

## Air Quality

### Description

The Virginia Department of Environmental Quality (DEQ) completed an Environmental Quality Ambient Air Monitoring report in 2003 (Sorensen, 2003). The parameters monitored near CEBE were PM10, sulfur dioxide, and ozone. The National Ambient Air Quality Standards (NAAQS) can be found in Appendix 19. Of these, ozone was the parameter that exceeded the EPA concentration standard for a few days, without exceeding the maximum number of days.

The PM10 monitoring sites nearest to CEBE were located in Winchester and Front Royal, Virginia (Appendix 20). Another PM10 monitoring site was located in Harrisonburg, Virginia (Appendix 20). PM10 is particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers. PM10 is the portion of total suspended particulate that has the capability to penetrate the thoracic region of the human respiratory system. These particles can impair visibility, effect climate, and contribute to acidic dry deposition. In 2003 these monitoring sites recorded well below the primary and secondary standard for PM10, which is an annual arithmetic mean of 50 and a 24-hour concentration of  $150 \text{ ug/m}^3$ , not to be exceeded more than once per year (Sorensen, 2003).

The sulfur dioxide ( $\text{SO}_2$ ) monitoring site nearest to CEBE was located in Harrisonburg, Virginia (Appendix 9.2).  $\text{SO}_2$  is created from the combustion of fossil fuels, refining of petroleum, manufacture of sulfuric acid, and smelting of sulfur-containing ore.  $\text{SO}_2$  causes chlorosis in plant leaves and can cause irritating effects in the respiratory tract. In the atmosphere,  $\text{SO}_2$  can be oxidized to  $\text{SO}_3$ , which can combine with other oxides to form sulfate aerosols and acid rain. The NAAQS primary standard for  $\text{SO}_2$  is an annual arithmetic mean of 0.03 ppm and a 24-hour concentration of 0.14 ppm, not to be exceeded more than once per year. The monitoring site located at the Valley DEQ office had a 24-hour maximum concentration of 0.011 ppm out of 363 samples. The annual arithmetic mean was 0.003 ppm (Sorensen, 2003).

The ozone monitoring site nearest CEBE was in the town of Rest, Virginia and another site was located near Luray, Virginia (Appendix 20). Ozone is formed by reactions among nitrogen oxides and organic compounds under solar ultraviolet radiation. Ozone concentrations are highest from April to October. Ozone injures vegetation and is a pulmonary irritant. The NAAQS primary standard for ozone is that the 3-year average of the 4<sup>th</sup> highest concentration may not exceed 0.08 ppm. The first, second, and third maximum concentrations from April to October 2003 was 0.094 ppm, 0.083 ppm, and 0.081 ppm, respectively. The maximum 1-hour concentration was 0.103 ppm, which is below the standard of 0.12 ppm. The monitoring site at the Luray Caverns Airport yielded first, second, and third maximum concentrations of 0.104 ppm, 0.091 ppm, and 0.085 ppm, respectively. All of these exceeded the standard of 0.08 ppm. The maximum 1-hour concentration was 0.111 ppm, which was below the standard of 0.12 ppm (Sorensen, 2003).

## Recommendations

Shenandoah National Park (SHEN), which begins approximately 8 miles southeast of CEBE and runs southwest along the Appalachian Mountains, maintains a seasonal deposition monitoring station at Big Meadows. This monitoring station is located at much higher elevations than CEBE. This could effect the air quality data and may not accurately reflect the air quality in CEBE (Olson, 2004). If it is desired to obtain air quality data specific to CEBE, SHEN should be helpful in creating a sampling program. Since ozone concentration near CEBE exceeded the EPA standard, it is recommended that this be closely monitored

## Viewshed

### Description

As part of the natural resource protection mission of the NPS, the Service strives to protect park viewsheds. There are several permanent structures and land use activities that degrade the viewshed of CEBE.

