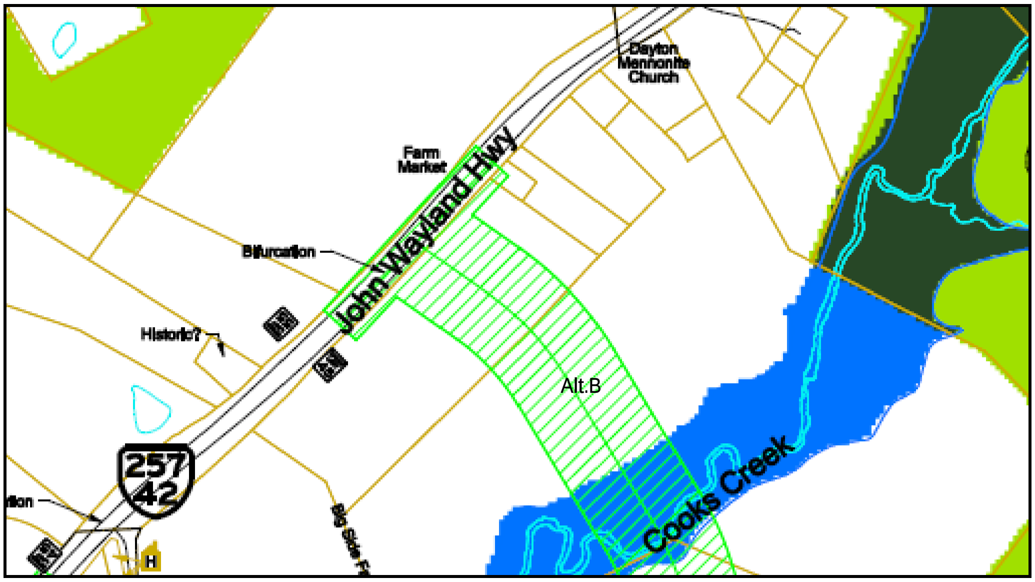
The roadway configuration and receptors (points for which CO concentrations are estimated) for the build (2018 and 2030) scenarios for Alternative B were modeled as specified in the Cal3Interface software for a worst-case pre-screen scenario for a T-intersection of two arterials with traffic in both directions (a "4x4" configuration in the Cal3Interface). As indicated in the FHWA guidance for the Cal3Interface software, this scenario assumes twelve foot lanes as well as queue and free-flow links for each leg.

Receptor locations were as specified the Cal3Interface software package for the worst-case scenario for this roadway configuration. Receptors were located at each corner, three meters from each intersecting roadway; along each side of the intersecting roadways at twenty-five meters and fifty meters from the corner; and at the midpoint on each side of the intersecting roadways.

Figure 1 below presents the project area and the focus (intersection of Route 42 and Alternative B) for the modeling. Figure 2 below presents the roadway configuration and receptor locations for a generic T-intersection as provided in the FHWA Cal3Interface guidance.

