3.8 Noise

3.8.1 What is noise?

Noise is "any sound that is undesired or interferes with a person's hearing of something".[58] Noise or sound is a pressure on the eardrum that is measured on a scale from one to one billion. To simplify this scale, engineers and scientists have established a decibel scale (dB) of 1 to 180 through a mathematical process called a logarithm, which is easier to use. The human ear can only hear certain frequencies of noise, so, in order to show only the level or frequencies that can be heard by the human ear, the scale is given an A-weighting, designated by dBA. The scale of 1 to 180 dB provides a range for the sound levels that fall within a human's normal range of hearing for various types of noises. Table 3.25 (page 3-132) provides an overview of several different types of noises and the associated sound level in dBA. The scale provides a better representation of the actual sound levels and how a person would be affected.

Traffic noise, defined as unwanted sound, is associated with highway traffic usually in the form of loud or persistent noises from cars and trucks. Traffic noises are generated from engines, mufflers, and tire contact with the roadway.

3.8.2 How are noise impacts estimated?

Noises affect people differently due to their environment and other various factors. Loud noises such as a car honking would bother most people while they were trying to sleep, while a softer noise during the day might bother certain individuals if they were trying to study or concentrate on a difficult task. The FHWA has developed the Noise Abatement Criteria (NAC) to determine how noise from roadway traffic affects the surrounding environment. NAC were developed through noise level studies, determinations of land uses, and various types of daily activities. A table was developed from these analyses for determining what dBA levels would disturb people during various activities and at various locations. When dBA levels reach the point that it creates a disruption for an activity, it is considered an impact.

The NAC separates land uses into five categories, which are grouped by the type of activity and includes how sensitive this activity is to noise (refer to Table 3.26, page 3-133). Only activity categories "B" and "C" were identified within the project study area. However contours were calculated for the first three categories (A, B, C) and were used for analysis since they compare exterior noises and would provide a planning tool for future development within the area.

[58] *Webster's New Collegiate Dictionary* (Springfield, Massachusetts:G&C Merriam Company, 1975)

Table 3.25
Common Noises and dBA Levels

Outdoor Noise	dBA	Indoor Noise
	110	rock band at 16.4 feet
jet flyover at 984.3 feet		
pneumatic hammer	100	subway train
gas lawn mower at 3.3 feet		
	90	
downtown area of large city	80	garbage disposal at 3.3 feet
		shouting at 3.3 feet
lawn mower at 6.6 feet	70	
commercial area		normal speech at 3.3 feet
air conditioning unit	60	clothes dryer at 3.3 feet
babbling brook		large business office
quiet urban area during the daytime	50	dishwasher in the next room
quiet urban area during the nighttime	40	library
	30	
	20	
	10	
		threshold of hearing
	0	

Source: National Institute on Deafness and Other Communication Disorders, 2007.

3.8.3 How was background noise determined in the project study area?

Potential sources of background noise include cars, trucks, farm equipment, and trains. An established network of roadways already exists throughout the project study area and, as a result, background traffic noises exist. Existing traffic and background noises were measured at 12 locations within the project study area using a noise measurement device, known as a dosimeter. Validation sites were chosen using several criteria including proximity to existing roadways, proximity to the proposed Build Alternative, and land uses (i.e. commercial and residential) within the project study area. The time and resources it would take to provide existing noise level readings for each receptor in the project study area would be very expensive. The FHWA-developed Traffic Noise Model (TNM) was used to take into account the factors from current

Table 3.26
FHWA Noise Abatement Criteria

Activity Category	dBA	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in categories A or B above.
D	-	Undeveloped lands
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: FHWA, Noise Policy FAQs Website, 2007.

and future traffic volumes and composition, topography, buildings, and roadways. The three-dimensional model calculates noise levels for an entire area and can predict both existing and future noise levels using various criteria and information included in the model.

3.8.4 How was TNM tested to ensure accuracy?

The model was tested to ensure that it was accurately predicting noise levels for the project study area. To test the model, existing noise levels were predicted using existing traffic data and were compared to the same locations where ambient noise levels were measured in the field. The comparisons of these measurements determined the accuracy of the model and are shown in Table 3.27 (page 3-134). In most cases, the predicted noise levels were slightly higher than those taken in the field. There were a few locations where the existing noise levels were higher than the predicted noise levels. Additional background noises were noted at these locations. On average, the TNM estimated noise levels were approximately one dBA higher than what was measured in the field. Generally, it would take at least a five dBA difference for the human ear to perceive a difference in sound in most exterior environments. Due to this, the TNM should accurately predict noise levels within one dBA or slightly higher than what should occur, which is a reasonable margin of variation.

