KINGS MOUNTAIN NATIONAL MILITARY PARK,

SOUTH CAROLINA

WATER RESOURCES SCOPING REPORT

Don P. Weeks

Technical Report NPS/NRWRD/NRTR-2002/296

WATER RESOURCES DIVISION

National Park Service - Department of the Interior
Fort Collins - Denver - Washington

United States Department of the Interior • National Park Service

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January, 2002

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United States Department of the Interior
National Park Service

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EXECUTIVE SUMMARY

Kings Mountain National Military Park (KIMO) is a historic site set aside to interpret an important battle in the Revolutionary War, marking the beginning of several British defeats that prevented England's attempt to conquer the nation. KIMO is centered around a topographic high that rises 150 feet above the surrounding area. This highpoint was where Major Patrick Ferguson and his British Loyalists were defeated by surrounding Patriot forces, led by Virginia colonel William Campbell. The water-related resources of this park serve not only as important natural components, but are an integral component of the historical context of the site and its cultural landscape.

This Water Resources Scoping Report is being provided at the request of KIMO to assemble information pertaining to the park's water resources. This report identifies and briefly describes the natural resources at KIMO and the significant water-related issues that park management is challenged to address.

For KIMO, several water-related issues exist. Many of the issues presented in this report center around the lack of basic information (i.e., baseline data) that would better assist the NPS's understanding of the park's water resources. Thus, the NPS may be unaware of significant and/or time-sensitive issues because the natural resource information is not available.

The contents of this report are limited to information made available to the author during the time this report was prepared. Where appropriate, issue-specific recommendation(s) previously proposed by NPS management via KIMO planning documents (i.e., RMP) are included. As a result, descriptions of the natural resources and water resource issues vary in detail, and inclusion of issue-related recommendations is inconsistent.

As part of the effort by the NPS WRD to produce this report for KIMO, WRD staff traveled to the park in 2001. The purposes of this travel were to: 1) introduce elements of the WRSR effort to KIMO, 2) become familiar with the water resources and high priority water-related issues at the park, and 3) obtain pertinent information from park files. The high-priority issues identified at KIMO during this effort include:

- Baseline Inventory and Monitoring
- Minerals Extraction
- Fish and Fisheries
- Atmospheric Deposition
- Recreational Management
- Wastewater Treatment
- Wetlands Management
- Hazardous Waste Management and Spill Contingency Planning
- Coordination

Each of these issues has aspects that affect the park's water resources, though some may not be under NPS control; therefore, it is important to recognize the fact that multi-agency communication and coordination are essential to successfully manage KIMO's watershed. The park is encouraged to use components of this scoping report, and build from the recommendations provided, to develop time-sensitive management strategies and project statements related to park-specific water resource issues.

INTRODUCTION

Kings Mountain National Military Park (KIMO) is the location of an important battle in our nation's young history. American frontiersmen defeated the British Loyalists in 1780 at this location during a critical point in the Revolutionary War. This battle was the beginning of several British defeats that eventually turned the tide on England's attempt to conquer the nation.

Equally important to KIMO's cultural significance, are the park's 3,945 acres of natural resources. Visitors come to experience the historical battle, while also enjoying the natural setting. Along with an informative visitor center and an interpretive hiking trail where the 1780 battle took place, KIMO offers a beautiful landscape of forest, rolling hills, and pristine streams for visitors to experience through hiking, horseback riding, and backcountry camping. Today's challenge for KIMO management is to establish a healthy balance in preserving both the park's cultural and natural resources.

This report provides some foundation toward a better understanding of KIMO's natural resources. The objective of this report is to present NPS management with a brief overview of KIMO's aquatic environments, existing water-related information and issues that pertain to KIMO, while also identifying some of the "information needs" that will better assist the park in providing a greater level of water resource protection. At the end of the report, an evaluation of this information is presented to determine if a more comprehensive Water Resources Management Plan (WRMP) is warranted for this NPS unit.

The initial information-gathering effort for this report included a 2-day visit by the author (NPS-Water Resources Division) to KIMO in June 2001. Information was derived from many sources, including interviews with park staff and review of existing natural resources information with emphasis on water resources. The author was also fortunate to visit many of the sites in KIMO (i.e., Kings Creek, KIMO maintenance facilities, etc.), which provided a better appreciation of the water resources and associated issues.

Location, Demography, Legislation, and Management

KIMO is located in north-central South Carolina, approximately 35 miles southwest of Charlotte, North Carolina (Figure 1). This NPS unit shares a common boundary with Kings Mountain State Park (Figure 2). KIMO is located in Cherokee and York counties, a rural area in South Carolina. The local economy is built around agriculture (crops and livestock), with industry increasing as an important part of the economy (Clemson University, 2000). The population of Cherokee County increased from 44,406 in 1990 to 47,169 in 1995 (5.8% increase), with a 2010 projected increase of 53,300 (16.7% increase since 1990). The population of York County increased from 131,497 in 1990 to 143,220 in 1995 (8.2% increase), with a 2010 projected increase of 198,600 (33.8% increase since 1990) (South Carolina Population Estimates, 2001).

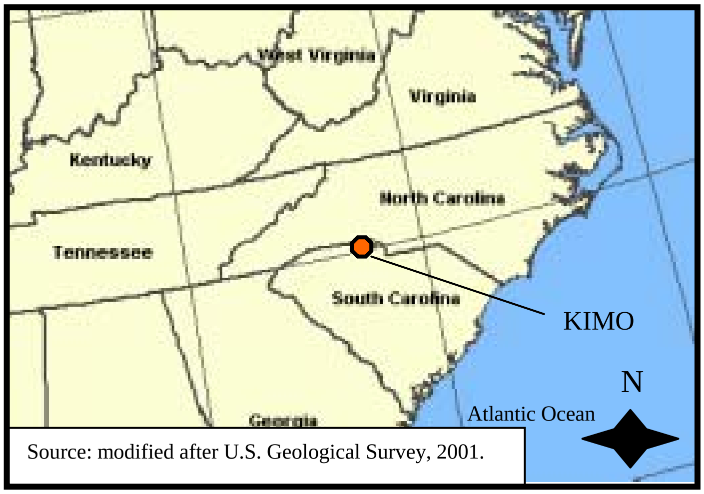


Figure 1. Regional Map, Kings Mountain National Military Park.

In 1931, KIMO was established to commemorate the Battle of Kings Mountain, fought on October 7, 1780 (46 Stat. 1508). In 1959, the boundaries of the park were revised to "facilitate protection and preservation" of the park (73 Stat. 108), which is the current configuration of the park today (3,945.29 acres).

According to KIMO's Master Plan, there are three prime resources in the park: 1) the Kings Mountain battlefield area and its significance to the American Revolution; 2) the potential for recreation use; 3) and the park's natural setting (National Park Service, 1974).

