The measured average ambient vibration level of 81 VdB with no train present on the track noticeably exceeded the typical background vibration levels in the range from 50 to 60 VdB (FTA 2006). At the time of this measurement, the at-grade crossing was open to street traffic, and the vehicles passing the rail crossing generated additional ground vibration. Further, the vibration measurement was taken on a section of curved track which can greatly increase vibration levels.

The average L_v of 103 VdB measured during the train pass by (with no street traffic moving) markedly exceeded the ambient vibration level at the site. The measurement was taken on a section of curved track and, as the result, is considerably higher than what would be expected for a straight-line track due to the rail curvature in the vicinity of the measurement location. Up to three receptors would be located along segments of curved track under Alternatives 2, 3 or 6 (see Section 4.12).

This single monitoring event is not sufficient to determine a general baseline condition in proximity to the freight rail tracks, but demonstrates the worst-case scenario due to the measurement location near a curved track, where the highest noise and vibration levels are generated. The rail noise and vibration impact analyses described in Section 4.12 are based on the modeling rather than measurement results and are not affected by the limited monitoring data.

3.13 AIR QUALITY

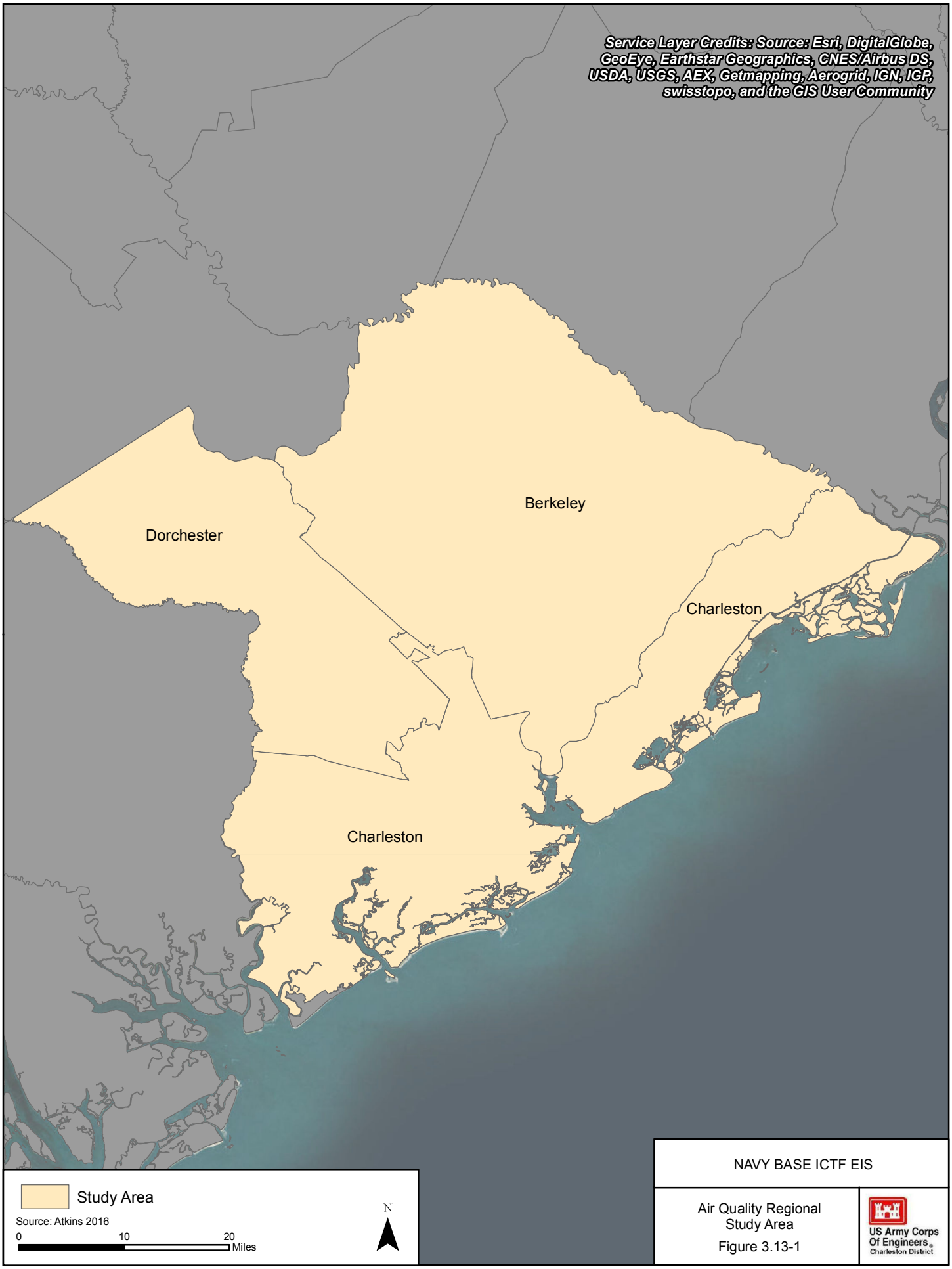
3.13.1 Existing Conditions

Air quality impacts have the potential to affect both the local area as well as having a regional impact. Due to pollution, transport areas outside of the immediate vicinity of the Project site could be negatively affected by any proposed project. The regional study area for air quality is represented by the Tri-County area of South Carolina, which consists of Charleston, Berkeley, and Dorchester counties (Figure 3.13-1). This area is located in the southeastern area of South Carolina and is bordered by the Atlantic Ocean on its southeastern side.

3.13.1.1 Air Resources

Air quality in a given location is described as the concentration of various pollutants in the atmosphere. Air quality is determined by several factors; including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

This section describes existing air quality conditions. Topics discussed in this section include climatology, air resource management, National Ambient Air Quality Standards (NAAQS), and local air quality of the Project site. More detailed discussions of existing air quality conditions are included in Appendix I.