Large-scale limestone quarries owned by Global Stone Chemstone are located on the west side of CEBE, directly outside the boundary (Figure 33). The quarries are split into a larger southern section and a smaller northern section separated by Cedar Creek. According to a 1997 aerial photograph, the stream is buffered by trees. A study of Civil War sites determined that the quarries along Cedar Creek and Middle Marsh Brook are visually intrusive (Lowe 1995). Aerial photographs reveal a forested buffer along parts of the quarries that would block visibility from the park but visibility is probably not completely blocked. It is anticipated that the quarries would expand northward and possibly eradicate the ruins of the 18<sup>th</sup>-century Nieswander's Fort (Lowe 1995).

Interstate 81 and Route 11 (Figure 34) both bisect the park running west and north-east. Interstate 81 travels through 33 miles of battlefield land, including land within the CEBE boundary. Approximately 319 acres of land within area battlefields were paved as of April 2004 and between 843 and 1091 more acres of battlefield land could be lost with an expansion to I-81. CEBE could be the hardest hit of the battlefields with the amount of paved land rising from 121 acres to between 182 acres and 273 acres. A large amount of land is expected to be taken from the core of Cedar Creek Battlefield and multi-level ramps and bridges could be built within the boundaries of CEBE (Fitts 2004). The future I-81 plans have not been developed. A multi-tiered I-81 corridor study and environmental review began in January 2004 and is expected to be completed during the summer of 2005. The Tier 1 study is expected to identify site-specific areas for further analysis, which will be performed in a Tier 2 study. When the Tier 1 environmental impact statement is complete, decisions will be made on the following: 1) improvement concepts for highway and rail facilities, such as the number of additional highway lanes that may be needed, partial or complete separation of trucks and passenger vehicles, and additional rail capacity, 2) approval to advance I-81 as a toll pilot project under current federal law, 3) roadway and rail components to be studied in Tier 2, and 4) possible purchase of right-of way parcels on a case-by-case basis. After completion of Tier 2, federal funding could be provided for VDOT to begin designing construction plans, purchasing right-of-ways, and building improvements. The Massachusetts-based firm of Vanasse Hangen Brustlin Inc. has been contracted to assist in completing the Tier 1 environmental impact statement (VDOT 2004).

A railroad runs through the quarry and enters CEBE on the western border (Figure 35). From here it runs north along the north eastern boundary of the park. Meadow Brook runs along the railroad and it is possible that debris could enter the creek as trains pass. According to 1997 aerial photographs, the railroad may impact the viewshed.

An industrial business park was built along US 11 south of Middletown (Lowe, 1995). According to Lowe, these buildings are visible from many parts of the battlefield. Construction northeast of Belle Grove along route 624 has also occurred, degrading the viewshed of the land preserved by the National Trust and the Cedar Creek Battlefield Foundation. In addition, the area between Cemetery Hill and Old Town Middletown has experienced townhouse and apartment construction. Residential development adjacent to the I-81 interchange has also occurred. Homes were constructed in 1991 on 3-acre lots south of route 634 and west of the Miller-McDaniel Farm, which were areas of intense combat during the Civil War. Lord Fairfax College and an elementary school located north of Middletown along US 11 may also be visually intrusive to CEBE. The section of CEBE south of I-81 probably has the highest visual integrity due to minimal access (Lowe 1995).

### Recommendations

It is recommended that severely degraded viewsheds be identified and prioritized within CEBE. Perhaps forested buffers could be created to improve viewsheds. In addition, this information could be used in prioritizing land to be acquired to become buffers and to improve viewsheds. It would be beneficial to check the status of the I-81 environmental review during the summer of 2005, when the first tier is due to be completed. In addition, VDOT's Chris Collins may be contacted at 804-225-4249 to determine if past environmental impact statements for I-81 are viewable.

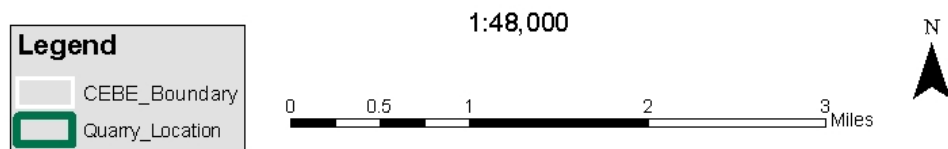


Figure 33. Limestone quarries located outside of the Cedar Creek and Belle Grove National Historical Park (CEBE). Aerial photograph provided by the Virginia Economic Development Partnership 2000.