Table 3.27
Ambient Noise Levels

Site	Location	Field Measured Noise Level (dBA)	TNM Predicted Noise Level (dBA)	Difference (TNM minus Field Measurement)	Comments
1	U.S. Route15	47	47	0	
2	U.S. Route15	60.1	61.7	1.6	
3	S.C. Route 38	58.3	60.2	1.9	
4	S.C. Route 381	51.6	50.9	-0.7	Dogs barking
5	S.C. Route 9	55.8	57.6	1.8	
6	S.C. Route 9	55.1	57.5	2.4	
7	S.C. Route 79	56.4	56.7	0.3	
8	S.C. Route 9	62.3	62.4	0.1	
9	S.C. Route 38	69.2	68.7	-0.5	Loud truck turning next to microphone
10	S.C. Route 9	65.1	65.3	0.2	
11	S.C. Route 38	57.5	59.1	1.6	
12	U.S. Route15	67.1	67.2	0.1	

A noise analysis was performed for the project study area and completed in accordance to FHWA's 23 CFR §772.15 *Procedures for Abatement of Highway Traffic Noise and Construction Noise*. Noise impacts from roadway traffic can occur in two ways. When noise levels approach, (within one dBA of the NAC for each land use category), or meet or exceed the NAC, then it would be considered to impact a receptor. The second type of noise impact would occur when there has been a substantial increase (by 15 dBA or greater) in the future noise levels as compared to existing levels.

To assume a worst case scenario, peak hour traffic volumes for 2005 and 2030 were used for the model. Table 3.28 presents the Noise Model inputs used for speed and vehicle mix for the various roadways in the study area. Noise levels were predicted for all of the Build Alternatives, including the No-build Alternative, and compared to the NAC and existing noise levels to determine if potential impacts were anticipated.

Because of the size of the project study area, locations were picked throughout to provide a uniform representation of sound levels and the potential areas that could be impacted. These sites were chosen because of their distance to the existing and proposed roadways and the types of land uses

Table 3.28
Noise Model Vehicular Data

Route	Speed (mph)	Automobiles (percent)	Medium Trucks (percent)	Heavy Trucks (percent)
I-95	70	72	4	24
I-73	70	91	3	6
U.S. Routes	55	90	4	6
State & Local	55	94	3	3

at each of the locations. TNM was used to develop NAC contours for the existing road networks under Existing, Future No-build, and future Build Conditions. For the Future Build Condition, it was assumed I-73 was constructed and traffic conditions on local routes may have been affected. A worse case scenario is presented for the 2030 Build Condition in Table 3.29 (page 3-136). In some cases, local routes at a few locations may see small increases in traffic because of vehicles accessing I-73 and therefore, would experience more noise. The majority of the other local routes would see a decrease in traffic due to I-73 and these locations would experience less noise. The approximate distances to the different land use categories in the NAC are shown above in Table 3.29 (page 3-136).

Table 3.30 (page 3-137) compares the approximate distances to the NAC land use categories along the Build Alternatives.

3.8.5 What are the anticipated noise impacts for the Build Alternatives?

In order to analyze and compare specific categories of noise impacts associated with the three Build Alternatives, contour distances were extrapolated from the TNM model and applied to detailed GIS land use data and structural information for the project study area. This provided the ability to calculate the number and types of structures that fell within the contours associated with each NAC category for each of the Build Alternatives. The two contours of concern are the 66 dBA contour (Category B) and the 71 dBA contour (Category C); no Category A receivers were identified adjacent to the Build Alternatives. The GIS analysis, summarized in Table 3.31 (page 3-138), provided a more detailed picture as to where impacts are located along the Build Alternatives and are shown on Figure 3-37 (page 3-139).

Construction Impacts

Areas along the Build Alternatives could be affected by noise generated from various construction activities. The major construction elements of this project are expected to be earth moving, hauling, grading, and paving. General construction noise impacts to individuals living or working

Table 3.29
Approximate Distance to NAC Contours
For Existing, Future No-Build, Future Build

Roadway	A (56 dBA) (feet)	B (66 dBA) (feet)	C (71 dBA) (feet)
I-95			
Existing (2006)	1,300	380	220
No-build (2030)	1,350	410	230
Build (2030)	1,400	440	250
S.C. ROUTE 79			
Existing (2006)	82	18	10
No-build (2030)	141	40	13
Build (2030)	216	51	16
U.S. ROUTE 15			
Existing (2006)	275	69	12
No-build (2030)	287	95	50
Build (2030)	256	82	31
S.C. ROUTE 381			
Existing (2006)	62	13	N/A
No-build (2030)	94	22	N/A
Build (2030)	150	33	14
S.C. ROUTE 9 (North of S.C. Route 385)			
Existing (2006)	74	34	16
No-build (2030)	236	70	43
Build (2030)	292	70	45
S.C. ROUTE 9 (South of S.C. Route 385)			
Existing (2006)	139	39	15
No-build (2030)	239	93	14
Build (2030)	239	93	14
S.C. ROUTE 38			
Existing (2006)	177	62	16
No-build (2030)	286	68	44
Build (2030)	216	61	27

near the project would be expected, particularly from noise generated by paving operations and from earth moving equipment. Overall, construction noise impacts are expected to be minimal since construction noise would be relatively short in duration and could be restricted to daytime hours.