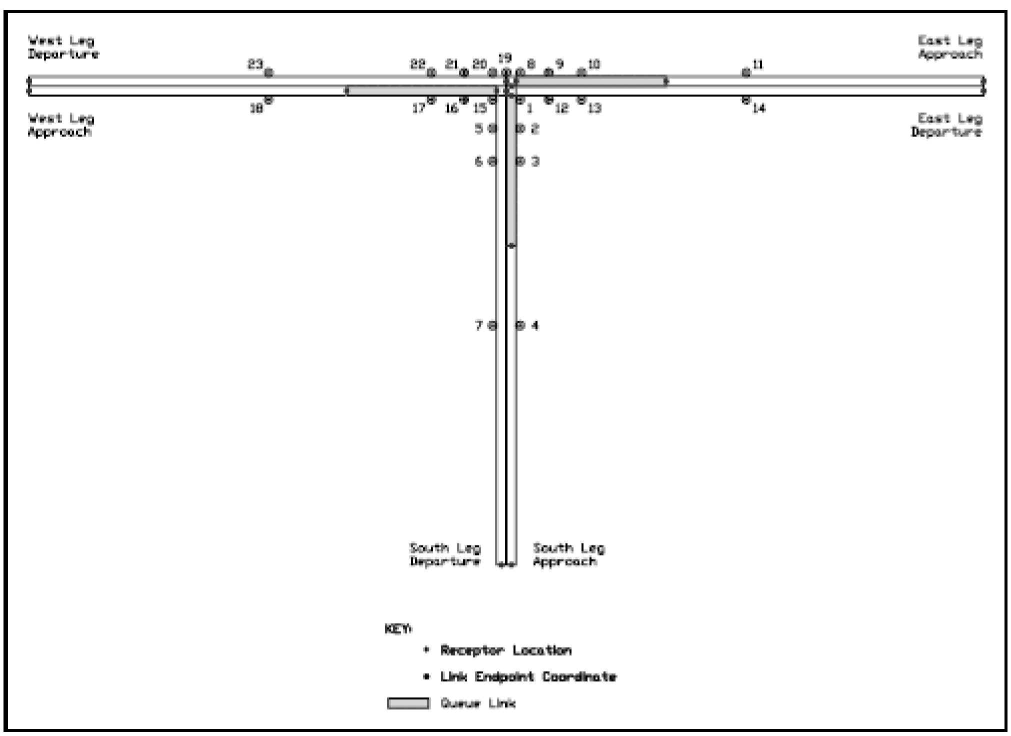
The worst-case pre-screen procedure as encoded in the Cal3Interface software provided by the FHWA assumes traffic volumes corresponding to LOS E operation. For signalized arterials (the design year condition), the worst-case pre-screen volume-to-capacity (V/C) ratio is set to 1.44 and capacity to 1037 vehicles per hour per lane. Signal timing is predefined with an average total signal cycle length of 120 seconds and weighted effective green time of 0.45.

## Figure 1: Project Area*




* Excerpted from “Bridgewater Bypass. Preliminary Candidate Build Alternatives”. The intersection modeled is Route 42 (John Wayland Highway) and Alternative B (shown intersecting Route 42 from the southeast).

## Figure 2: Cal3Interface Pre-Screen Worst-Case Scenario Receptor Locations




Source: Figure 2.5 (Receptor Locations / Link Configurations of the Pre-Defined 2-Way, 3-Leg Intersection Option) reproduced from “CAL3Interface – A Graphical User Interface for the CALINE3 and CAL3QHC Highway Air Quality Models”, Michael Claggett, Ph.D., FHWA Resource Center, 12300 West Dakota Avenue, Suite 340, Lakewood, Colorado 80, ca 2006.

Projected maximum concentrations for CO are presented in Table 5 below. Including assumed background concentrations of 6 ppm for the one-hour standard and 3 ppm for the eight-hour standard as noted previously, the projected peak concentrations are 11.3 and 6.7 ppm, respectively, for one- and eight-hour periods. These occur for the worst-case traffic volumes assumed within the FHWA Cal3Interface model corresponding to a LOS E operating condition for the intersection being modeled, for the base year (2005). Peak concentrations in the design year using the same worst-case traffic volumes drop to 9.5 and 5.5 ppm for the one- and eight-hour standards, respectively.

For comparison, peak concentrations based on modeled volumes for the same intersection (JW Highway and Alternative B) drop to 8.7 and 4.9 ppm for the respective one- and eight-hour standard, in the design years.

In all scenarios, forecast peak concentrations for CO are well below the respective one- and eight-hour standards of 35 and 9 ppm.

The results indicate that, despite the projected increase in traffic, ambient levels of CO in the vicinity of the project are expected to remain well below both the one-hour and the eight-hour NAAQS. The project therefore is not expected to cause or contribute to a violation of the CO standards.

Table 5: Projected Maximum (Worst-Case) CO Concentrations (ppm) & Receptor Locations*

| Scenario | Base Year (2005) | Interim Year (2018) | Design Year (2030) |
|---|---|---|---|
| *Worst-Case Volumes:* | | | |
| One-Hour Standard (35 ppm) | 11.3 (1) | 10.0 (1) | 9.5 (1) |
| Eight-Hour Standard (9 ppm) | 6.7 (1) | 5.8 (1) | 5.5 (1) |
| *Modeled Volumes:* | | | |
| One-Hour Standard (35 ppm) | 6.8 (1) | 8.1 (1) | 8.7 (8) |
| Eight-Hour Standard (9 ppm) | 3.6 (1) | 4.5 (1) | 4.9 (1) |

* Including background concentrations of 6 ppm for the one-hour standard and 3 ppm for the eight-hour standard. Receptor locations noted are only the first location if more than one location have the same value. As noted previously, all forecasts are for the intersection of JW Highway and Alternative B, selected as the worst case scenario intersection.