To manage the important resources of KIMO, the following broad goals and objectives have been established (National Park Service, 1999):

1. To preserve and maintain the park's existing historical monuments as cultural resources available today and in the future for visitor appreciation.
2. To manage the natural resource base to enhance park historical values, to buffer the park from any possible exterior development that could constitute visual intrusions on the scene, and to take any needed steps to protect natural processes, property, and people in the park.

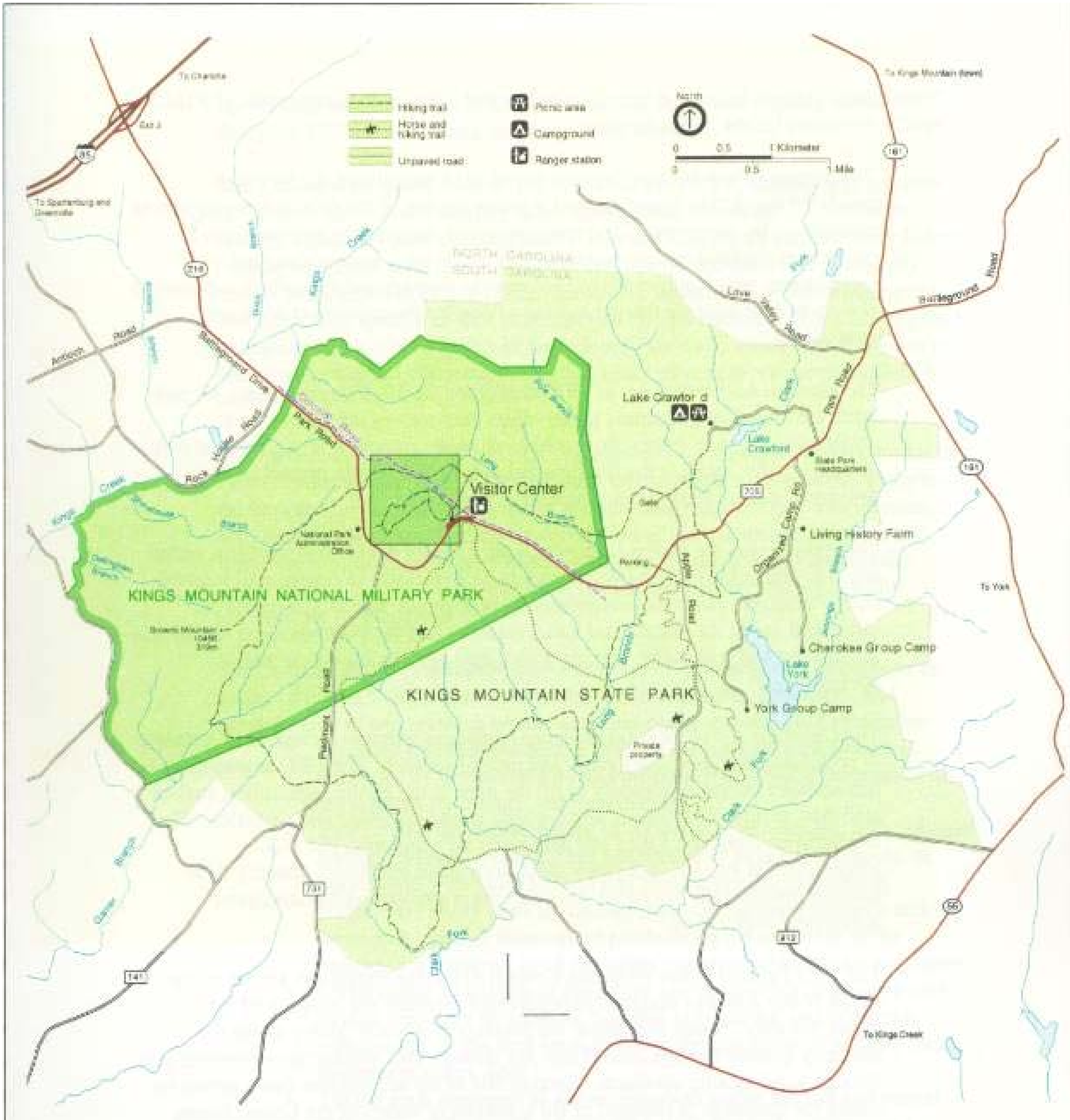


Figure 2. Kings Mountain National Military Park, South Carolina.

Some additional legislation and executive orders that help guide management of KIMO's aquatic resources include the following:

The *National Park Service Organic Act* of 1916 established the NPS and mandated that it "shall promote and regulate the use of the federal areas known as national parks, monuments, and reservations by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of future generations."

The *General Authorities Act* of 1970 reinforced the 1916 *Organic Act* – all park lands are united by a common preservation purpose, regardless of title or designation. Hence, federal law protects all water resources in the national park system equally, and it is the fundamental duty of the NPS to protect those resources unless otherwise indicated by Congress.

Congress passed the *National Environmental Policy Act* (NEPA) in 1969, which requires that federal actions which may have significant environmental impacts shall: "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment."

The *Clean Air Act* of 1970 (as amended) regulates airborne emissions of a variety of pollutants from area, stationary, and mobile sources. The 1990 amendments to this act were intended primarily to fill the gaps in the earlier regulations, such as acid rain, ground level ozone, stratospheric ozone depletion and air toxics. The amendments identify a list of 189 hazardous air pollutants. The U.S. Environmental Protection Agency must study these chemicals, identify their sources, determine if emissions standards are warranted, and promulgate appropriate regulations.

The 1972 *Federal Water Pollution Control Act*, more commonly known as the *Clean Water Act*, was designed to restore and maintain the integrity of the nation's waters. States implement the protection of water quality under the authority granted by the Clean Water Act through best management practices and through water quality standards. Section 404 of the act requires that a permit be issued for discharge of dredged or fill materials in waters of the United States, including wetlands. The U.S. Army Corps of Engineers administers the Section 404 permit program. Section 402 of the act requires that a National Pollutant Discharge Elimination System (NPDES) permit be obtained for the discharge of pollutants from any point source into the waters of the United States. In general, all discharges and storm water runoff from major industrial and transportation activities, municipalities, and certain construction activities must be permitted by the NPDES program. The U.S. Environmental Protection Agency usually delegates NPDES permitting authority to the state.

The *Endangered Species Act* of 1973 requires the NPS to identify and promote the conservation of all federally listed endangered, threatened, or candidate species within any park unit boundary. This act requires all entities using federal funding to consult with the Secretary of Interior on activities that potentially impact endangered flora and fauna. It requires agencies to protect endangered and threatened species as well as designated critical habitats. While not required by legislation, it is NPS policy to also identify state and locally listed species of concern and support the preservation and restoration of those species and their habitats.