Table 3.30
Approximate Distance to NAC Contour (feet)

Location	Alternative 1	Alternative 2 (Preferred)	Alternative 3
I-74 to S.C. Route 79			
A (56 dBA)	545	530	580
B (66 dBA)	155	160	155
C (71 dBA)	75	85	75
S.C. Route 79 to U.S. Route 15			
A (56 dBA)	545	545	560
B (66 dBA)	165	160	165
C (71 dBA)	90	90	90
U.S. Route 15 to S.C. Route 381			
A (56 dBA)	580	580	580
B (66 dBA)	170	175	170
C (71 dBA)	95	95	95
S.C. Route 381 to S.C. Route 34			
A (56 dBA)	580	580	560
B (66 dBA)	170	165	170
C (71 dBA)	95	85	95
S.C. Route 34 to I-95			
A (56 dBA)	550	560	545
B (66 dBA)	165	175	165
C (71 dBA)	95	95	95

3.8.6 What happens when impacts occur and can impacts be mitigated?

When traffic noise impacts occur, analysis of noise abatement measures must be completed to determine if noise impacts can be mitigated. Methods used to reduce noise levels must be practicable to build, as well as cost effective. Methods cannot be used if they are determined to be unsafe to construct or if the methods are too costly when compared to the benefits.

Due to the rural setting of the project study area, areas of high density development and residential areas were avoided to the extent possible during the development of the Build Alternatives. The avoidance of developed areas has reduced the number of potentially impacted receivers. The following noise abatement measures were evaluated for areas with the highest potential for noise impacts to determine the feasibility and reasonableness of their implementation.

Table 3.31
Noise Impacts Based on GIS Analysis

Alternatives	Commercial	Residential	Other	Total
Alternative 1				
66 dBA	0	6	0	
71 dBA	0	0	0	
Total	0	6	0	6
Alternative 2				
66 dBA	0	3	0	
71 dBA	0	0	0	
Total	0	3	0	3
Alternative 3				
66 dBA	0	2	0	
71 dBA	0	0	0	
Total	0	2	0	2

3.8.6.1 No-build Alternative

This noise abatement measure would involve not constructing the project. The No-Build Alternative would have no impacts associated with the construction of I-73. However, this measure would not satisfy the purpose and need for the project.

3.8.6.2 Highway Alignment

Highway alignment selection involves the horizontal or vertical orientation of the proposed project in such a way as to minimize impacts and costs. The selection of Build Alternatives for noise abatement purposes must consider the balance between noise impacts and other engineering and environmental parameters. For noise abatement, a horizontal alignment selection is primarily a matter of placing the roadway at a sufficient distance from noise sensitive areas. As stated above, this method was used during the development of Build Alternatives and has been implemented throughout the entire process.

3.8.6.3 Traffic System Management Measures

Traffic management measures that limit vehicle type, speed, volume and time of operations are often effective noise abatement measures. However, an interstate facility design is generally not conducive to limiting vehicles' use, type and speed. An interstate consists of a controlled access roadway designed to move traffic from point A to point B in a safe and effective manner. Limiting one or all of the above variables not only reduces the effectiveness of the facility, but may also create an unsafe roadway environment. For this project, traffic management measures are not considered appropriate for noise abatement due to their limiting effect on the capacity, level-of-service, and safety of the proposed project.

3.8.6.4 Noise Barriers

Noise barriers involve constructing solid barriers to effectively diffract, absorb, and/or reflect highway traffic noise, which may include earth berms and/or noise walls. The evaluation of the