** Worst-case volumes are as specified in the FHWA Cal3Interface model using CAL3QHC, and correspond to LOS E for the intersection.

## Mobile Source Air Toxics (MSATs)

The FHWA 2/3/2006 Interim Guidance (as referenced previously) establishes a three-tiered approach to determine the level of analysis needed for MSATs in a project-level study. These tiers or levels are reviewed below, using text from the guidance. The project is assessed in relation to the guidance following this review.

***(1) 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, "[f]or 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 "[t]he 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.

***(2) Projects with Low Potential MSAT Effects***

The types of projects included in this category are those that serve to improve operations of highway, transit or freight 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 of these types of projects are minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design year traffic is not projected to meet the 140,000 to 150,000 AADT criteria.

Projects in this category are to be addressed with a qualitative analysis following the guidance provided by FHWA.

***(3) 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.

Traffic forecasts for the project are significantly less than the 140,000 to 150,000 AADT threshold specified in the federal guidance for a Category 3 project (*Projects with Higher Potential MSAT Effects*). However, as the project involves the construction of a new roadway facility on a new location, it falls into the second category, i.e., those with "*Low Potential MSAT Effects*".

As noted above, projects in the second category are addressed with a qualitative analysis following the guidance provided by FHWA. A qualitative analysis consistent with federal guidance is therefore provided below for this project.

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In addition to the criteria air pollutants for which there are national ambient air quality standards, EPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners) and stationary sources (e.g., factories or refineries).

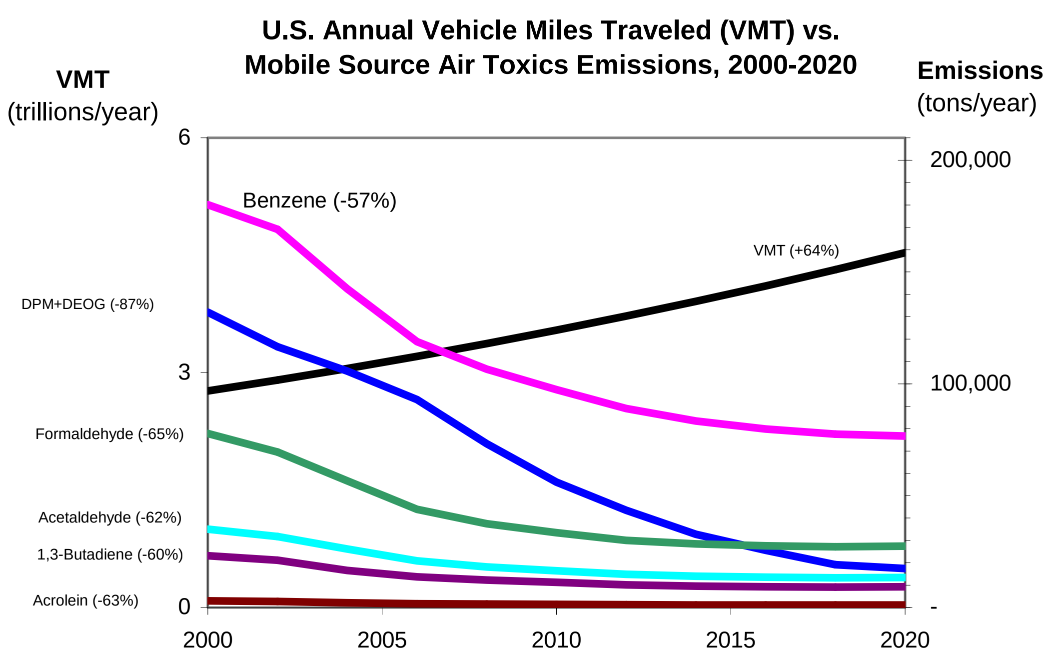
Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics defined by the Clean Air Act. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The EPA is the lead Federal Agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. The EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources. 66 FR 17229 (March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel PM emissions by 87 percent, as shown in the graph below.