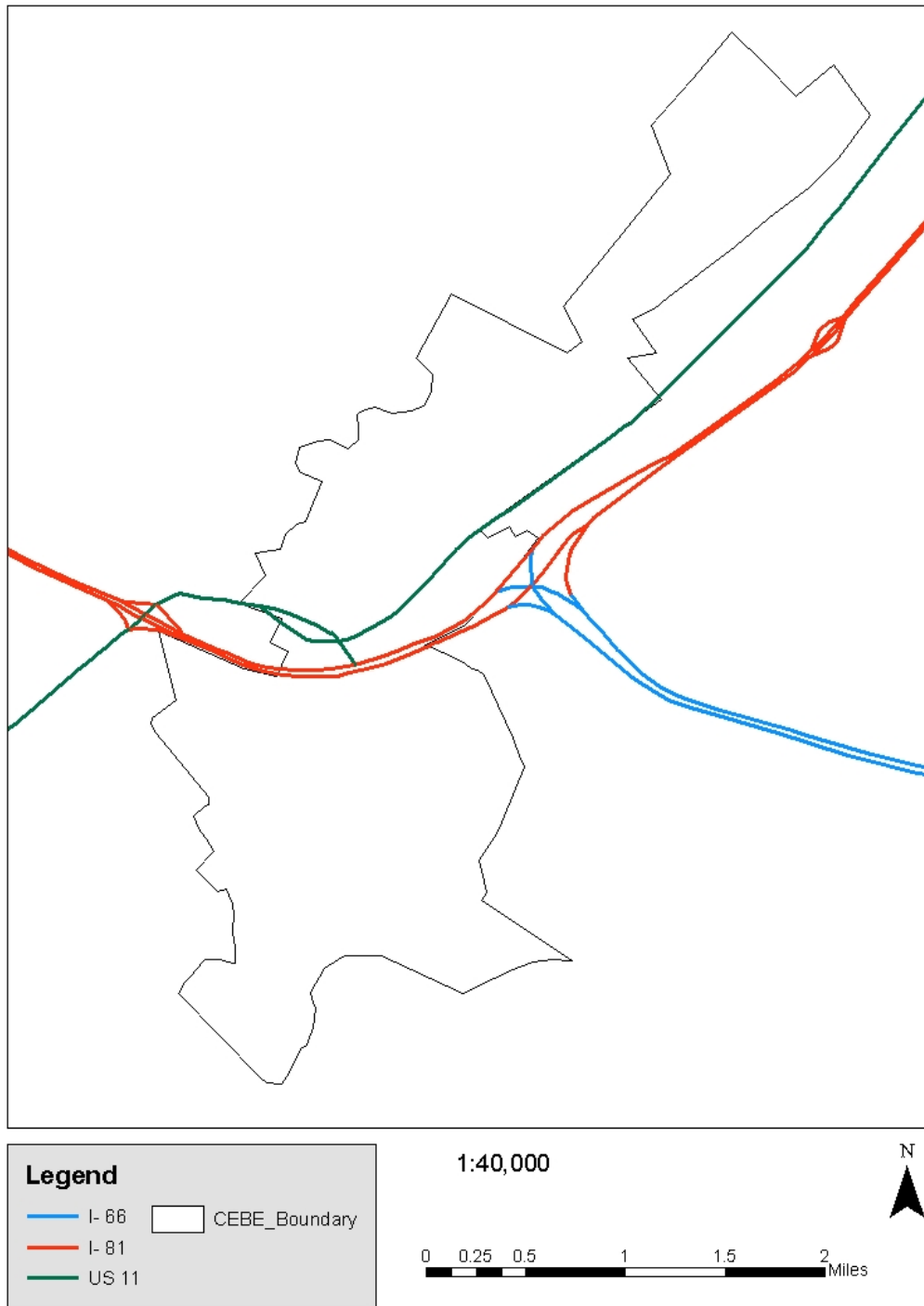


Figure 34. Major roads in the Cedar Creek and Belle Grove National Historical Park (CEBE). Data provided by the Virginia Department of Transportation 2001.