The *Redwood National Park Act* (1978) amended the *General Authorities Act* of 1970 to mandate that all park system units be managed and protected "in light of the high public value and integrity of the national park system." Furthermore, no activities should be undertaken "in derogation of the values and purposes for which these various areas have been established", except where specifically authorized by law or as may have been or shall be directly and specifically provided for by Congress.

The *National Parks Omnibus Management Act* of 1998 attempts to improve the ability of the NPS to provide state-of-the-art management, protection, and interpretation of and research on the resources of the national park system by:

- Assuring that management of units of the national park system is enhanced by the availability and utilization of a broad program of the highest quality science and information;
- Authorizing the establishment of cooperative agreements with colleges and universities, including but not limited to land grant schools, in partnership with other Federal and State agencies, to establish cooperative study units to conduct multi-disciplinary research and develop integrated information products on the resources of the national park system, or of the larger region of which parks are a part;
- Undertaking a program of inventory and monitoring of national park system resources to establish baseline information and to provide information on the long-term trends in the condition of national park system resources, and;
- Taking such measures as are necessary to assure the full and proper utilization of the results of scientific study for park management decisions. In each case in which an action undertaken by the NPS may cause a significant adverse effect on a park resource, the administrative record shall reflect the manner in which unit resource studies have been considered. The trend in the condition of resources of the national park system shall be a significant factor in the annual performance.

Executive Order 13112: *Invasive Species* complements and builds upon existing federal authority to aid in the prevention and control of invasive species.

Executive Order 11988: *Floodplain Management.* The objective of the E.O. is, "…to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is an practicable alternative." For non-repetitive actions, the E.O. states that all proposed facilities must be located outside the limits of the 100-year floodplain. If there were no practicable alternative to construction within the floodplain, adverse impacts would be minimized during the design of the project.

Director's Order #2: Park Planning provides the policies and guidance related to park planning. The Park Service has a mandate in its Organic Act and other legislation to preserve resources unimpaired for the enjoyment of future generations. NPS park planning will help define what types of resource conditions, visitor uses, and management actions will best achieve that mandate. The NPS is to maintain an up-to-date General Management Plan (GMP) for each unit of the national park system. The purpose of the plan is to ensure that each park has a clearly defined direction for natural and cultural resource preservation and visitor use. KIMO, although established in 1931, still does not have a GMP. In 1974, a "Master Plan" was approved to serve as a guiding document through the bicentennial years until the present. Now more than ever the park needs to complete a GMP, which will guide management through some of the challenges identified in this report (KIMO PMIS #69978). A park's Resources Management Plan (RMP) describes the specific management actions needed to protect and manage the park's natural and cultural resources. The RMP identifies existing resources and conditions, present actions, and identifies future needs consistent with legislative and administrative guidance, resource significance, and other park planning documents. KIMO's most recent RMP was approved in 1999. Discipline-specific planning documents that complement the RMP (e.g., Fire Management Plan, Water Resources Scoping Report) are prepared for NPS units when warranted.

DESCRIPTION OF NATURAL RESOURCES

At the time of the battle of Kings Mountain, a mature virgin forest probably covered the area. The rolling uplands consisted of a climax oak/hickory forest. During the agricultural revolution in the 19th century, the Kings Mountain region was cleared and used for agricultural purposes. The cultivation of cotton spread rapidly across the Piedmont region of the Carolinas. Exotic plants and animals were introduced by the farmers, many of them still extant on former home sites today (National Park Service, 1974). When the NPS acquired this land in 1931, it was mostly pasture and farmland (National Park Service, 1999). With the passing of time, the abandoned agricultural fields have, through the process of secondary succession, become the forests of today (National Park Service, 1974).

Climate

The climate of KIMO is of the modified continental type and is warm and temperate. The average rainfall is about 47 inches annually that is evenly distributed through the year. For example, eight months have a 30-year precipitation average that ranges from 3.9 to 4.2 inches (see Figure 3). Statistically the wettest and driest months are March (4.7 inches) and April (2.9 inches), respectively. From 1961-1990, the average monthly air temperatures ranged from 78.1° F in July to 39.7 ° F in January (National Climate and Data Center, 2001). Winters are fairly short and relatively mild. Periods when the temperature is below freezing seldom exceeds four or five days (United States Department of Agriculture, 1962).

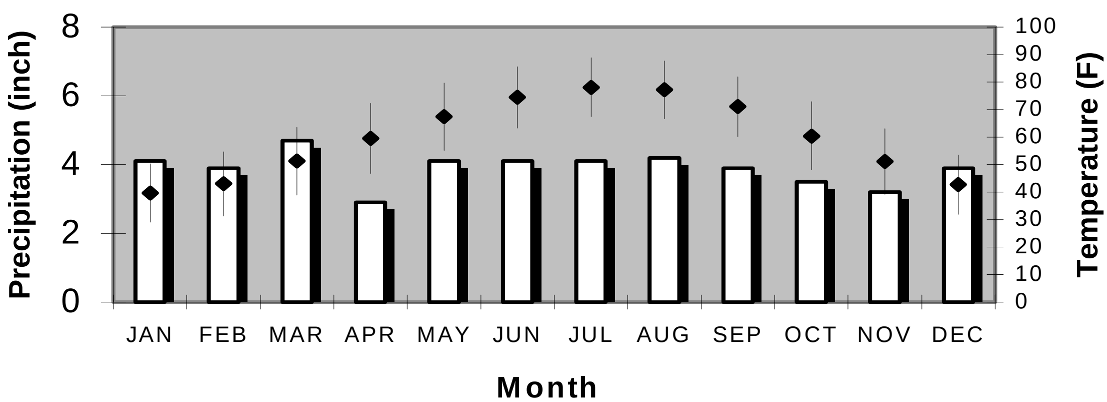


Figure 3. Monthly mean precipitation (bars) and air temperature range (diamond-whiskers) (1961-1990), Gastonia, North Carolina (National Climate and Data Center, 2001).

Physiography

KIMO lies within the upland section of the *Piedmont* physiographic province. The *Piedmont* is bounded to the east by the Fall Line and *Coastal Plain* province, and to the west by the mountains of the *Blue Ridge* province (Figure 4). The *Piedmont* province is characterized by a gently rolling topography of deeply weathered bedrock, with some solid outcrop (William & Mary, 2000). Knobs, hills, and small mountains known as monadocks are typically composed of the more erosion resistant rocks such as quartz (Kennemore, 1995). This rolling landscape is cut by or bounded by valleys of steeper slope and relief. The highest elevation in KIMO occurs along Brushy Ridge (1060 feet (msl)), and the lowest elevation occurs on the northwest boundary at Kings Creek (646 feet (msl)) (Kennemore, 1995).

KIMO is centered on a topographic high, where first and second-order streams drain the landscape (Figure 2). This environmental setting appears ideal for an NPS unit with regards to protecting and preserving the water resources. The park, for the most part, is at the top of its watershed, with minimal external influence from adjacent watersheds.