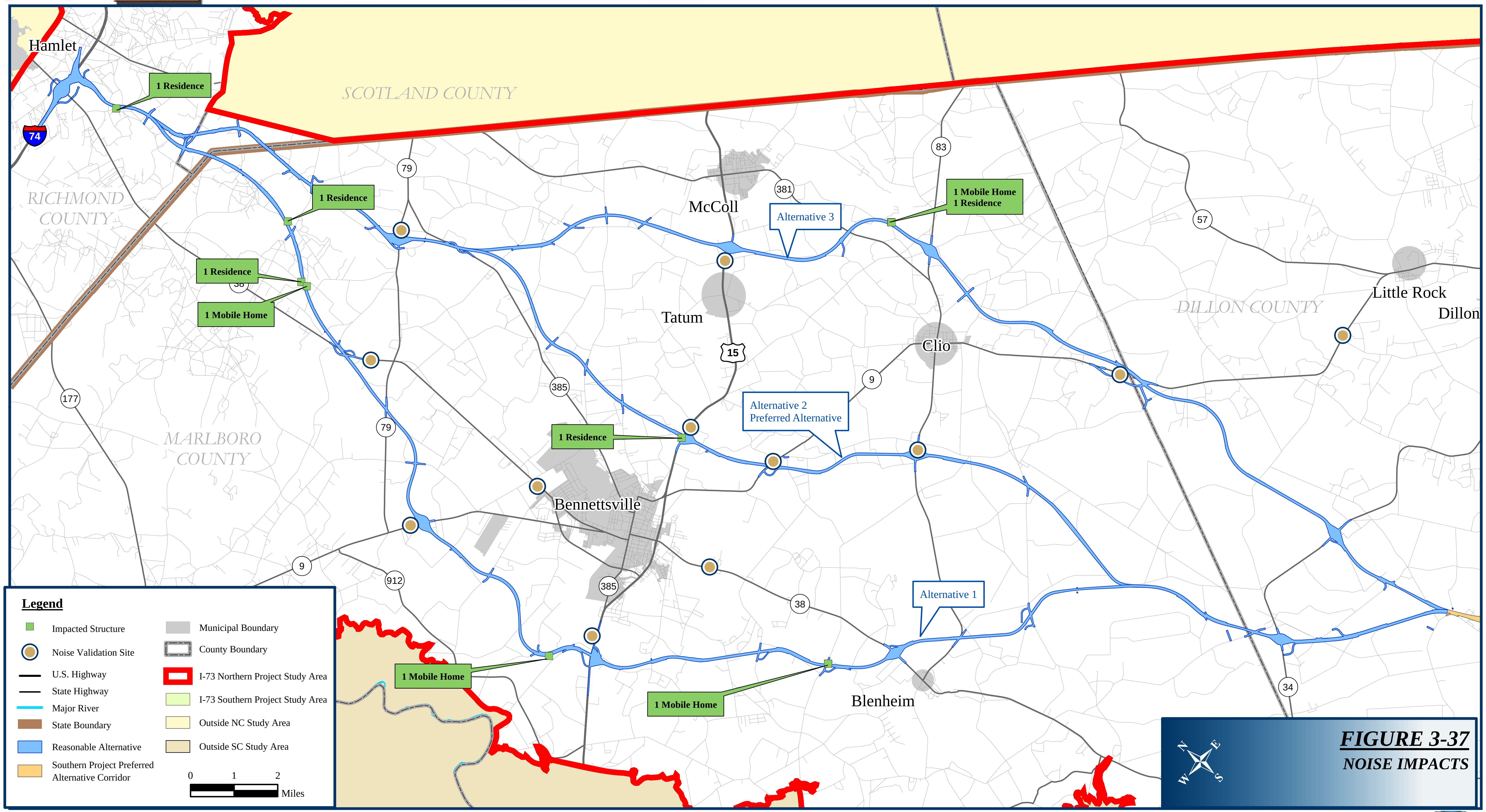

FIGURE 3-37
NOISE IMPACTS

reasonableness and feasibility of noise wall construction is based on many factors, some of which include the following:

- constructability;
- cost;
- height;
- anticipated noise increase/decrease;
- noise reduction obtained;
- number of receptors benefited;
- residents' views;
- land use type; and,
- whether land use changes are expected.

The SCDOT noise abatement criteria states that a noise barrier should cost no more than $25,000 per benefited receptor and NCDOT allows a cost of $35,000 per benefited receptor. In addition, if a noise wall is constructed, the wall cannot be higher than 25 feet based on specifications by SCDOT, NCDOT, and FHWA. A benefited receiver is defined as one that achieves a five dBA reduction in noise, whether that receptor was impacted or not. The SCDOT and NCDOT have both determined that the cost of abatement for isolated receptors compared to the benefits provided is cost prohibited.

Development within the project study area is sparse and the Build Alternatives chosen were located well away from the more highly developed areas, thereby further reducing the number of impacted noise receivers. Noise impacts associated with all of the Build Alternatives consisted of isolated areas of one to two impacted residential structures.

