

Relocation of the Ambient Air Quality Monitoring Station at Congaree Swamp National Monument

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Introduction

The primary focus of this plan is to relocate the current ambient air quality monitoring station from its existing location in the Wise Lake area of Congaree Swamp National Monument. In relocating the ambient air quality station it is desirable to compare data collected at the old and new locations. Data comparability will be verified by simultaneously operating certain existing instrumentation at the Wise Lake station with the new monitoring station that will be located near Dawson Cabin. The ambient air quality monitoring relocation plan for Congaree Swamp National Monument is designed primarily to gather baseline air quality information, identify air pollution source regions, and meet Environmental Protection Agency (EPA) National Ambient Air Quality Standards. The park's Resource Management Plan guides the overall management of cultural and natural resources with the park. This ambient air quality monitoring relocation plan is an action plan in response to problems identified in the Resource Management Plan.

Background

Congaree Swamp National Monument was authorized by an act of Congress on October 18, 1976. The 22,200 acre park contains a significant tract of old-growth bottomland hardwood forest lying within a portion of the Congaree River floodplain. In 1983, the United Nations Educational, Scientific and Cultural Organization designated the park as an International Biosphere Reserve. On October 24, 1988, 15,000 acres of Congaree Swamp National Monument was designated as Wilderness. Congaree Swamp National Monument is designated as a Class II Floor Area under the Clean Air Act, as amended in 1977, and 1990, by recommendation of the U.S. Department of the Interior (Federal Register 43002 June 25, 1980). The Class II Floor Area designation allows for re-designation to Class I and may not be re-designated to Class III.

The significance of Congaree Swamp NM lies in: (1) it's unique bottomland hardwood forest community associated with the swamp-like floodplain, with visible former river courses reflected in its topography and vegetative patterns, (2) the remarkable size of its loblolly pine, bald cypress, tupelo, sweetgum, sycamore, cottonwood, oak, and holly trees, not in diameter, but especially in height; and (3) the presence of a swamp ecology of the hardwood-type, with relatively unspoiled fauna.

The South Carolina Department of Health and Environmental Control (SCDHEC) has operated an ambient air quality monitoring station in the Wise Lake area of Congaree Swamp National Monument since 1981. The station measures ozone, sulfur dioxide, nitrogen dioxide, mercury (precipitation and ambient), particulate matter (total suspended particulates and particulate matter less than 10 microns), and precipitation chemistry. The SCDHEC performs: routine weekly station visits, instrument maintenance, data validation, data reporting, instrument calibrations, and periodic performance and system audits.

The current Wise Lake ambient air quality monitoring station is located in a designated wilderness area of the park. Monitoring was started prior to International Biosphere Reserve and wilderness designations which now preclude modifications or improvements to the Wise Lake station. The monitoring shelter and associated instrumentation are constructed on approximately 10 to 12 foot stilts to accommodate periodic flooding of the Congaree River. During periods of flooding the site is only accessible by boat. Electrical service is provided by buried cable, however, when the line eventually fails will not be repaired because of wilderness designation. The station has limited and unreliable telephone service by cellular connection. Meteorological measurements are not made at the station which hinders regional analysis of source regions impacting park resources. The Wise Lake site marginally meets EPA siting criteria and modifications would be needed at the site to correct this situation, e.g., installation of a new shelter, moving the shelter away from the tree line.

Park Air Quality Related Values

Air quality related values (AQRVs) monitoring specific to air pollution effects is not currently performed at the park. The continued collection of baseline ambient air quality data is needed for future research efforts that may be proposed. AQRVs are the key indicator for air pollution effects in the park. AQRVs are defined as those park values which are dependent upon and affected by changes in air quality. AQRVs can include visibility, and scenic, cultural, biological, and recreational resources. Congaree Swamp National Monument resources that may be adversely affected by changes in air quality include archeological objects and resources, visibility, vegetation, wildlife, water quality, and soils.

Monitoring AQRVs may involve any combination of visual examination, photography, data collection on sensitive species which react to changes in air quality before hardier species, and air, water and soil sampling to establish baseline data and identify how air pollutants are affecting park resources. The following table illustrates some of the more common air pollution effects and the pollutants that cause them:

Potential Air Pollution Effects

Visibility effects: Visible plumes, layered haze, regional haze, atmospheric discoloration, reduction of visual range

Vegetation effects: Superficial damage to leaves, conifer needles, changes in growth rates and/or suppression of growth, disruption of reproductive processes, increased susceptibility to disease, pests, and adverse weather conditions, loss of individuals or large numbers of a community, possible alterations in the entire terrestrial and/or aquatic ecosystem.