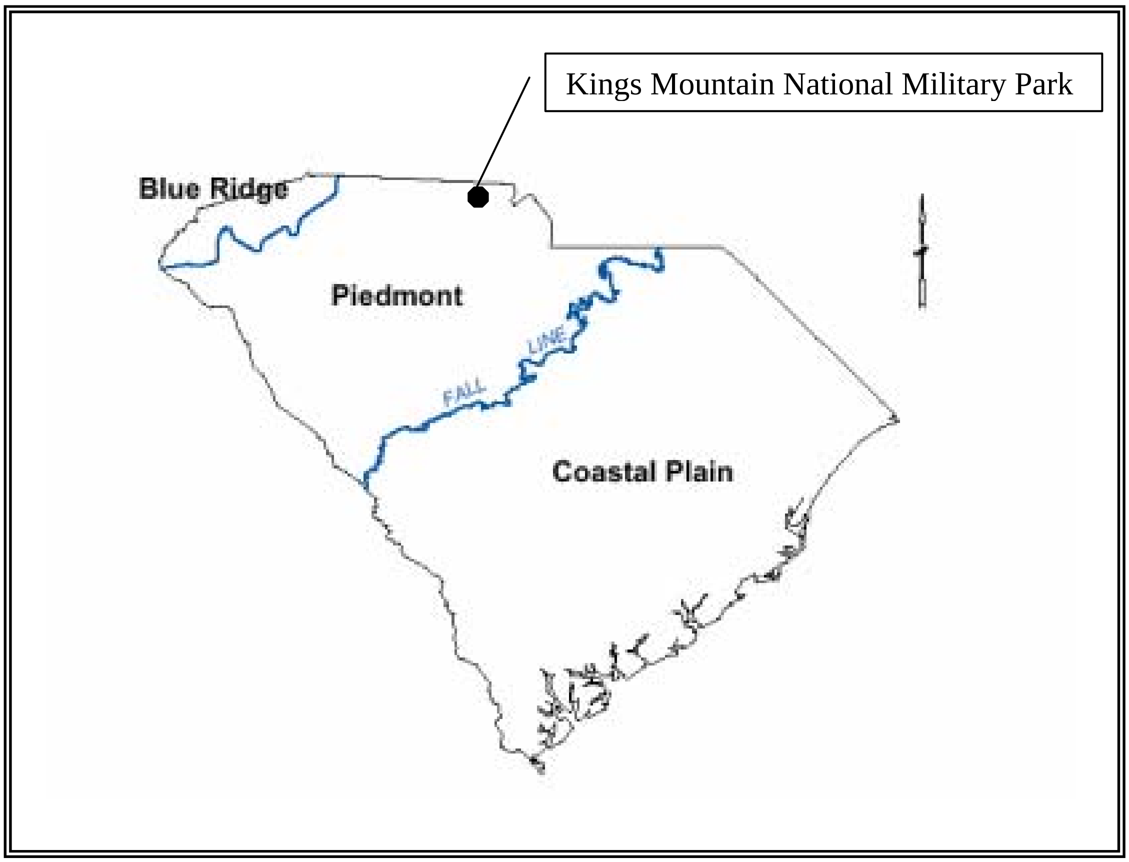


Figure 4. Location of physiographic provinces and the fall line in South Carolina.

Geology

KIMO is situated in the north-central *Piedmont* of South Carolina. Rocks of the *Piedmont* occur in belts that conform to the regional northeasterly trend of major structural features. The belts are delineated by gross differences in rock types, grade of metamorphism, and structure (Butler, 1965). In general there are broad bands, many miles wide, of rather coarsely crystalline granites, schists, and gneisses alternating with broad bands of finer grained rocks called slate, shale, phyllite, argillite or sericite schist (Johnson and Heron, 1965).

KIMO is located in the Kings Mountain belt, which is bounded on the northwest by the Inner Piedmont belt and on the southeast by the Charlotte belt (Carolina Terrane), see Figure 5 [Horton (1981), Stowell (1997)]. The Kings Mountain belt was defined by King (1955) to include distinctive metasedimentary rocks such as quartzite, conglomerate, and marble associated with mica schists that are partly volcanic in origin. The belt begins near the Catawba River in North Carolina, extending southwest for 80 km through Gaffney, South Carolina.

Structurally, the Kings Mountain belt is interpreted as a large, north-plunging antiform with subsidiary synforms primarily located on the west flank of this structure. Several generations of folding greatly complicate stratigraphic interpretations of this area (Horton and Butler, 1977).

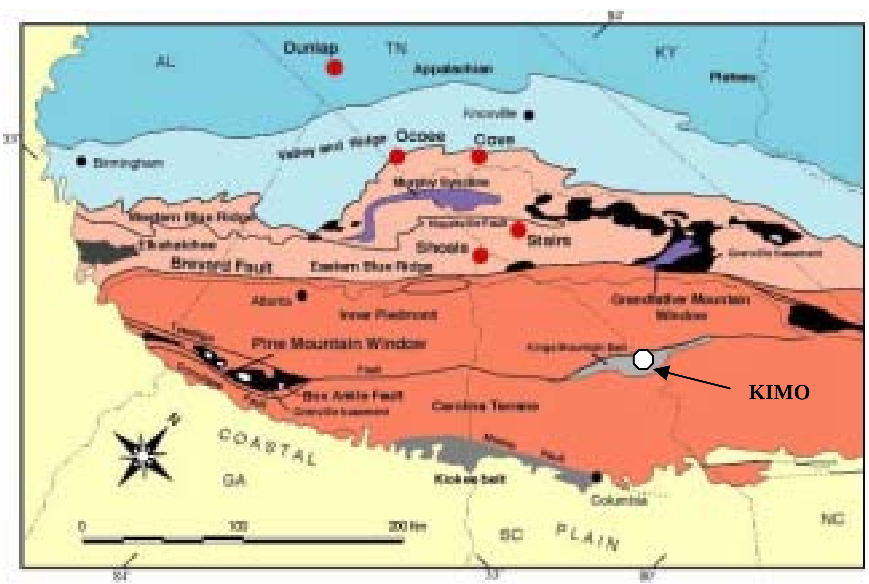


Figure 5. Location of the Kings Mountain belt (Stowell, 1997).