Of the Build Alternatives, only Alternative 1 had an impact density of residential structures high enough to warrant a barrier analysis. A construction cost of $20 a square foot was used for the cost analysis. The cost of the benefited receptors was calculated by dividing the cost of the noise wall by the number of receptors benefited by the wall. Based on preliminary analysis, the noise barrier at this location was found not to be reasonable based on cost per benefited receptor ($53,000 per benefited receiver).

3.9 Air Quality

3.9.1 How is air quality measured?

The USEPA established the National Ambient Air Quality Standards (NAAQS) for atmospheric pollutants that are considered harmful to public health in accordance with *The Clean Air Act of 1970* (CAA, as amended). The SCDHEC Bureau of Air Quality and NCDENR Division of Air Quality are responsible for regulating and ensuring compliance with the Clean Air Act in South Carolina and North Carolina respectively.

The criteria pollutants that are measured under NAAQS are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.[59] In Table 3.32, these pollutants are listed, along with their attainment standards, description, sources, and the potential effects they may have on human health. Transportation projects only contribute to four of the six criteria pollutants listed: ozone, carbon monoxide, particulate matter, and nitrogen dioxide.[60]

The United States is divided into geographical areas that are classified as either in nonattainment or attainment for air quality. If an area has exceeded the NAAQS levels for any of the six criteria pollutants, then it is in nonattainment. In these areas, the USEPA requires states to develop a State Implementation Plan to address regional goals for attaining NAAQS. Each plan includes measures to reduce transportation pollutant emissions. Geographic areas that have all six criteria pollutants below NAAQS are considered to be in attainment. All four counties in the project study area are considered to be in attainment for the 8-hour NAAQS for ground level ozone. These four counties are also shown to be in attainment for 2.5 particulate matter standards established by USEPA in July 1997. The four-county area is currently in attainment of the NAAQS standards.

3.9.2 What are the potential air quality issues associated with a transportation project?

In 1997, the USEPA determined that the 1-hour "peak" NAAQS for ground-level ozone was not adequately protecting human health and changed it to an 8-hour average standard of 0.08 parts per million.[61] This 8-hour standard would be phased in, and once an area has reached this standard for three years, it would no longer use the 1-hour standard. However, if geographical areas were already meeting the 1-hour standard, they could voluntarily enter into an Early Action Compact with the USEPA through their State Implementation Plan to set milestones to meet the more stringent

[59] USEPA, National Ambient Air Quality Standards Webpage, http://www.epa.gov/ttn/naaqs/ (December 15, 2006).

[60] FHWA, "Air Quality Planning for Transportation Officials," http://www.fhwa.dot.gov/environment/aqplan/index.htm (December 15, 2006).

[61] USEPA, USEPA's Revised Ozone Standards, http://www.epa.gov/ttn/oarpg/naaqsfin/o3fact.html (December 15, 2006).

Table 3.32
Criteria Pollutants Measured Under the NAAQS

Pollutant	Standard				Description	Possible Effects to Human Health
	Averaging Time	ppm†	µg/m³*	Type of standard¥		
Carbon monoxide	1 hour 8 hours	35 9	40,000 10,000	Primary Primary	Carbon monoxide forms when carbon is not completely burned in fuel. It is an odorless and colorless gas that is mainly formed from vehicle exhaust.	Breathing carbon monoxide reduces the body's ability to deliver oxygen to vital organs in the body. It can affect the heart, lungs, and central nervous system. Inhaled in high amounts, it can cause poisoning or death.
Lead	1 quarter	-	1.5	Primary & Secondary	Lead is usually released into the environment as a result of processing metals. Utilities, waste incinerators, and lead-acid battery manufacturers are sources of lead.	Lead can cause damage to major organs such as the brain, liver, and kidneys. It can cause seizures, mental disorders, reproductive problems, high blood pressure, anemia, and osteoporosis.
Nitrogen dioxide	1 year	0.053	100	Primary & Secondary	Nitrogen dioxide is an odorless and colorless gas that comes from various sources such as vehicle, industrial, and utility emissions.	It is a component of ozone, which causes numerous respiratory problems.
Ozone	8 hours	0.08	157	Primary & Secondary	Ozone is created when nitrogen oxide compounds mix with volatile organic compounds in the presence of sunlight. Sources of the compounds creating ozone include vehicle and industrial emissions, gasoline vapors, and chemical solvents.	Ozone causes respiratory problems such as decreased lung function, asthma, wheezing, coughing, pain when breathing, and higher susceptibility to respiratory illnesses such as pneumonia and bronchitis.
Particulate Matter diameter less than/equal to 10 µm	24 hours 1 year	- -	150 50	Primary & Secondary Primary & Secondary	Particulate matter forms when small solid particles combine with liquid droplets to form dust, dirt, haze, soot, or smoke. These can be emitted from primary sources such as unpaved roads, construction sites, fields, or smokestacks. They can also be emitted as a result of secondary reactions of gases released from automobiles and industrial plants.	Particulate matter causes a variety of respiratory problems, from asthma and bronchitis, to decreased lung capacity and function. If particulate matter is very small, it can be transferred to the cardiovascular system and cause irregular heartbeat and even non-fatal heart attacks.
Particulate Matter diameter less than/equal to 25 µm	24 hours 1 year	- -	65 15	Primary & Secondary Primary & Secondary		
Sulfur oxides	3 hours 24 hours 1 year	0.50 0.14 0.03	1,300 365 80	Secondary Primary Primary	Sulfur dioxide is formed when fuel such as coal and oil is burned and sulfur is released into the atmosphere and mixes with oxygen. Main sources of sulfur dioxide include fuel burning utility plants, petroleum refineries, large ships and locomotives, and metals processing plants.	Sulfur dioxide can cause respiratory illnesses such as asthma, decreased lung function, and susceptibility to other illnesses such as pneumonia and bronchitis. It can also aggravate existing heart diseases.