As a result, EPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of CAA Section 202(l) that will address these issues and could make adjustments to the full 21 and the primary six MSATs[13].

**Unavailable Information for Project Specific MSAT Impact Analysis**

This document includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not enable prediction of the health impacts of the emission changes associated with the project. Due to these limitations, the following discussion is included in accordance with Council of Environmental Quality (CEQ) regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information:




Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

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13 On February 9, 2007, EPA announced that it is issuing a final rule for the "Control of Hazardous Air Pollutants from Mobile Sources". The EPA fact sheet (EPA420-F-07-017) released for the final rule states: "The final standards will significantly lower emissions of benzene and the other air toxics in three ways: (1) by lowering benzene content in gasoline; (2) by reducing exhaust emissions from passenger vehicles operated at cold temperatures (under 75 degrees); and (3) by reducing emissions that evaporate from, and permeate through, portable fuel containers." Thus, although the graph provided in the text only forecasts emissions through 2020, EPA's new MSAT2 Rule should result in additional emission reductions beyond 2020 that were not envisioned when the MSAT1 Rule or this graph were developed.

**Information that is Unavailable or Incomplete**

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. Emissions: The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model--emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of PM under the conformity rule, EPA has identified problems with MOBILE6.2 as an obstacle to quantitative analysis. These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

2. Dispersion. The tools to predict how MSATs disperse are also limited. The EPA'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 NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate 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 (NCHRP) is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will 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.

3. Exposure Levels and Health Effects. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs 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 MSATs, 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 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 MSATs**

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes 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 a focus of a number of EPA 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. While not intended for use as a measure of or 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 EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The EPA 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 is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from EPA'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.
- Acetaldehyde is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- Diesel exhaust (DE) is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.
- Diesel exhaust also represents chronic respiratory effects, possibly the primary non-cancer 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.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by EPA, FHWA, and industry, has undertaken a major 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[14]. Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more importantly, they 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 this project.

**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. While available tools do allow a reasonable prediction of relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from this project and MSAT concentrations or

14 South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); Highway Health Hazards, The Sierra Club (2004) summarizing 24 Studies on the relationship between health and air quality); NEPA's Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles, Environmental Law Institute, 35 ELR 10273 (2005) with health studies cited therein.

exposures created by this project cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) 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 document, FHWA provides a qualitative assessment and acknowledges that the project may result in increased exposure to MSAT emissions in 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.

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the project. The qualitative assessment presented is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, which may be obtained from the FHWA website (http://www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm).

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Emissions will likely be lower than present levels in the design year 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 study area are likely to be lower in the future in virtually all locations.

Accordingly, for this project, there may be localized areas where VMT would increase, and other areas where VMT would decrease. Therefore it is possible that localized increases and decreases in MSAT emissions may occur. However, even if these increases do occur, they too will be substantially reduced in the future due to implementation of EPA's vehicle and fuel regulations.

In sum, in the design year it is expected that MSAT levels could be higher in some locations than others, but current tools and science are not adequate to quantify them. 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.

## Construction & Other Potential Impacts

Comments provided by the DEQ in relation to the State Environmental Review Process (SERP) for projects located in Rockingham County, Virginia[15] are as follows:

> *This project lies in an area that is currently in attainment with all of the National Ambient Air Quality Standards (NAAQS). Projects that lie within 6.2 miles (10 km) of Shenandoah National Park, a Class 1 Prevention of Significant Deterioration (PSD) Area, will be required to proactively employ strict dust prevention measures to protect air quality. Projects within the PSD area will require via contract that water, a water truck/applicator, and a water operator are present at all times. General care should be observed to minimize VOC and NOx emissions. VDOT must adhere to these measures to ensure that air quality is not impacted by project construction. The following DEQ air pollution regulations must be adhered to during the construction of this project: 9 VAC 5-50-60 et seq., Fugitive Dust precautions; and 9 VAC 5-40-5600 et seq., Open Burning precautions.*

For reference, the project location is more than 10 km from Shenandoah National Park.