Soils

The soils in KIMO are classified as the Tatum-Nason-Manteo association (United States Department of Agriculture, 1962; United States Department of Agriculture, 1965), as well as mixed alluvial soil of the low floodplains (Kennemore, 1995). This association is described as a deep, well-drained friable soil over sericitic schist (United States Department of Agriculture, 1962). The soils on ridgetops and moderate side slopes in the area are eroded very fine sandy loams and silty clay loams. The Tatum soils have a yellowish-brown surface soil and a yellowish-red to red subsoil. The surface soil of the Nason soil is grayish brown, and the subsoil is mottled strong brown and yellowish red. The Manteo soils have shallow surface soils and a gravelly subsoil of thin, discontinuous, firm clay. Generally, these soils take water slowly and are moderately permeable. The amount of surface runoff is large. These soils are low in organic matter, moisture-supplying capacity, and fertility (United States Department of Agriculture, 1965). Due to the very low natural fertility of these soils, application of fertilizers is typically needed to support crops (United States Department of Agriculture, 1965). The composition of these soils is suitable for brick production and they are mined adjacent to the park for this reason.

The mixed alluvial soil found along the shallow floodplain of small creeks is poorly developed due to periodic flooding. During these floods, large amounts of surficial sediment are moved (United States Department of Agriculture, 1965). The high mobility of this soil prevents it from developing well-defined horizons. A moderate amount of organic matter, small pebbles, and gravel are typically mixed with this soil. The water table is usually found within three feet of the surface in some places (Kennemore, 1995).

Hydrology

Watersheds

The park is located within the 24,868-mi^2 Santee River Basin and Coastal Drainage, a U.S. Geological Survey National Water-Quality Assessment (NAWQA) study basin (Figure 6). The upland areas of KIMO drain into the Broad River.

On a larger scale, the surface drainage for the KIMO area is a dendritic pattern (United States Department of Agriculture, 1965). This drainage pattern is similar to the branches of a tree, where no single direction is favored over another, so that the smaller channels came to be oriented randomly (Strahler, 1981).

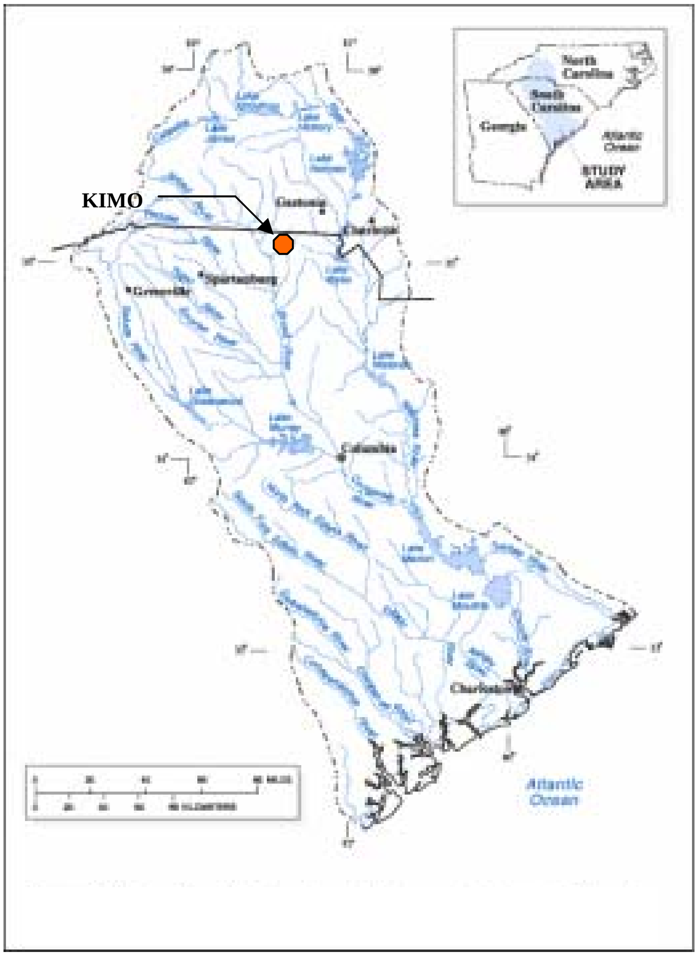


Figure 6. Santee River Basin and Coastal Drainages NAWQA study basin, North and South Carolina (Maluk and Kelley, 1998).

Surface Water

KIMO, although a relatively small NPS unit, encompasses a variety of surface water resources, from floodplain habitat to mountain seeps and streams. The Kings Creek drainage receives input from the northwest portion of the park. Dellingham Branch and Stonehouse Branch convey water toward the northwest into Kings Creek, which defines the park boundary in that area. The Long Branch drainage receives input for the eastern half of KIMO and conveys water toward the southeast out of the park. The Garner Branch drainage receives input from the southwest sector of the park and conveys water toward the southwest and eventually into Kings Creek south of the park (see Figure 2). All of these streams are part of the Broad River drainage (Figure 6).

According to the South Carolina Water Plan, minimum flows for streams should be established to protect fish and wildlife, and preserve water quality (Cherry and Badr, 1998). Mitigation techniques to locate an alternative water supply should be considered if a stream's flow is less than the minimum flow or undesired effects are occurring because of water withdrawals (Cherry and Badr, 1998).

Riparian Forest

The natural riparian areas along the streams in and around KIMO contain diverse, dynamic, and complex biophysical habitats. These riparian areas are known to be important in controlling the physical and chemical environment of streams and in providing detritus and woody debris for streams and near-shore areas of water bodies. For example, riparian forests of mature trees (30 – 75 years old) are known to reduce delivery of nonpoint source pollution to streams and lakes (Lowrance *et al*., 1985). Riparian vegetation has well-known beneficial effects on bank stability, biological diversity and water temperatures of streams (Karr and Schlosser, 1978). These interfaces between terrestrial and freshwater ecosystems are very sensitive to environmental change (Naiman and Décamps, 1997). Defining and ultimately managing riparian habitat is important to the preservation of KIMO's natural resources.

Wetlands

Wetlands represent transitional environments, located between uplands and deepwater areas. Flora within these wetland systems exhibit extreme spatial variability, triggered by very slight changes in elevation. Temporal variability is also great because the surface water depth is highly influenced by changes in precipitation, evaporation and/or infiltration. In reviewing the National Wetland Inventory (NWI) maps prepared by the U.S. Fish and Wildlife Service, there are no wetlands identified in KIMO. However; it should be noted that wetlands may exist in KIMO since the NWI aerial survey does not capture small wetlands (< 0.5 acre). For the Cowardin classification system, a wetland must have one or more of the following attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin *et al*., 1979).

Ground Water

Crystalline rocks in South Carolina and much of the Appalachia are an important source of water. This type of geology does not typically produce high well yields, but is capable of providing yields sufficient for individual homes, farms, and small businesses (Koch, 1966). Most ground water wells obtain water from the zone of sediment overlying the rock. Ground water in unweathered crystalline rock occurs in joints, faults, and fractures (Fetter, 1980). Ample water (yields up to 5 gpm) can usually be found for domestic needs. Higher yields are uncommon, although a carefully selected site could result in a higher yield (Koch, 1966). Larger well yields are typically found in valleys rather than hilltops, with fracture traces enhancing groundwater yields (Fetter, 1980).