†ppm = parts per million. * µg/m³ = micrograms per cubic meter. ¥ Primary standards are set to protect public health. Secondary standards are designed to protect public welfare. Source: USEPA, Air and Radiation Section, http://www.epa.gov/air/criteria.html Last accessed March 16, 2006.

8-hour standard. As long as these areas worked to reach milestones set in the compact, then the USEPA would defer requiring the ozone 8-hour average standard. Once the USEPA approved these compacts, and the milestones were reached, these areas would receive deferrals from the 8-hour average standard.

In 2004, SCDHEC and NCDENR submitted Early Action Compact State Implementation Plans, including Early Action Compacts for implementing measures to attain the 8-hour average standard. Early Action Compacts in South Carolina were submitted for the majority of the counties in both attainment and nonattainment areas, including Dillon and Marlboro Counties. North Carolina submitted Early Action Compacts only for areas that were designated as nonattainment for NAAQS. Since Richmond and Scotland Counties are in attainment, Early Action Compacts were not submitted.

There are no monitoring stations within the project study area; however, there are three monitoring stations in counties surrounding the project study area. South Carolina has two sites: the Pee Dee station located in Darlington, South Carolina and monitors for ozone, and the Chesterfield station located in McBee, South Carolina, which monitors for ozone and particulate matter. Neither station has exceeded the 8-hour standard for ozone in the past three years. The Candor Station is located in Candor, North Carolina and monitors for particulate matter. Data from this station show that the three-year average for particulate matter is below the established standards.

As part of the Early Action Compact State Implementation Plan in South Carolina, transportation conformity is not required. However, through interagency meetings, air quality and transportation officials agreed on the importance of considering air quality goals in transportation planning. As a result, FHWA, Federal Transit Authority, and SCDOT met with SCDHEC, USEPA, as well as local Councils of Governments to sign a memorandum of agreement outlining consultation procedures for transportation conformity. In addition, a Smart Highways Checklist was to be used when developing Long Range Transportation Plans and Transportation Improvement Programs. The Smart Highways Checklist would help meet state and federal air quality standards, as well as goals set forth in the Early Action Compacts.[62]

With the approval of the 2004 State Implementation Plan revision, when an area in South Carolina is deemed in nonattainment, it is then required to implement transportation conformity and the necessary consultation procedures, outlined in the memorandum of agreement. Areas in South Carolina that were designated nonattainment for the 8-hour ozone standard, but had the effective date of the designation deferred as a result of the Early Action Compact, are not required to implement transportation conformity.

[62] SCDHEC, Bureau of Air Quality, "South Carolina Early Action Compact SIP," http://www.scdhec.gov/eqc/baq/html/eap_sip.html (December 15, 2006).

North Carolina Administrative Code 15A NCAC §02D. 2000 entitled *Transportation Conformity*, requires all transportation programs, projects, and plans to conform in areas that are designated as nonattainment or maintenance areas under 40 CFR §81.334.

In addition to the criteria air pollutants for which there are NAAQS, the USEPA also regulates 21 Mobile Source Air Toxics (MSATs),[63] which are a subset of the 188 air toxics defined by the CAA. MSATs are mostly from human made sources, such as 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.

Definition

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.

These MSATs are considered to potentially cause harmful health or environmental effects.[64] Six of these have been identified as priority MSATs, and include benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene.[65]

FHWA has provided interim guidance on addressing MSATs in the NEPA analysis through *Memorandum HEPN-10: Interim Guidance on Air Toxic Analysis in NEPA Documents*.[66] This memorandum is included in Appendix D. While a basic discussion of potential MSAT emission impacts from the proposed project has been addressed, technical resources are not available at this time to determine project-specific health impacts from MSATs associated with the Build Alternatives. Due to the lack of technical resources, a discussion regarding incomplete or unavailable information is provided below, along with FHWA guidance and CEQ guidance in Appendix D (specifically 40 CFR §1502.22(b)).