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Berkeley
Dorchester
Charleston
Charleston
Study Area
Source: Atkins 2016
0
10
20
Miles
N
NAVY BASE ICTF EIS
Air Quality Regional Study Area
Figure 3.13-1
US Army Corps Of Engineers
Charleston District

3.13.1.2 Climatology

The regional study area is low in elevation and has many rivers and streams that feed into the Atlantic Ocean through Charleston Harbor. The Project site is in North Charleston, on a peninsula between the Ashley and Cooper Rivers.

The climate is humid subtropical, characterized by mild winters and hot, humid summers. January usually demonstrates the lowest annual temperatures, with an average minimum temperature of 36.4 degrees Fahrenheit (°F) and an average temperature of 47.7°F. On average, the warmest month is July, with highs of 90.9°F and an average of 80.5°F. The summer months have the most precipitation, with August on average being the wettest month. Average precipitation in August is 5.88 inches and winters have mild precipitation varying around 3 inches each month (NOAA 2016c). Snowfall is rare, occurring every few years with an average of less than 1 inch annually (SERCC 2012).

Wind patterns in South Carolina are largely influenced by the Atlantic Ocean to the east and the Appalachian and Blue Ridge Mountains to the west. Average surface wind speeds range between 6 and 10 mph. Wind direction varies seasonally. In the winter months, as cyclones move around the mountains, the winds are from the southwest. As they move over the Atlantic, the wind direction shifts to northeast. Winds in the spring are southwest on average. In the summer months, air flows from the Gulf of Mexico yielding south and southwestern winds. In autumn, a continental high-pressure pattern fosters northeast winds (SCDNR 2010).

3.13.2 Air Pollutants and Criteria

Presented below is a description of each of the criteria air pollutants for which a NAAQS has been established, and their known health effects. The South Carolina Ambient Air Quality Standards (SCAAQS) are the same as the NAAQS (Table 3.13-1); therefore, any standard that is met for the NAAQS will also meet the SCAAQS. All references to ambient air quality standards hereafter in this document will be to the NAAQS. In addition, diesel particulate matter (DPM) is described, which is a Hazardous Air Pollutant (HAP).