Animal effects: Eye and respiratory impairment, increased susceptibility to other agents or to disease, decreased availability of necessary food sources, reduction of reproduction capacity in certain aquatic species

Soil effects: Acidification, toxification, leaching of essential nutrients

Water quality effects: Acidification, toxification, eutrophication

Effects on natural and man-made structures: Discoloration and/or erosion of building facades, decomposition and soiling of limestone formations, Indian ruins and artifacts

Pollutants

Nitrogen dioxide, fine particles (especially sulfates and nitrates), photochemical smog

Ozone, sulfur dioxide, nitrogen dioxide, acid deposition, and metals

ozone, sulfur dioxide, nitrogen dioxide, acid deposition, lead and other metals

Acid deposition (including sulfates and nitrates), metals

Acid deposition, metals, phosphates, particulates

Acid deposition, ozone, particulates, nitrogen dioxide

Park Ambient Air Quality Monitoring Objectives

Ambient air quality monitoring is a critical and fundamental part of the park's Resource Management Plan. It provides the basis for early identification of pollution problems and possible intervention before serious resource damage can occur. It provides for examining links between effects on park AQRVs and types, quantities, rates, and locations of air pollution emissions. It further provides critical information to park managers for making informed and effective policy decisions on air resource management issues affecting the park. The primary objectives of ambient air quality monitoring within Congaree Swamp National Monument are:

- (1) protect park cultural and natural resources,
- (2) insure attainment of National Ambient Air Quality Standards (NAAQS), and
- (3) provide long-term baseline information on air quality trends in the park.

To effectively meet these objectives the following ambient air quality monitoring parameters should be continually monitored:

Ozone

Ozone (O₃) is found in two layers of the atmosphere, the stratosphere and the troposphere. In the stratosphere, ozone is a form of oxygen found naturally that provides a protective layer shielding the earth from ultraviolet radiation's harmful health effects on humans and the environment. In the troposphere, ozone and other photochemical oxidants can have adverse effects on plants, animals, and human health. Effects include poor visibility, eye irritation, respiratory problems, and foliar injury on vegetation.

In November 1997, the EPA adopted a new eight hour ozone NAAQS based on scientific and medical research which indicated that extended exposure to lower levels of ozone may be as harmful as short-term exposure to elevated levels. The new standard is set at 85 parts per billion (ppb) and is exceeded when the average of the fourth maximum eight hour average over a three year period is 85 ppb or greater. The average of the fourth maximum eight hour average over a three year period will be used to determine areas of violation of the ozone standard. The following table shows the five maximum eight hour ozone concentrations for Congaree Swamp National Monument since 1981:

Year	1 st Max 8-hr ppb	2 nd Max 8-hr ppb	3 rd Max 8-hr ppb	4 th Max 8-hr ppb	5 th Max 8-hr ppb	3-yr Avg. 4 th Max 8-hr ppb
1981	71	67	63	60	58	*
1982	49	47	45	44	44	*
1983	101	96	88	75	69	60
1984	90	73	73	73	68	64
1985	70	70	67	64	61	71
1986	85	79	77	76	74	71
1987	72	70	68	68	68	69
1988	77	67	67	67	65	70
1989	99	93	91	74	74	70
1990	95	92	92	89	88	77
1991	64	61	60	59	59	74
1992	77	75	68	67	66	72
1993	67	66	66	63	62	63
1994	76	74	69	65	63	65
1995	87	79	77	76	71	68
1996	85	77	75	74	68	72
1997	69	69	68	66	65	72
Average	78.47	73.82	71.41	68.24	66.06	

Primary O₃ NAAQS: 8-hour concentration of 85 ppb or greater (based on a three year average of the 4th highest daily maximum 8-hour ozone average).

Secondary O ₃ NAAQS:	Same as the primary NAAQS.
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Sulfur Dioxide

Sulfur Dioxide (SO₂) is a heavy, pungent (at concentrations exceeding 500 ppb), colorless, gaseous air pollutant formed primarily by the combustion of sulfur containing fuels, ore smelting, petroleum processing, sulfuric acid manufacturing, paper mills, and industrial boilers. Nation-wide, coal-fired power plants are the largest sources of SO₂. SO₂ can be extremely corrosive to stone, paint, and metals and damaging to vegetation. SO₂ can also combine with moisture in the atmosphere to form sulfuric acid (H₂SO₄) which is a component of acid precipitation that causes acidification of soil and water.

Primary SO ₂ NAAQS:	Annual arithmetic mean not to exceed 30 ppb. 24-hr concentration not to exceed 140 ppb more than one time per year.
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Secondary NAAQS:	3-hour concentration not to exceed 500 ppb more than one time per year.
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Particulate Matter

Particulate matter (PM) is a broad classification of non-gaseous pollutants that consists of very fine solid particles and liquid droplets or aerosols. Particulates are produced from many sources, including utility plants, wood burning stoves, leaf burning, vehicle exhaust, incinerators, rock quarries, coal processing, smelting, construction, farming, and roadways. Common forms of particulates include fly ash, soot, soil, minerals, fibers, metals, oil aerosols, and tire rubber.

Particulate matter can soil and damage building surfaces and may damage vegetation by interfering with plant photosynthesis due to the formation of a film on leaf surfaces reducing exposure to sunlight. Particulate matter can also produce haze which diminishes visibility and the amount of sunlight reaching the earth.