The USEPA is the lead Federal Agency for administering the *Clean Air Act* and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources. 66 FR 17229 (March 29,

[63] Federal Register, *Control of emissions of Hazardous Air Pollutants from Mobile Sources*, 66 FR 17235.
[64] USEPA, Mobile Source Air Toxics Website, http://www.epa.gov/otaq/toxics.htm (December 8, 2006).
[65] FHWA, *HEPN-10: Interim Guidance on Air Toxic analysis in NEPA Documents,* (February 3, 2006), http://www.fhwa.dot.gov/ENVIRONMENT/airtoxic/020306guidapc.htm (December 8, 2006).
[66] *Ibid*.

2001). This rule was issued under the authority in Section 202 of the *Clean Air Act*. In its rule, USEPA 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 particulate matter emissions by 87 percent (refer to Chart 3.1).

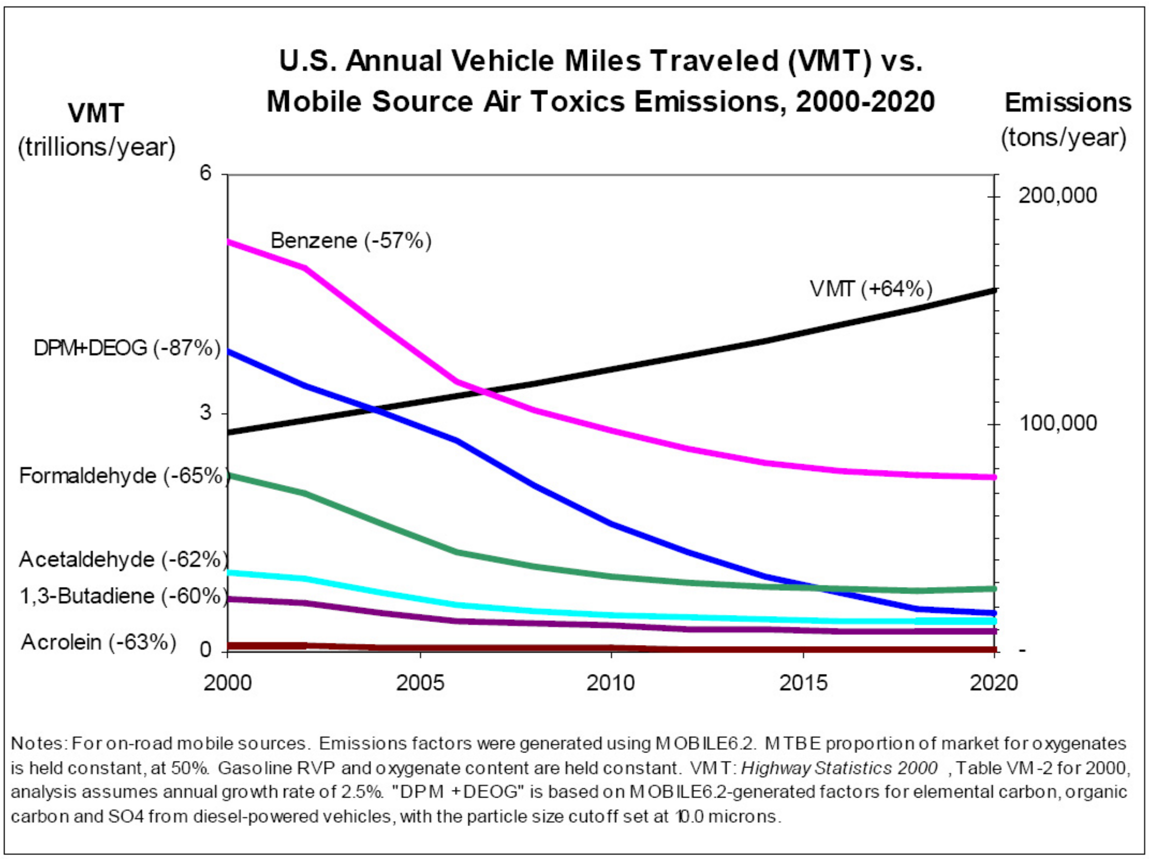

Chart 3.1 U.S. Annual VMT vs. Mobile Source Air Toxics Emissions, 2000 to 2020

Source: FHWA, HEPN-10: Interim Guidance on Air Toxic analysis in NEPA Documents.