Emissions may be produced in the construction of this project from heavy equipment and vehicle travel to and from the site, as well as from fugitive sources. Construction emissions are short term or temporary in nature. In order to mitigate these emissions, all construction activities are to be performed in accordance with VDOT *Road and Bridge Specifications*.

## Conclusion

Build scenarios for the proposed bypass were assessed for potential air quality impacts and conformity with applicable air quality regulations and requirements. The assessment indicates that the project would meet all applicable air quality analysis and conformity requirements. As such, it will not cause or contribute to a violation of national ambient air quality standards (NAAQS) as established by the US Environmental Protection Agency (US EPA).

Additionally, best available information indicates that, nationwide, regional levels of air toxics are expected to decrease in the future due to fleet turnover and the continued implementation of more stringent emission and fuel quality regulations. Nevertheless, it is possible that some localized areas may show an increase in emissions and ambient levels of these pollutants due to locally increased traffic levels associated with the project.

This project lies in an area that is currently in attainment with all of the NAAQS. General care should be observed to minimize VOC and NOx emissions. VDOT must adhere to these measures to ensure that air quality is not impacted by project construction. The following DEQ air pollution regulations must be adhered to during the construction of this project: *9 VAC 5-50-60 et seq., Fugitive Dust precautions*; and *9 VAC 5-40-5600 et seq., Open Burning precautions*.

Emissions may be produced in the construction of this project from heavy equipment and vehicle travel to and from the site, as well as from fugitive sources. Construction emissions are

[15] "DEQ SERP Comments Rev.3", spreadsheet listing DEQ comments by county, dated June 29, 2007.

short term or temporary in nature. In order to mitigate these emissions, all construction activities are to be performed in accordance with VDOT *Road and Bridge Specifications*.

# Attachment A

## *Traffic Projections (Excerpts)*

*Forecasts provided by Parsons Transportation Group of Virginia (PTG):*

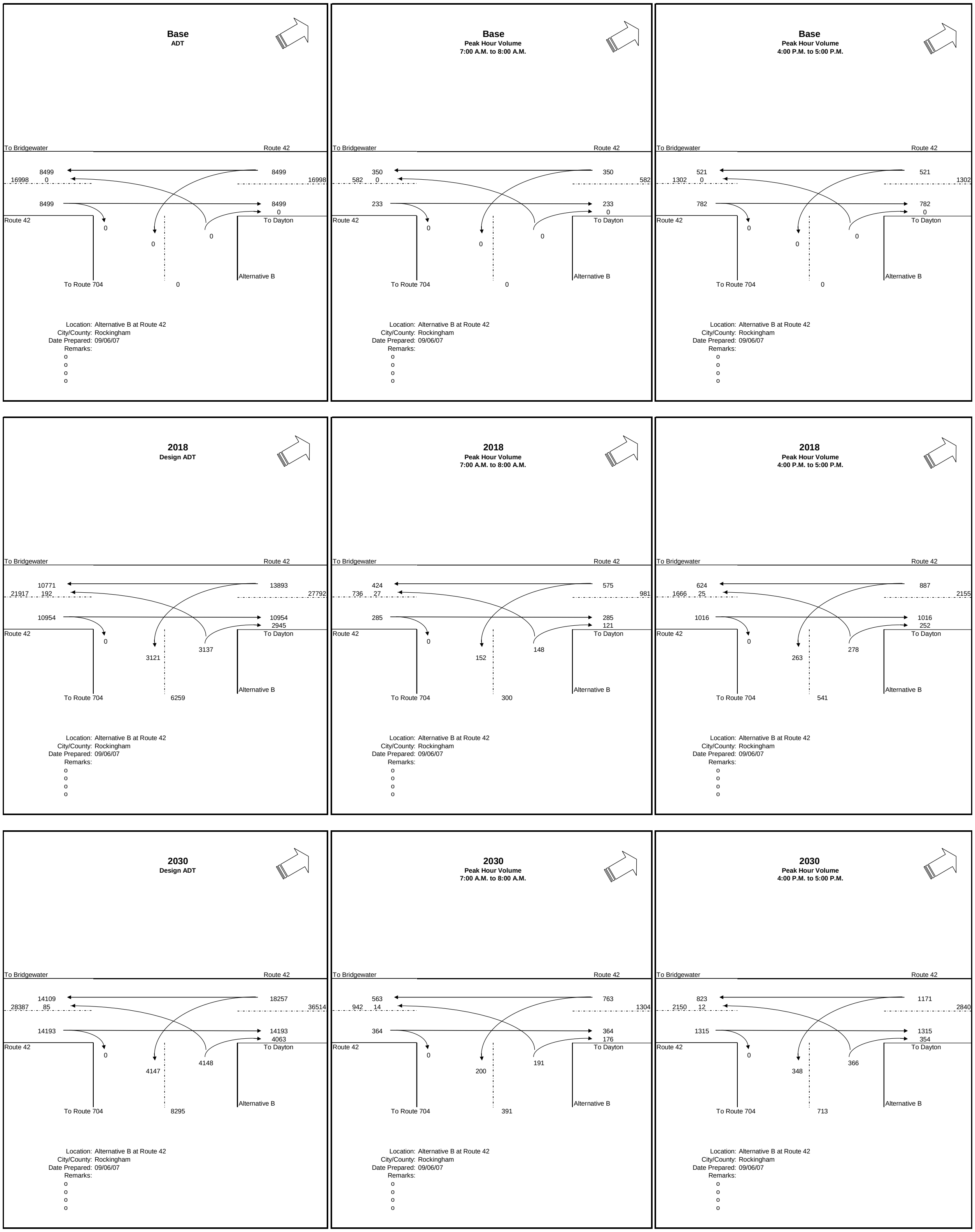
1. *Excerpt showing operating speeds for Segment 28 (JW Highway and Alternative B) by time of day from MS Excel spreadsheet file entitled "Traffic for Environ 08_20_07.xls", dated August 28, 2007.*