Ozone (O_3) is one of a number of substances called photochemical oxidants that are formed when volatile organic compounds (VOC) and nitrogen oxide (NO_X), react with sunlight and are by-products of the internal combustion engine. The damaging effects of photochemical smog are generally related to the concentrations of ozone. Ozone may pose a health threat to those who already suffer from respiratory diseases as well as to healthy individuals. Breathing ozone can trigger a variety of health problems, including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Additionally, ozone has been tied to crop damage, typically in the form of stunted growth and premature death. Ozone can also act as a corrosive, resulting in property damage such as the embitterment of rubber products (EPA 2015a).

Table 3.13-1
National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Average Time	Level	Form
Carbon Monoxide		Primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide		Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		Primary and Secondary	Annual	53 ppb	Annual Mean
Ozone		Primary and Secondary	8-hour	0.070 ppm	Annual fourth-highest daily max 8-hour concentration, averaged over 3 years
Particle Pollution	***$PM_{2.5}$***	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
		Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
		Primary and Secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		Primary	1-hour	75 ppb	99th percentile of 1-hour daily max concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: EPA 2016.
µg/m^3 = micrograms per cubic meter
ppm = parts per million
ppb = parts per billion

Carbon Monoxide (CO) is a colorless, odorless gas produced by the incomplete combustion of fuels. Because CO is emitted directly from internal combustion engines, unlike ozone, motor vehicles operating at slow speeds are the primary source of CO in North Charleston. Therefore the highest ambient CO concentrations are generally found near congested transportation corridors and intersections. The primary adverse health effect associated with CO is the interference of normal oxygen transfer to the blood, which may result in tissue oxygen deprivation (EPA 2015b).

Respirable Particulate Matter (PM_{10}) and **Fine Particulate Matter ($PM_{2.5}$)** consist of extremely small, suspended particles or droplets 10 microns and 2.5 microns or smaller in diameter, respectively. Some sources of particulate matter, like pollen and windstorms, are naturally occurring; however, in populated areas, most particulate matter is caused by road dust, diesel soot, and combustion products, abrasion of tires and brakes, and construction activities. Both PM_{10} and $PM_{2.5}$ may adversely affect the human respiratory system, especially in those people who are naturally sensitive or susceptible to breathing problems (EPA 2015c).

Nitrogen Dioxide (NO_2) is a by-product of fuel combustion. The principal form of NO_2 produced by combustion is nitrogen oxide (NO). NO reacts with oxygen in the air to form NO_2, creating the mixture of NO and NO_2 commonly called NO_X. Other oxides of nitrogen, including nitrous acid and nitric acid, are part of the nitrogen oxide family. While EPA's NAAQS covers this entire family, NO_2 is the component of greatest interest and the indicator for the larger group of nitrogen oxides. Current scientific evidence links short-term NO_2 exposures, ranging from 30 minutes to 24 hours, with adverse respiratory effects, including airway inflammation in healthy people and increased respiratory symptoms in people with asthma. Also, studies show a connection between breathing elevated short-term NO_2 concentrations and increased visits to emergency departments and hospital admissions for respiratory issues, especially asthma (EPA 2015d).

Sulfur dioxide (SO_2) is a colorless, pungent gas. At levels greater than 0.5 parts per million (ppm), the gas has a strong odor, similar to rotten eggs. It enters the atmosphere as a pollutant mainly as a result of burning high sulfur content fuel oils and coal, and from chemical processes occurring at chemical plants and refineries. Sulfuric acid is formed from SO_2, which is an aerosol particle component that may lead to acid deposition. Acid rain deposition into water, vegetation, soil, or other materials can harm natural resources and materials. Sulfur oxides (SO_X) include SO_2 and sulfur trioxide (SO_3). Although SO_2 concentrations have been reduced to levels well below state and national standards, further reductions are desirable because SO_2 is a precursor to sulfates. Sulfates are a particulate formed through the photochemical oxidation of SO_2. Long-term exposure to high levels of SO_2 can cause irritation of existing cardiovascular disease, respiratory illness, and changes in the defenses in the lungs. When people with asthma are exposed to high levels of SO_2 for short periods of time during moderate activity, effects may include wheezing, chest tightness, or shortness of breath (EPA 2015e).