Figure 35. Railroad located within the Cedar Creek and Belle Grove National Historical Park (CEBE). Aerial photograph provided by the Virginia Economic Development Partnership 2000.



## Lightscape

### Description

One of the missions of the NPS is to preserve the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. There are several sources of light that could affect CEBE's lightscape. I-81 and US-11 contribute unnatural light due to vehicle headlights. Trains contribute unnatural light as well. The housing developments, industrial parks, and the cities of Middletown and Strasburg contribute additional light visible from CEBE that disrupt the night sky. Facilities in the park also contribute minimal light.

### Recommendations

Areas with the greatest disruption of natural lightscape should be identified in the field and prioritized. Vegetative buffers could be implemented to block unnatural light from traffic and trains. Only low intensity lights should be used for illuminating park facilities.



## Soundscape

### Description

One important part of the NPS mission is to preserve or restore natural resources, including natural soundscapes. Several sources of intrusive sounds exist within and around CEBE that are permanent. I-81 and US-11 are located in the center of the park (Figure 34) and can probably be heard from several areas in the park. The expansion scheduled for I-81 would also contribute noise pollution from construction equipment. In addition, trains that enter CEBE can be heard throughout the park. The Global Stone Chemstone quarry is located fairly close to CEBE and probably affects sound quality within CEBE due to blasting and heavy machinery operation.

### Recommendations

Areas with the greatest disruption of natural soundscapes should be identified in the field and prioritized. Vegetative buffers may partially block traffic sounds but more successful sound barriers may be constructed along I-81 if they are not already in place. Unfortunately, these may negatively impact viewsheds until vegetative buffers are mature.



## Literature Cited

- Boyd, David. 2002. Virginia Department of Conservation and Recreation. Virginia's Scenic Rivers - Designated, Qualifying, and Worthy of Further Study. Metadata.
- Chesapeake Bay Local Assistance Department, Department of Conservation and Recreation. 2002. Virginia's Bay Act Program. <http://www.cblad.virginia.gov/abtprogram.cfm> .
- Chesapeake Bay Program. 2003. Bay Pollutants. <http://www.chesapeakebay.net/stressor1.htm> .
- Department of Conservation and Recreation and Commonwealth of Virginia. 2004. Natural Heritage Resources for Cedar Creek and Belle Grove National Historical Park.
- Department of Conservation and Recreation. 2004. Virginia Natural Heritage Karst Program: Cave and Karst Protection. <http://www.dcr.virginia.gov/dnh/karsthome1.htm> .
- Department of Environmental Quality. August 2004. Water Quality Assessment Guidance Manual for Y 2004; 305(b)/303(d) Integrated Water Quality Report.
- Fitts, Deborah. 2004. Virginia's Interstate 81 Widening To Impact Battlefields. The Civil War News. [http://www.civilwarnews.com/archive/articles/I-81\\_widening.htm](http://www.civilwarnews.com/archive/articles/I-81_widening.htm) .
- Jamestown, Rhode Island Visitor Information Center. Building New England: The Taconic and Acadian Orogenies. <http://www.jamestown-ri.info/acadian.htm> .
- Lowe, David. 1995. Study of Civil War Sites in the Shenandoah Valley of Virginia. <http://www2.cr.nps.gov/abpp/shenandoah/svs3-15.html> .
- McCarty, Linda. 2004. Cave Restoration Preserves Piece of Civil War History: Scouts Protect Markings of Union, Confederate Soldiers. Winchester Star. [http://www.winchesterstar.com/TheWinchesterStar/040929/Area\\_CavE.asp](http://www.winchesterstar.com/TheWinchesterStar/040929/Area_CavE.asp) .
- National Park Service. 2004. Nature and Science – Nonnative Species. <http://www.nps.gov/shen/pphtml/subenvironmentalfactors28.html> .
- Natural Resource Conservation Service. 2004. Hydric Soils-Introduction. <http://soils.usda.gov/use/hydric/intro.html> .
- Natural Resource Conservation Service. 2004. Prime Farmland. <http://www.va.nrcs.usda.gov/technical/Soils/primefarmland.html> .