As a result, USEPA 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.

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 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 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 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 USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the 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. Research is being conducted 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 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 USEPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. 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 noncancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by USEPA, 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.[67] 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 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."

3.9.3 Would air quality be impacted by the proposed project?

Air quality impacts are not anticipated by the proposed project. In general, the proposed project would improve the flow of heavy truck traffic through this area relieving congestion along existing routes, which would have positive effects on the region's air quality. In addition, both Dillon and Marlboro Counties in South Carolina have entered into Early Action Compacts to set goals for cleaner air. This project also has been included in the both North Carolina and South Carolina's Transportation Infrastructure Programs (STIPs), which are reviewed for air quality compliance. With the Early Action Compacts in place, and standard review of the project as part of the STIPs would increase mobility within this area. In view of the qualitative analysis (see below), the proposed project is not likely to impact air quality in the project study area.

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

Meaningful or reliable estimates of MSAT emissions and effects cannot be determined for the proposed project due to the technical shortcomings of current emission/dispersion models as well as the uncertain science with respect of health effects from MSAT emissions. 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 for the proposed project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the Build 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*.[68]

For each Build Alternative the amount of MSATs emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. Because the VMT (refer to Table 2.13, page 2-38) estimated for the Build Alternatives are similar, it is expected there would be no appreciable difference in overall MSAT emissions among the three Build Alternatives. Regardless of the Build Alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 to 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the project study area are expected to be lower in the future in virtually all cases.

During the development of the Build Alternatives, areas of high density development, communities, neighborhoods, and residential areas were avoided to the extent possible. However, the Build Alternatives would have the effect of moving some traffic closer to nearby homes and businesses; therefore, there may be localized areas where ambient concentrations of MSATs could be higher under the Build Alternatives than the No-build Alternative.

As discussed above, the magnitude and the duration of the potential increases by the Build Alternatives when compared to the No-build Alternative cannot be accurately quantified due to the inherent deficiencies of current models. In summary, when a highway is widened and as a result, moves closer to receptors, the localized level of MSAT emissions for the Build Alternatives may be higher relative to the No-build Alternative, but this may be offset by increases in speed and reduction of congestion (which are associated with lower MSAT emissions). Additionally, MSATs would be lower in other locations when traffic shifts away. On a regional basis, USEPA's vehicle and fuel

[68] Clagett and Miller, *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives,* http://www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm (May 18, 2007).

regulations, coupled with fleet turnover, may cause substantial reductions over time that, in almost all cases, cause region-wide MSAT levels to be lower than today.

Construction Impacts

Air quality impacts may occur during construction due to the dust and fumes from equipment, earthwork activities, and vehicles accessing the construction site. Air quality impacts may also occur from an increase of vehicle emissions from traffic delays due to construction activities. Construction activities could include staging of construction for interchange locations, delivery of equipment and materials, and longer waiting times at traffic signals.

Best management practices that limit dust generation are described in the *South Carolina Stormwater Management and Sediment Control Handbook For Land Disturbance Activities*[69] and *A Guide To Site Development and Best Management Practices For Stormwater Management and Sediment Control.*[70] These methods include vegetative cover, mulch, spray-on adhesive, calcium chloride application, water sprinkling, stone, tillage, wind barriers, and construction of a temporary graveled entrance/exit to the construction site.

In accordance with Section 107.07 of the *South Carolina Highway Department Standard Specifications for Highway Construction,*[71] the contractor would comply with *South Carolina Air Pollution Control Laws, Regulations and Standards*.[72] In addition, for portions of the roadway being built in North Carolina, the contractor would be required to comply with the *North Carolina Air Quality Rules, Policies and Regulations*.[73] The contractor would also comply with county and other local air pollution regulations. Any burning of cleared materials would be conducted in accordance with applicable state and local laws, regulations and ordinances and the regulations of the North Carolina's and South Carolina's State Implementation Plan for air quality, in compliance with South Carolina's Regulation 62.2, *Prohibition of Open Burning* and North Carolina's *Open Burning* Regulation, found in 15A NCAC 02D.1900.

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[69] SCDHEC-OCRM, *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities* (2003), Appendix E.

[70] SCDHEC-OCRM, *A Guide to Site Development and Best Management Practices for Stormwater Management and Sediment Control*.

[71] SCDOT, *Standard Specifications for Highway Construction* (2000).

[72] SCDHEC, Bureau of Air Quality Control, *South Carolina Air Pollution Control Laws, Regulations, and Standards.*

[73] NCDENR, Division of Air Quality, *Air Quality Rules, Policies, and Regulations,* http://daq.state.nc.us/rules/rules/ (January 30, 2007).