Lead (Pb) occurs in the atmosphere as particulate matter. The major sources of lead emissions have historically been from the combustion of leaded gasoline in on-road motor vehicles and from industrial sources. The use of leaded gasoline is no longer permitted for on-road motor vehicles and airborne lead has significantly declined. Other sources of lead include the manufacturing and recycling of batteries, paint, ink, ceramics, ammunition, and secondary lead smelters. Lead accumulates in bones, soft tissue, and blood, and can affect the kidneys, liver, and nervous system. The more serious effects of lead poisoning include behavior disorders, mental retardation, and

neurological impairment. Low levels of lead in fetuses and young children can result in nervous system damage, which can cause learning deficiencies and low intelligence quotients. Lead may also contribute to high blood pressure and heart disease (EPA 2015f). The Proposed Project will not emit lead; therefore, lead is eliminated from further review in this analysis.

Volatile Organic Compounds (VOCs) are defined as any compound of carbon, excluding CO, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Common sources of VOCs are on-road motor vehicles and solvent evaporation. Although health-based standards have not been established for VOCs, health effects can occur from exposures to high concentrations because of interference with oxygen uptake. In general, higher concentrations of VOCs are suspected to cause eye, nose, and throat irritation; headaches; loss of coordination; nausea; and damage to the liver, kidneys, and central nervous system (EPA 1999a). It should be noted that there are no NAAQS for VOCs because they are not classified as criteria pollutants. They are included in this analysis, however, because a reduction in VOC emissions reduces certain chemical reactions that contribute to the formulation of O_3.

Hazardous Air Pollutants (HAPs), also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The EPA is required to control 187 hazardous air pollutants. Examples of HAPs include benzene, which is found in gasoline; perchlor-ethlyene, which is emitted from some dry-cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. One of the HAP anticipated to result from the implementation of the Proposed Project is diesel particulate matter (DPM) (EPA 2015g).

DPM is a mixture of particles that is a component of diesel exhaust (DE). The EPA lists DE as a mobile source air toxic, or HAP, due to the cancer and noncancer health effects associated with exposure to whole DE. Chronic inhalation exposure is likely to pose a lung cancer hazard, as well as damage the lung in other ways depending on exposure, and short-term exposures can cause irritation and inflammatory symptoms of a transient nature (EPA 2002). DPM (expressed as grams of DPM/m^3) has historically been used as a surrogate measure of exposure for whole DE. Although uncertainty exists as to whether DPM is the most appropriate parameter to correlate with human health effects, it is considered a reasonable choice until more definitive information about the mechanisms of toxicity or mode(s) of action of DE becomes available (EPA 2015h).

3.13.2.1 Emission Sources

Ambient air quality is affected by stationary, mobile, and natural sources. Stationary sources can be divided into two major subcategories: point and area sources. Point sources occur at an identified location and are usually associated with manufacturing and industry. Examples are boilers or combustion equipment that produce electricity or generate heat. Area sources are widely distributed and produce many small emissions. Examples of area sources include residential and commercial

water heaters, painting operations, portable generators, lawn mowers, agricultural fields, landfills, and consumer products such as barbeque lighter fluid and hair spray. Construction activities that create fugitive dust such as excavation and grading also contribute to area source emissions.

Mobile sources refer to emissions from on- and off-road motor vehicles, including tailpipe and evaporative emissions. On-road sources may be legally operated on roadways and highways. Off-road mobile sources include aircraft, trains, and construction equipment. Natural sources refer to emissions from naturally occurring sources or event in nature, such as wildfires and volcanic eruptions (EPA 2015i).

3.13.2.2 Local Air Quality

North Charleston and the Tri-County area are highly industrialized and have many mobile sources contributing to air pollution, including trucks, cars, trains, and OGVs (ocean going vessels) from the Port and other port facilities. O_3 levels in North Charleston are relatively high due to the industrial and mobile sources of the area. The primary source of CO is motor vehicles operating at slow speeds. The primary source of particulate matter is mobile sources. Fuel combustion is the primary source of NO_2. The primary source of SO_2 is from OGVs in the ports (SCPA 2013).