2. *Excerpt showing turning movements for the intersection of JW Highway & Alternative B from MS Excel spreadsheet file entitled "Intersection traffic data for VDOT.xls", dated September 7, 2007.*

3.

| | | | | | | |
|---|---|---|---|---|---|---|
| Analysis Segment: | 28 | | | | | |
| Location: | John Wayland Hwy (42) | From: South of Killdeer Lane | | | To: | 0 |
| Base Year Daily Traffic: | 17000 | | | | | |
| 2018 Daily Traffic: | 22700 | F Type: 2 | Lane capacity: | 1600 | Table offset: | 15 |
| 2030 Daily Traffic: | 28400 | A Type: 2 | Speed: | 47 | Truck lookup: | 5 |
| Daily Percent Trucks (2x, 4t): | 1.0% | One-way link: 1 | Exponent: | 3 | | |
| Daily Percent Trucks (2x, 6t): | 1.0% | Lanes: 4 | V/C coefficient: | 0.3 | | |
| Daily Percent Trucks (3+ x): | 1.0% | | | | | |

| | Base Year 2005 | | | | | | | | Interim Year 2018 | | | | | | | | Forecast Year 2030 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Percent Trucks | | | Directional Volumes | | Operating Speeds | | | Percent Trucks | | | Directional Volumes | | Operating Speeds | | | Percent Trucks | | | Directional Volumes | | Operating Speeds | |
| Start Time | Volume | 2 axle, 4 tire | 2 axle, 6 tire | 3+ axles | Peak Dir | Off-Peak Dir | Peak Dir | Off-Peak Dir | Volume | 2 axle, 4 tire | 2 axle, 6 tire | 3+ axles | Peak Dir | Off-Peak Dir | Peak Dir | Off-Peak Dir | Volume | 2 axle, 4 tire | 2 axle, 6 tire | 3+ axles | Peak Dir | Off-Peak Dir | Peak Dir | Off-Peak Dir |
| 6:00 | 235 | 1.1% | 1.1% | 0.8% | 167 | 68 | 47.0 | 47.0 | 313 | 1.1% | 1.1% | 0.8% | 223 | 90 | 47.0 | 47.0 | 392 | 1.1% | 1.1% | 0.8% | 279 | 113 | 47.0 | 47.0 |
| 7:00 | 584 | 1.3% | 1.3% | 0.9% | 396 | 188 | 47.0 | 47.0 | 780 | 1.3% | 1.3% | 0.9% | 529 | 252 | 46.9 | 47.0 | 976 | 1.3% | 1.3% | 0.9% | 662 | 315 | 46.9 | 47.0 |
| 8:00 | 829 | 1.4% | 1.4% | 1.0% | 498 | 332 | 46.9 | 47.0 | 1107 | 1.4% | 1.4% | 1.0% | 664 | 443 | 46.9 | 47.0 | 1385 | 1.4% | 1.4% | 1.0% | 831 | 554 | 46.8 | 46.9 |
| 9:00 | 1045 | 1.5% | 1.5% | 1.0% | 625 | 420 | 46.9 | 47.0 | 1395 | 1.5% | 1.5% | 1.0% | 835 | 560 | 46.8 | 46.9 | 1745 | 1.5% | 1.5% | 1.0% | 1044 | 701 | 46.5 | 46.9 |
