APPENDIX E

MOBILE SOURCE AIR TOXICS (MSAT) ANALYSIS

APPENDIX E – MOBILE SOURCE AIR TOXICS – DISCUSSION OF IMPACTS

Contents

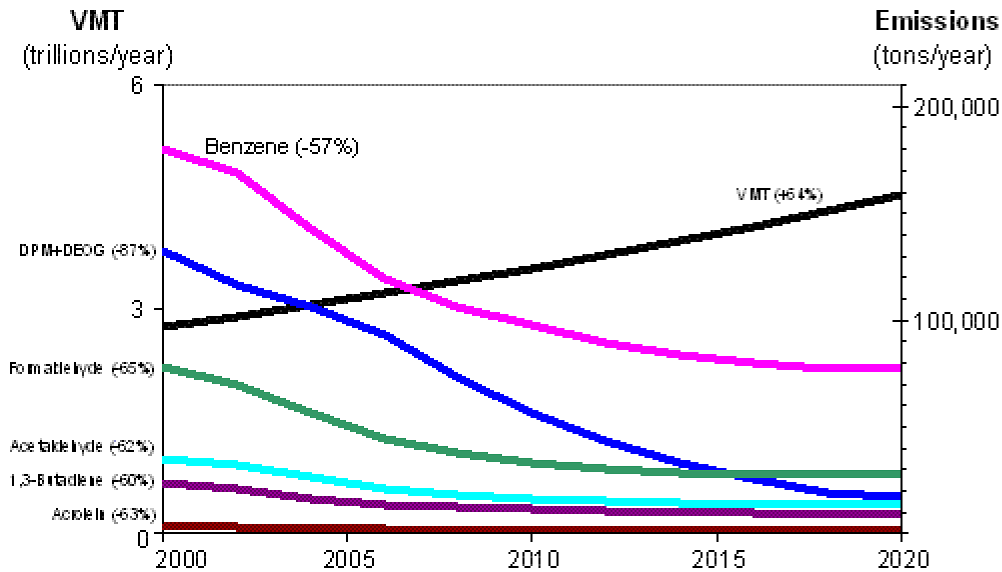
E.1 MOBILE SOURCE AIR TOXICS

In addition to the criteria air pollutants for which there are National Ambient Air Quality Standards (NAAQS), 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 CFR 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, national low emission vehicle (NLEV) standards, 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 **Exhibit E-1**.

Exhibit E-1. Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000–2020



Source: FHWA Web site: www.fhwa.gov/environment/airtoxic/vmtmsat2020.htm

Notes: For on-road mobile sources. Emissions factors were generated using MOBILE 6.2. MTBE proportion of market for oxygenates is held constant, at 50 percent. 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 percent. "DPM + DEOG" is based on MOBILE 6.2-generated factors for elemental carbon, organic carbon, and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns. 1 short ton = 907,200,000 mg.

On February 9, 2007, and under authority of CAA Section 202(l), EPA signed a final rule, *Control of Hazardous Air Pollutants from Mobile Sources*, which sets standards to control MSATs from motor vehicles. Under this rule, EPA is setting standards on fuel composition, vehicle exhaust emissions, and evaporative losses from portable containers. The new standards are estimated to reduce total emissions of MSATs by 330,000 tons in 2030, including 61,000 tons of benzene. Concurrently, total emissions of volatile organic compounds (VOC) will be reduced by over 1.1 million tons in 2030 as a result of adopting these standards.

E.2 MOBILE SOURCE AIR TOXICS IMPACT ANALYSIS

Unavailable Information for Project Specific MSAT Impact Analysis. This EIS includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not enable us to predict the project-specific health impacts of the emission changes associated with the alternatives in this EIS. Due to these limitations, the following discussion is included in accordance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

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 a 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.

- **Emissions.** The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs within 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 upon 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 the 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 upon 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 MOBILE 6.2 as an obstacle to quantitative analysis.

  These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE 6.2 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.

- **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 certain times at specific highway project locations across an urban area in order 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.

- **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 during which 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 upon 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 EPA conducted the last 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 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 upon 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 upon 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[1,2]. 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, these studies do not provide information that would be useful in alleviating the uncertainties listed above and enable us 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 us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives and MSAT concentrations or exposures created by each of the project alternatives 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 any of the alternatives would have "significant adverse impacts on the human environment."

Qualitative Impact Assessment for Mobile Source Air Toxics. In this DEIS, FHWA has provided a qualitative analysis of MSAT emissions relative to the various alternatives, and has acknowledged that all project alternatives 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.

The FHWA has developed a tiered approach for analyzing MSATs in NEPA documents. Depending upon the specific project circumstances, FHWA has identified three levels of analysis (*Memorandum – Interim Guidance on Air Toxic Analysis in NEPA Documents*, FHWA, February 2006):

- No analysis for projects with no potential for meaningful MSAT effects;
- Qualitative analysis for projects with low potential MSAT effects; or
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

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[1] 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.

[2] Department of Preventive Medicine, University of Southern California Los Angeles, WJ Gauderman, H. Vora, R. McConnell et al., *Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age: A Cohort Study.* The Lancet, (2007).

Projects requiring a quantitative analysis include projects that have the potential for meaningful differences among project alternatives. To fall into this category, projects 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 annual average daily traffic (AADT) volumes are projected to be in the range of 140,000 to 150,000, or greater, by the design year; and also
- 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).

The proposed project falls into the qualitative analysis category due to its length and regional importance. The project would not qualify as requiring a quantitative analysis because it would not significantly alter a major intermodal facility, nor would the AADT be in the 140,000 to 150,000 range.