South Carolina has many air monitors placed throughout the state to measure and record the existing conditions of the local air quality. For each criteria pollutant, the ambient air quality monitored nearest to the Project site is reported in Table 3.13-2. The nearest monitoring station is the Jenkins Avenue station, which is 1.6 miles from the Project site, and monitors Pb, NO_2, PM_{10}, and SO_2. The Cape Romain station is the nearest monitoring station that monitors CO and is approximately 30 miles from the Project site. The Bushy Park station is the nearest monitoring station that monitors O_3 and is approximately 9 miles from the Project site. The nearest monitoring station that monitors $PM_{2.5}$ is the Charleston Public Works (CPW) station and is approximately 4 miles from the Project site. Areas that meet the NAAQS are classified as "attainment" areas, while areas that do not meet these standards are classified as "non-attainment" areas. The severity of the classifications for non-attainment range in magnitude from: marginal, moderate, serious, severe, and extreme. All criteria pollutants for Berkeley, Charleston, and Dorchester Counties are in attainment of the NAAQS and the SCAAQS (EPA 2015j).

DPM is not directly measured by the EPA or state monitoring sites; however, the size of diesel particulates that are of greatest health concern are those that are in the categories of fine and ultra-fine particles (EPA 2015c). Fine particles, also known as $PM_{2.5}$, are a criteria pollutant and measured in the area. $PM_{2.5}$ measurements are used to assess the DPM emissions near the Project site. Ultra-fine particles are a subset of $PM_{2.5}$ emissions and therefore are included as part of the monitored $PM_{2.5}$ data.

Table 3.13-2
Local Air Quality Monitoring for 2013

Pollutant		Primary/ Secondary	Average Time	Level (Standard)	SCDHEC Monitoring Station	Level (Monitored)
Carbon Monoxide *(1)*		Primary	8-hour	9 ppm	Cape Romain	0.3 ppm
			1-hour	35 ppm	Cape Romain	0.6 ppm
Lead *(2)*		Primary and Secondary	Rolling 3-month average	0.15 µg/m^3	Jenkins Ave	0.01 µg/m^3
Nitrogen Dioxide		Primary	1-hour	100 ppb	Jenkins Ave	36 ppb
		Primary and Secondary	Annual	53 ppb	Jenkins Ave	6.66 ppb
Ozone		Primary and Secondary	8-hour	0.070 ppm	Bushy Park	0.061 ppm
Particle Pollution	***$PM_{2.5}$***	Primary	Annual	12 µg/m^3	CPW	8.2 µg/m^3
		Secondary	Annual	15 µg/m^3	CPW	8.2 µg/m^3
		Primary and Secondary	24-hour	35 µg/m^3	CPW	20 µg/m^3
	PM_{10}	Primary and Secondary	24-hour	150 µg/m^3	Jenkins Ave	42 µg/m^3
Sulfur Dioxide *(3)*		Primary	1-hour	75 ppb	Jenkins Ave	16 ppb
		Secondary	3-hour	0.5 ppm	Jenkins Ave	0.016 ppm

Source: SCDHEC 2015a, b.

µg/m^3 = micrograms per cubic meter

ppm = parts per million

ppb = parts per billion

(1) CO values for 2013 are not available. The values shown here are those taken in 2010, the most recent year CO was monitored in South Carolina.

(2) Lead values were not available for 2013. 2012 data, recorded as a 3-year maximum, was used as a proxy from SCDHEC's Ambient Air Quality Summary for 2012, downQ2ed from http://www.scdhec.gov/HomeAndEnvironment/Air/AmbientAir/.

(3) Three-hour SO_2 values were not available for 2013. 2012 data was used as a proxy from SCDHEC's Ambient Air Quality Summary for 2012, downloaded from http://www.scdhec.gov/HomeAndEnvironment/Air/AmbientAir/.