Water Quality

KIMO is located within a U.S. Geological Survey NAWQA study basin (Santee River Basin and Coastal Drainage), established in 1994. The long-term goals of NAWQA are to describe the status of and trends in the quality of a large representative part of the Nation's surface- and ground-water resources, and to identify all major factors that affect the quality of these resources. NAWQA emphasis is on regional scale water-quality problems. According to Hughes (2001), regional-scale issues of concern in the Santee River Basin include:

1) Enrichment by nitrogen and phosphorus. Determining the capacity of rivers to assimilate wastewater from treatment plants without causing environmental degradation and the contribution of point and non-point source pollution to nutrient enrichment has been a major task for environmental agencies.
2) Sediment erosion due to agricultural practices of the 19^{th} and 20^{th} centuries.
3) Runoff that includes trace elements and synthetic organic compounds from urban areas.
4) Pesticide and nutrient contamination. Although farming within the basin has steadily declined since the 1920's, agriculture accounted for 18 percent of land use in 1970.

As described earlier in this report, KIMO is at the top of its watershed, resulting in minimal external influence on park water resources. This environmental setting appears ideal for an NPS unit with regards to protecting and preserving the water resources. Over half of KIMO's boundary (south and east) is shared with Kings Mountain State Park, providing additional protection to the natural systems. This is supported by a two-year study at KIMO (Zubricki, 1994 and 1995; Taylor, 1995 and 1996), where water quality data suggest that the water resources within the park boundary are relatively unimpacted. Kings Creek, which forms a small part of the park's northwest boundary, is the exception. Most of Kings Creek's watershed lies outside the protection of federal and state lands. Land use within this watershed includes agriculture, mining, and rural residential, which can contribute to water quality impacts on both surface and ground water systems. This water quality study provides a needed baseline for the park's water resources. Basic field parameters (water temperature, conductivity, pH, total dissolved solids, and turbidity) were recorded from five streams (Long Branch, Garner Branch, Dellingham Branch, Stonehouse Branch, and Kings Creek). The water quality data are summarized in Figures 7a and 7b. The Izaak Walton League of America's Stream Quality Survey was used to track the distribution and diversity of benthic macroinveretebrates in Long Branch, Garner Branch, Stonehouse Branch, and Kings Creek. This survey technique has been approved by EPA Region III. Results from this biological survey are graphically presented in Figure 7c.

In 1997, the NPS Water Resources Division completed a comprehensive summary of existing surface-water quality data for KIMO, the *Baseline Water Quality Inventory and*

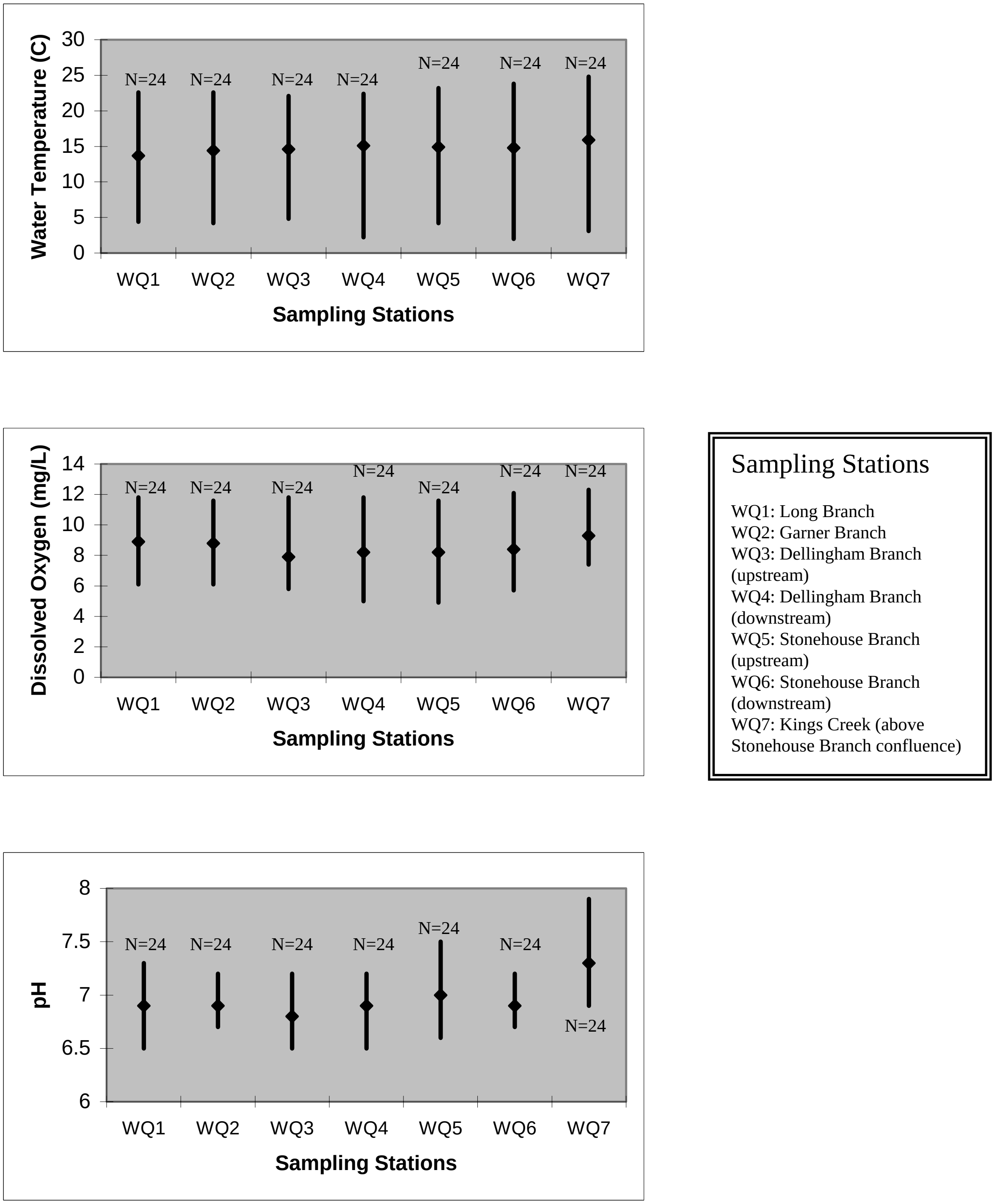
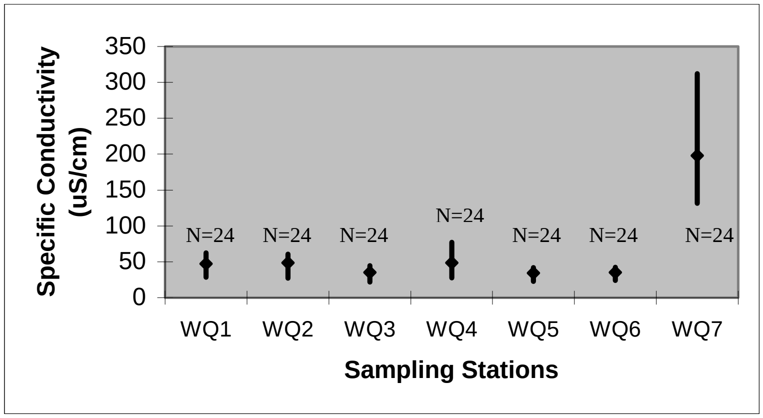
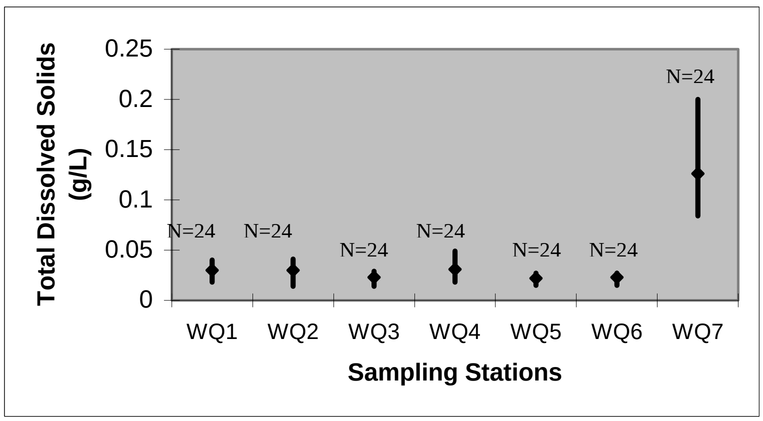