| 10:00 | 1022 | 1.4% | 1.4% | 1.0% | 553 | 469 | 46.9 | 47.0 | 1365 | 1.4% | 1.4% | 1.0% | 738 | 627 | 46.8 | 46.9 | 1708 | 1.4% | 1.4% | 1.0% | 924 | 784 | 46.7 | 46.8 |
| 11:00 | 1071 | 1.3% | 1.3% | 1.0% | 521 | 549 | 46.9 | 46.9 | 1430 | 1.3% | 1.3% | 1.0% | 696 | 734 | 46.9 | 46.8 | 1789 | 1.3% | 1.3% | 1.0% | 871 | 918 | 46.7 | 46.7 |
| 12:00 | 1072 | 1.1% | 1.1% | 0.9% | 534 | 538 | 46.9 | 46.9 | 1431 | 1.1% | 1.1% | 0.9% | 713 | 719 | 46.8 | 46.8 | 1791 | 1.1% | 1.1% | 0.9% | 892 | 899 | 46.7 | 46.7 |
| 13:00 | 1416 | 1.1% | 1.1% | 0.9% | 756 | 660 | 46.8 | 46.9 | 1891 | 1.1% | 1.1% | 0.9% | 1009 | 881 | 46.6 | 46.7 | 2365 | 1.1% | 1.1% | 0.9% | 1263 | 1103 | 46.1 | 46.4 |
| 14:00 | 1347 | 1.2% | 1.2% | 0.9% | 724 | 623 | 46.8 | 46.9 | 1799 | 1.2% | 1.2% | 0.9% | 967 | 832 | 46.6 | 46.8 | 2250 | 1.2% | 1.2% | 0.9% | 1210 | 1040 | 46.2 | 46.5 |
| 15:00 | 1197 | 1.2% | 1.2% | 0.9% | 543 | 654 | 46.9 | 46.9 | 1598 | 1.2% | 1.2% | 0.9% | 725 | 874 | 46.8 | 46.7 | 2000 | 1.2% | 1.2% | 0.9% | 907 | 1093 | 46.7 | 46.4 |
| 16:00 | 1304 | 1.1% | 1.1% | 0.9% | 675 | 630 | 46.9 | 46.9 | 1742 | 1.1% | 1.1% | 0.9% | 901 | 841 | 46.7 | 46.7 | 2179 | 1.1% | 1.1% | 0.9% | 1127 | 1052 | 46.4 | 46.5 |
| 17:00 | 1322 | 1.0% | 1.0% | 0.8% | 628 | 694 | 46.9 | 46.9 | 1766 | 1.0% | 1.0% | 0.8% | 839 | 926 | 46.7 | 46.7 | 2209 | 1.0% | 1.0% | 0.8% | 1050 | 1159 | 46.5 | 46.3 |
| 18:00 | 1091 | 0.9% | 0.9% | 0.7% | 534 | 557 | 46.9 | 46.9 | 1457 | 0.9% | 0.9% | 0.7% | 713 | 744 | 46.8 | 46.8 | 1823 | 0.9% | 0.9% | 0.7% | 892 | 931 | 46.7 | 46.7 |
| 19:00 | 853 | 0.7% | 0.7% | 0.6% | 473 | 380 | 47.0 | 47.0 | 1139 | 0.7% | 0.7% | 0.6% | 631 | 508 | 46.9 | 46.9 | 1425 | 0.7% | 0.7% | 0.6% | 790 | 635 | 46.8 | 46.9 |
| 20:00 | 742 | 0.4% | 0.4% | 0.6% | 373 | 369 | 47.0 | 47.0 | 991 | 0.4% | 0.4% | 0.6% | 499 | 493 | 46.9 | 46.9 | 1240 | 0.4% | 0.4% | 0.6% | 624 | 616 | 46.9 | 46.9 |
| 21:00 | 604 | 0.7% | 0.7% | 0.6% | 271 | 333 | 47.0 | 47.0 | 806 | 0.7% | 0.7% | 0.6% | 362 | 444 | 47.0 | 47.0 | 1008 | 0.7% | 0.7% | 0.6% | 452 | 556 | 47.0 | 46.9 |