The AADTs for the various DSAs vary by segment and range from 41,400 to 95,600 AADT on the western end of the project and 15,400 to 24,800 AADT on the eastern end of the project. **Table E-1** shows the 2035 AADT volume forecasts for the DSAs (*Traffic Forecast for TIP Projects R-3329 & R-2559 Monroe Connector/Bypass*, Wilbur Smith Associates, September 2008).

TABLE E-1: YEAR 2035 TRAFFIC PROJECTIONS ALONG MONROE CONNECTOR/BYPASS

Project Segment	Annual Average Daily Traffic (AADT)	
	DSAs A, A1, A2, A3 B, B1, B2, B3	DSAs C, C1, C2, C3 D, D1, D2, D3
I-485 to Stallings Road	41,400	95,600
Stallings Road to Indian Trail-Fairview Road	49,100	48,200
Indian Trail-Fairview Road to Unionville-Indian Trail Road	50,700	51,200
Unionville-Indian Trail Road to N Rocky River Road	51,500	52,300
N Rocky River Road to US 601	46,200	46,600
US 601 to NC 200 (Morgan Mill Road)	35,000	35,200
NC 200 (Morgan Mill Road) to Austin Chaney Road	24,400	24,800
Austin Chaney Road to Forest Hills School Road	19,300	19,600
Forest Hills School Road to US 74	15,400	16,400

Source: *Traffic Forecast for TIP Projects R-3329 & R-2559 Monroe Connector/Bypass*, Wilbur Smith Associates, September 2008

The highest traffic volumes would be 95,600 AADT for DSAs C, C1, C2, C3, D, D1, D2, and D3, in the area where these DSAs would improve a segment of existing US 74.

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. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can provide a basis for identifying and comparing the potential differences among MSAT emissions (if any) from the various alternatives.

The qualitative assessment presented below 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*, found at: www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm.

For each DSA, the amount of MSATs emitted would be proportional to the vehicle miles traveled, (VMT) assuming that other variables such as fleet mix are the same for each alternative. **Table E-2** shows the projected 2035 VMT and vehicle hours traveled (VHT) in the Metrolina region as a whole and also just in Union County (a subset of the Metrolina region), under the No-Build Alternative and the DSAs. The VMT and VHT for Union County under the various scenarios are presented in addition to the VMT and VHT for the Metrolina region as a whole because the Metrolina region is so large (13 counties). Including information for the smaller area of Union County provides another picture of the trends projected for each alternative in the county where the majority of the project is located.

TABLE E-2: VEHICLE MILES AND VEHICLE HOURS TRAVELED UNDER VARIOUS SCENARIOS

Scenario	Region	2035 Vehicle Miles Traveled (VMT) in 1000's			2035 Vehicle Hours Traveled (VHT) in 1000's		
		Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak
No-Build Alternative	Union County Only	11,481	2,649	3,042	253.6	58.6	67.4
	Entire Metrolina Region	121,306	28,764	32,378	2,455.6	585.5	666.3
Detailed Study Alternatives A, A1, A2, A3, B, B1, B2, B3 – Toll Facility	Union County Only	10,971	2,543	2,913	238.8	55.2	63.4
	Entire Metrolina Region	121,262	28,752	32,349	2,451.1	584.3	664.5
Detailed Study Alternatives C, C1, C2, C3, D, D1, D2, D3 – Toll Facility	Union County Only	11,503	2,659	3,054	250.8	57.8	66.6
	Entire Metrolina Region	121,221	28,751	32,326	2,450.4	584.4	664.0

Source: *VMT/VHT Analysis*, Wilbur Smith Associates, October 2008.

As shown in **Table E-2**, the estimated 2035 daily VMT in Union County is approximately the same (less than one percent difference) for DSAs C, C1, C2, C3, D, D1, D2, and D3 as it would be for the No-Build Alternative. The 2035 daily VMT in Union County is slightly lower (about 4 percent) for DSAs A, A1, A2, A3, B, B1, B2, and B3 than predicted for the No-Build Alternative. These differences between the DSAs and the No-Build Alternative are less than 1 percent when considering the Metrolina region as a whole.

Because the VMT estimate for the No-Build Alternative is slightly higher than or about the same as any of the DSAs, higher levels of regional MSATs are not expected from any of the DSAs compared to the No-Build Alternative. In addition, because the estimated VMT under each of the DSAs are nearly the same, varying by less than five percent when just considering Union County and by less than one percent for the Metrolina region as a whole, it is expected there would be no appreciable difference in overall MSAT emissions among the various DSAs.

Also, regardless of the alternative chosen, 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 that MSAT emissions in the study area are likely to be lower in the future in virtually all locations.

Because of the specific characteristics of the DSAs (i.e. new location roadway), 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. The localized increases in MSAT emissions would likely occur along the new roadway sections that would be built where there are few major roadways and little industry, such as the area east of US 601. 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.

As discussed in **Section 2.3.2.2** of this Draft EIS, schools, hospitals, and community facilities were mapped and avoided where possible in the development of the DSAs. There are three public schools (and no private schools) located near the boundaries of the DSA corridors, as shown in **Figure 3-3**. These are Stallings Elementary School, Sardis Elementary School, and Forest Hills High School. None would be directly impacted by the proposed functional designs in any of the DSAs (**Section 3.2.4**). There are no hospitals or nursing homes within or near the DSA corridors.

In summary, under all DSAs in the design year, it is expected there would be either no change or a slight reduction in MSAT emissions in the immediate area of the project, relative to the No-Build Alternative, due to similar VMT amongst the alternatives. In comparing the DSAs, 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.