Figure 7a. 1994-1995 Water Quality Data (maximum, minimum, arithmetic mean) for Select Streams at Kings Mountain National Military Park (data source: Taylor, 1996).





Sampling Stations

WQ1: Long Branch
WQ2: Garner Branch
WQ3: Dellingham Branch (upstream)
WQ4: Dellingham Branch (downstream)
WQ5: Stonehouse Branch (upstream)
WQ6: Stonehouse Branch (downstream)
WQ7: Kings Creek (above Stonehouse Branch confluence)

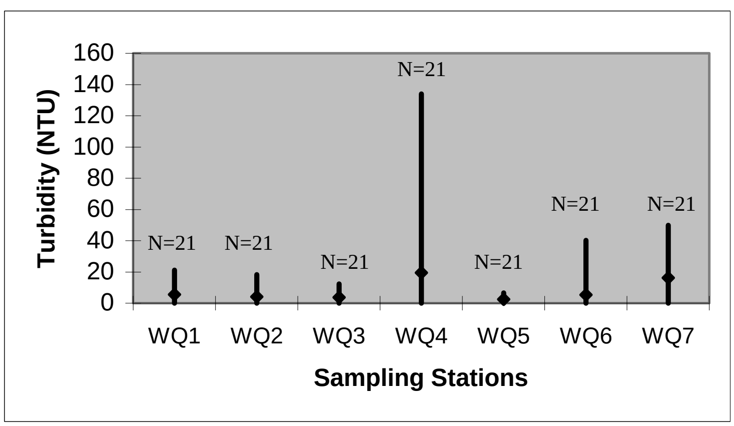
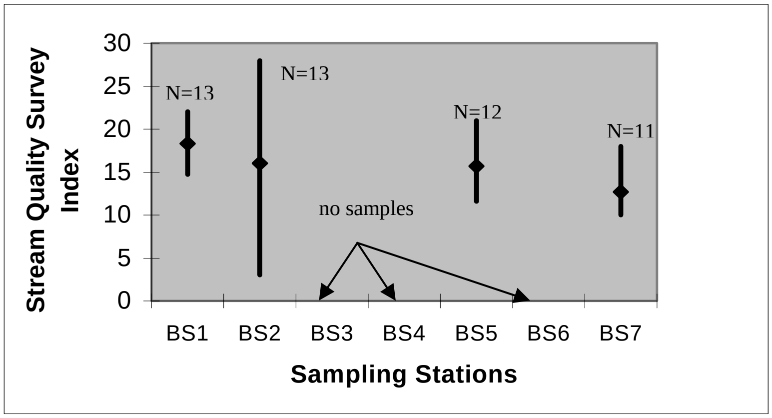
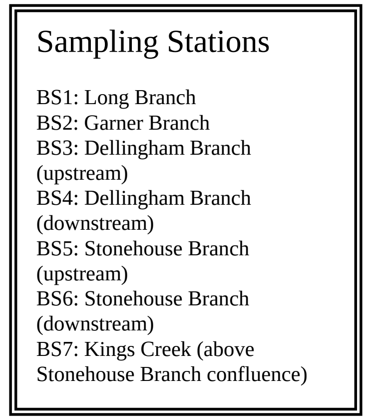


Figure 7b. 1994-1995 Water Quality Data (maximum, minimum, arithmetic mean) for Select Streams at Kings Mountain National Military Park (data source: Taylor, 1996).





Index Key: < 11 = poor, 11-16 = fair, 17-22 = good, > 22 = excellent

Figure 7c. 1994-1995 Biological Integrity Data (maximum, minimum, arithmetic mean) for select streams at Kings Mountain National Military Park (data source: Taylor, 1996).

Analysis, Kings Mountain National Military Park. The information contained in this report represents data retrievals from six EPA national databases; (1) Storage and Retrieval (STORET); (2) River Reach File (RF3); (3) Industrial Facilities Discharge (IFD); (4) Drinking Water Supplies (DRINKS); (5) Flow Gages (GAGES); and (6) Water Impoundments (DAMS). The stations yielding the longest-term records within KIMO's boundary are: (1) Long Branch Creek (KIMO 0005); (2) Kings Creek at the end of Howser House Road (KIMO 0006); (3) Stonehouse Branch near Kings Creek confluence (KIMO 0009); (4) Stonehouse Branch near Dellingham Road (KIMO 0010); (5) Dellingham Branch near Dellingham Road (KIMO 0008); and (6) Dellingham Branch near Kings Creek confluence (KIMO 0007). The stations yielding the longer-term records within the study area, but outside the park boundary, are: (1) Clark Fork upstream of Crawford Lake at Route 2245 near SC Routes 161 and 705 (KIMO 0012); (2) Long Branch Creek at SC Route 216 below Kings Mountain Park Recreation Area (KIMO 0004); (3) Clark Creek near Crawford Lake (KIMO 0011); and (4) Garner Creek (KIMO 0002). The results of the KIMO water quality criteria screen found four groups of parameters that exceeded screening criteria at least once within the study area. The study area included sampling sites immediately outside of KIMO's boundary. Dissolved oxygen and pH exceeded their respective EPA criteria for the protection of freshwater aquatic life. Fecal-indicator bacteria concentrations (fecal coliform) and turbidity exceeded the NPS-WRD screening limits for freshwater bathing and aquatic life. Monitoring sites within KIMO's boundary that exceeded the screening criteria one or more times were KIMO 0005, 0007, 0008 (pH); KIMO 0006 (dissolved oxygen); KIMO 0007 (turbidity); and KIMO 0005, 0006, 0007, 0008, 0009, 0010 (fecal coliform).