Particulate matter is characterized according to particle diameter. Particles that are greater than 50 microns (50µm) in diameter rapidly settle out of the atmosphere due to their mass. Particles less than 50µm in diameter remain suspended in the atmosphere for longer periods of time and are classified as Total Suspended particulates (TSP). Particulate matter less than 10µm (PM₁₀) are respirable and contribute to regional haze and visibility impairment. Continuing scientific and medical studies now indicate that particles 2.5µm in size (PM_{2.5}) and smaller pose a greater threat to human health than particles in the 10µm range. In response to these findings the EPA adopted new PM_{2.5} standards which became effective September 16, 1997.

Primary PM ₁₀ NAAQS:	Annual arithmetic mean not to exceed 50 micrograms per cubic meter (µg/m ³) (based on a three year average). Maximum 24-hr concentration of 150 µg/m ³ . Average number of expected exceedances per year not to exceed 1.0 over the last three year period.
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Secondary PM ₁₀ NAAQS:	Same as the primary NAAQS.
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Primary PM _{2.5} NAAQS:	Annual mean not to exceed 15 µg/m ³ (based on three year average of annual means). 24-hour concentration not to exceed 65 µg/m ³ (based on a three year average of the annual 98 th percentile).
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Secondary PM _{2.5} NAAQS:	Same as the primary NAAQS.
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Nitrogen Dioxide

Nitrogen dioxide (NO₂) is a reddish brown gas that is produced during the high temperature combustion of fossil fuels. During combustion, nitrogen and oxygen are combined, or oxidized, to form a family of highly reactive gases called nitrogen oxides (NO_x) which includes NO₂ and nitrogen oxide (NO). In addition to the NO₂ produced during combustion, it is also formed by the photochemical reaction of NO in the presence of sunlight. The rate of reaction is dependent upon the intensity of the sunlight. Major combustion or oxidation sources that produce NO₂ include motor vehicles, power plants, incinerators, industrial boilers, and some chemical processes.

NO₂ plays an important role in the atmospheric reactions that generate ozone. NO₂ is also a contributor to the formation of acid precipitation which can damage plant and aquatic life and cause deterioration of stone and masonry-type buildings and statues.

Primary NO₂ NAAQS: Annual arithmetic mean not to exceed 50 ppb.

Secondary NO₂ NAAQS: Same as the primary NAAQS.

Wet Deposition

Precipitation chemistry provides long-term trends in concentration and deposition of major cations and anions in precipitation. In addition to measuring acid precipitation, wet deposition can determine the effectiveness of emission controls in reducing sulfur and nitrogen pollution, nitrogen cycling in ecosystems, and terrestrial, aquatic, atmospheric, and materials effects of air pollutants in rainfall. Measurements typically include, acidity, pH, conductivity, bromide, chloride, fluoride, nitrate, nitrite, phosphorus, sulfate, ammonia-nitrogen, calcium, magnesium, potassium, and sodium.

Mercury

Mercury is emitted to the ambient air from a variety of fuel combustion, incineration and industrial processes and natural sources. Mercury is deposited by wet and dry processes to forest ecosystems, from which it can ultimately be transported to and bioaccumulate in highly toxic forms in the food chain of aquatic ecosystems.

Meteorology

Meteorological measurements are critical in characterizing air masses passing over the park. They also assist in validating air quality data. Typical parameters are wind direction, wind speed, temperature, relative humidity, solar radiation, and rainfall.

Relocating the station to the Dawson Cabin area of the park will allow for the simultaneous measurement of meteorological parameters with air quality measurements. The attached wind rose (Figure 1) was produced by Mr. David Joseph, Physical Scientist, National Park Service Air Resources Division-Denver, from data collected at the fire weather station near Dawson Cabin. The wind rose is a graphical plot of wind direction and wind speed data after the meteorological tower was increased in elevation on September 29, 1997.

Action Plan

The proposed actions to be undertaken with consultation with the SCDHEC include:

1. The SCDHEC will relocate the Wise Lake air quality station to the Dawson Cabin area of Congaree Swamp National Monument prior to the start of the 1999 ozone season (April 1, 1999). Following the end of the 1999 ozone season (October 31, 1999) remove the air quality shelter, associated equipment, and other structures from the Wise Lake site.
2. The SCDHEC will operate ozone monitors at both Wise Lake and Dawson Cabin stations for data comparability analysis during the 1999 ozone season (April 1 - October 31, 1999).
3. The SCDHEC will have access to the existing meteorological sensors at the Dawson Cabin fire weather station for simultaneous SCDHEC datalogger meteorological measurements.
4. The SCDHEC will provide for the installation of telephone and electrical utilities to the new Dawson Cabin air quality station.
5. The National Park Service will provide and maintain an adequate clearing at the Dawson Cabin area that will meet EPA siting criteria.

Superintendent
Congaree Swamp National Monument

Date

South Carolina Department of Health and Environmental Control

Date

COSW 9/30/97 - 5/98

January 1

December 31

Midnight-11 PM

NOTE: Frequencies
indicate direction
from which the
wind is blowing.

CALM WINDS 3.99%