Source: Excerpt from PTG spreadsheet entitled "*Intersection traffic data for VDOT.xls*", dated September 7, 2007.

# Attachment B

*Sample Cal3Interface/CAL3QHC File Input*

***Cal3Interface Worst-Case Analysis Input File for CAL3QHC (2030 Design Year)***

```
'UPC 17541 (Bridgewater Bypass)',60.0,108,0.0,0.0,23,0.3048,1,0
'S Leg, E Side - 3 m',33.843,-33.843,5.9
'S Leg, E Side - 25 m',33.843,-106.021,5.9
'S Leg, E Side - 50 m',33.843,-188.042,5.9
'S Leg, E Side-Midblk',33.843,-600.000,5.9
'S Leg, W Side - 25 m',-33.843,-106.021,5.9
'S Leg, W Side - 50 m',-33.843,-188.042,5.9
'S Leg, W Side-Midblk',-33.843,-600.000,5.9
'E Leg, N Side - 3 m',33.843,33.843,5.9
'E Leg, N Side - 25 m',106.021,33.843,5.9
'E Leg, N Side - 50 m',188.042,33.843,5.9
'E Leg, N Side-Midblk',600.000,33.843,5.9
'E Leg, S Side - 25 m',106.021,-33.843,5.9
'E Leg, S Side - 50 m',188.042,-33.843,5.9
'E Leg, S Side-Midblk',600.000,-33.843,5.9
'W Leg, S Side - 3 m',-33.843,-33.843,5.9
'W Leg, S Side - 25 m',-106.021,-33.843,5.9
'W Leg, S Side - 50 m',-188.042,-33.843,5.9
'W Leg, S Side-Midblk',-600.000,-33.843,5.9
'W Leg, N Side - 0 m',0.0,33.843,5.9
'W Leg, N Side - 3 m',-33.843,33.843,5.9
'W Leg, N Side - 25 m',-106.021,33.843,5.9
'W Leg, N Side - 50 m',-188.042,33.843,5.9
'W Leg, N Side-Midblk',-600.000,33.843,5.9
'2030 Design Year',9,1,0,'C'
2
'S Leg App - Queue','AG',12.0,-24.0,12.0,-400.0,0.0,24.0,2
120,62,2.0,2074,70.197,1600,1,3
1
'S Leg App - FreeFlow','AG',12.0,0.0,12.0,-1200.0,2074,7.983,0.0,43.7
1
'S Leg Dep - FreeFlow','AG',-12.0,0.0,-12.0,-1200.0,2074,7.983,0.0,43.7
2
'E Leg App - Queue','AG',24.0,12.0,400.0,12.0,0.0,24.0,2
120,62,2.0,2074,70.197,1600,1,3
1
'E Leg App - FreeFlow','AG',0.0,12.0,1200.0,12.0,2074,7.292,0.0,43.7
1
'E Leg Dep - FreeFlow','AG',0.0,-12.0,1200.0,-12.0,2074,7.292,0.0,43.7
2
'W Leg App - Queue','AG',-24.0,-12.0,-400.0,-12.0,0.0,24.0,2
120,62,2.0,2074,70.197,1600,1,3
1
'W Leg App - FreeFlow','AG',0.0,-12.0,-1200.0,-12.0,2074,7.292,0.0,43.7
1
'W Leg Dep - FreeFlow','AG',0.0,12.0,-1200.0,12.0,2074,7.292,0.0,43.7
1.0,0.0,4,1000.0,0.0,'Y',5,1,72
```