## Literature Cited (continued)

- Natureserve. 2004. Distribution of Native U.S. Fishes by Watershed.  
<http://www.natureserve.org/getData/dataSets/watershedHuCs/index.jsp> .
- Olson, Gordon. 2004. Chief Ranger Natural Resources Division, Shenandoah National Park. Telephone conversation.
- Orndorff, Randall, and George Harlow Jr. 2002. Hydrogeologic Framework of the Northern Shenandoah Valley Carbonate Aquifer System. U.S. Geological Survey Water-Resources Investigations Report 02-4174. Georgia.
- Owens, Roland. 2004. Virginia Department of Environmental Quality. Virginia 04\_IR Assessment Monitoring Stations. ESRI metadata.  
<http://www.esri.com/metadata/esriprof80.html> .
- Rader, Eugene et al. 1996. Geologic Map of Clarke, Frederick, Page, Shenandoah, and Warren Counties, Virginia: Lord Fairfax Planning District. USGS Publication 143.
- Rader, Eugene and Thomas Biggs. 1976. Geology of the Strasburg and Toms Brook Quadrangles, Virginia. USGS Report of Investigations 45.
- Roberts, Chad and C.M. Bailey. 2003. Geology of Virginia. College of William and Mary. <http://www.wm.edu/geology/virginia/>.
- Rosgen, D.L. and H.L. Silvey. 1996. Applied River Morphology. Wildland Hydrology Books. Fort Collins, CO.
- Scotese, Scott. 2003. Taconic Orogeny. Syracuse University of New York, Stony Brook. <http://www.ic.sunysb.edu/Stu/ckramer/TaconicOrogeny.htm> .
- Sorensen, Crystal. Department of Environmental Quality. 2003. Virginia Ambient Air Monitoring 2003 Data Report.
- Southworth, Scott. 2002. Digital Geologic Map and Database of the Frederick 30' x 60' Quadrangle, Maryland, Virginia, and West Virginia. USGS Open File Report 02-437. Virginia.
- Topozone. 1994. Strasburg Quadrangle. 1:24000 scale. [www.topozone.com](http://www.topozone.com) .
- Topozone. 1999. Middletown Quadrangle. 1:24000 scale. [www.topozone.com](http://www.topozone.com) .

## Literature Cited (continued)

- Virginia Department of Forestry. 2002. Fall Cankerworm.  
<http://www.dof.state.va.us/gis/datadownload.html> .
- Virginia Department of Forestry. Gypsomoth. 2002, 2003.  
<http://www.dof.state.va.us/gis/datadownload.html> .
- Virginia Department of Game and Inland Fisheries (VDGIF). 2004. Pintail Trax.  
<http://www.dgif.state.va.us/wildlife/pintailtrax/index.html> .
- Virginia Department of Game and Inland Fisheries (VDGIF). 2004. Tundra Swan Trax.  
<http://www.dgif.state.va.us/wildlife/swan/index.html> .
- Virginia Department of Game and Inland Fisheries (VDGIF). 2002. Shenandoah River (North Fork). [http://www.dgif.state.va.us/fishing/rivers/shenandoah\\_nf/](http://www.dgif.state.va.us/fishing/rivers/shenandoah_nf/) .
- Virginia Department of Transportation (VDOT). 2004. I-81 Corridor.  
<https://webmail.psu.edu/webmail/main.html> .
- Virginia Fish and Wildlife Information Service (VAFWIS). 2004. Species Information.  
<http://vafwis.org/WIS/ASP/default.asp> .
- Virginia Geographic Information Network (VGIN). 2002. Virginia Base Mapping Program. <http://www.vgin.vipnet.org/VBMP/1118-VBMPstatus.doc> .
- United States Department of Agriculture and Natural Resources Conservation Service. 2004. Soil Survey Geographic Database for Shenandoah, Warren, and Frederick Counties. Virginia.
- United States Geological Survey. 2000. Aquifer Susceptibility in Virginia: Data on Chemical and Isotopic Composition, Recharge Temperature, and Apparent Age of Water from Wells and Springs, 1998-2000. Open-File Report 03-246.
- Woodward, Susan L. 1997. Physiographic Provinces of Virginia. Radford University Geography Department.  
<http://www.runet.edu/~swoodwar/CLASSES/GEOG202/physprov/physprov.htm>