The 1997 baseline water quality report for KIMO provides specific information and selected graphical summaries on water quality data retrieved during the inventory (National Park Service, 1997). According to the report, potential anthropogenic sources of contaminants include industrial and municipal wastewater discharges; mining and quarrying operations; stormwater runoff; recreational use; atmospheric deposition; and agricultural runoff. Field observations made during my visit included riparian vegetation reduced along some stream reaches, or in some cases completely removed, to accommodate cattle grazing within the Kings Creek watershed. Also, a low density of rural homes exists in the area, which have individual septic and ground water systems.

The complex nature of crystalline rocks found in South Carolina make it difficult to define distinct chemical characteristics for each rock type. The amount of dissolved solids and other mineral matter that ground water will pick up is dependent, among other things, on the length of time the water is moving through the rock openings. Shallow wells are usually low in dissolved solids because the ground water has not had sufficient time to pick up all chemical characteristics of the rock. Deep wells usually contain higher quantities of dissolved solids (Koch, 1966). Differences in the length of time ground water has been in contact with rock can be one reason for variation in pH, dissolved solids, and chemical content in water from wells in the same rock type. Obviously, another reason for variation in water chemistry is travel through different rock types.

Ground water within the *Piedmont* phyiographic region, which includes KIMO, can contain relatively high concentrations of radon. This is a result of the uranium-bearing metamorphic rock that composes part of the *Piedmont* (Hughes, et al., 2000).

KIMO is located in the Cumberland/Piedmont Inventory and Monitoring Network, which is one of 12 networks (32 total networks) currently funded (beginning in 2001) through the Natural Resource Challenge to design and implement a water quality monitoring program. This program is to be fully integrated with the network-based Park Vital Signs Monitoring Program. The overall objective of the water quality component of Vital Signs is to improve the quality of impaired waters and to maintain the quality of pristine waters in parks. Specifically, by 2005, 85% of the NPS units will have unimpaired water quality. Joe Meiman, the hydrologist at Mammoth Cave National Park, is leading this effort for the Cumberland/Piedmont Network, with support from the NPS-Water Resources Division. In 2001, Mr. Meiman visited all the parks in the network, including KIMO, as part of the initial planning and design phase of this effort.

Biological Resources

Water resources are especially important to the success of KIMO's flora and fauna. KIMO should seek to perpetuate the native animal life and native plant life as part of the natural ecosystems and historical scene of the Battle of Kings Mountain. "Native" biological resources are defined as all species that as a result of natural processes have occurred, now occur, or may occur in the future on lands designated as National Parks (National Park Service, 2000). Since a comprehensive evaluation of biological resources extends beyond this report, the following two sections concentrate on park biological resources that are federally-listed as threatened, endangered, or candidate species, and state-listed as endangered or species of special concern. Along with providing some basic background information, the purpose of this section is to begin exposing some of the biological concerns in the region that may apply to KIMO and serve as indicators to water-related issues.

Fauna

Four listed species - northern cricket frog (*Acris crepitans crepitans*), Carolina darter (*Etheostoma collis*), bald eagle (*Haliaeetus leucocephalus*) and pickerel frog (*Rana palustris*) - occur in York County (Appendix A) (South Carolina Department of Natural Resources, 2001a). Due to existing habitat at KIMO, the potential presence for some of these species in the park is high. For example, the small streams in KIMO offer prime habitat for the Carolina darter, according to the South Carolina Department of Natural Resources. There are no listed fauna found in Cherokee County (South Carolina Department of Natural Resources, 2001a).

Flora

The vegetation at KIMO reflects a long history of anthropogenic disturbance and manipulation. Clear-cutting for farming took place as the area was settled in the latter part of the 18th century. In the early 19th century, cattle were raised until the land became overgrazed. In the 1890's cotton became the cash crop, but due to the depletion of the land, cotton production steadily decreased in the 1930's. In addition to clearing the land, the early residents introduced many species of exotic plants. Many of these plants have become a permanent part of the vegetation community (e.g., yucca and honeysuckle). There are at least 11 known exotic plant species in the park (KIMO PMIS #3818).

Once the cleared fields were abandoned, the fast-growing pines dominated the landscape. Over time, hardwoods are beginning to dominate some areas due to heavy cutting of pines and pine beetle impacts (National Park Service, *no date*) (National Park Service, 1999). Today, KIMO contains four distinct forest communities; 1) Piedmont/Low Mountain Alluvial Forest, 2) Mesic Mixed Hardwood Forest, 3) Piedmont Monadnock Forest, and 4) Chestnut Oak Forest (Kennemore, 1995). According to Kennemore (1995):

1) The composition of the forest communities in KIMO is determined more by soil moisture content than nutrient content.
2) The relative lack of fixed nutrients in soils above the floodplain is a result of their having been leached out by rainwater and carried downhill into the floodplains, possibly contributing to the increased density and diversity of the herbaceous and shrub layers in the floodplain.

There are numerous plant species found in both York and Cherokee counties that are listed (see Appendix B). Inventories should be conducted in the park to confirm the presence of listed floral species.

WATER RESOURCE ISSUES

The park's water-related issues presented in this section were identified during a two-day information-gathering effort in KIMO by the author. Along with a technical literature review, information sources included interviews with NPS management and other federal and state agencies.

Baseline Inventory and Monitoring

To effectively manage natural resources, inventory and monitoring activities should integrate into the overall natural resources planning and management process. Information obtained from these activities better assists the NPS toward understanding how the various environments in a park unit function naturally, and helps isolate anthropogenic changes. According to the NPS, *Natural Resources Inventory and Monitoring Guideline* (NPS-75), NPS units have the primary responsibility for implementing inventory and monitoring programs. The major issue for the natural resource management program at KIMO is the lack of direction due to large gaps in natural resource baseline data. As a result, the present status of the park's natural resources, including water resources, is difficult to assess due to the lack of baseline data (National Park Service, 1999). KIMO should define, assemble, and synthesize baseline inventory data describing the park's water resources under its stewardship and should monitor key aspects of these resources, including interrelationships with visitor carrying capacities at regular intervals to detect changes that may require intervention, and to provide reference points for comparison with other environments and time frames. The collection of adequate information and data to support planning and the analysis of impact of environmental resources, including cultural resources, will precede any final decisions about the preservation or treatment of natural resources (National Park Service, 2000).

The results from the two-year water quality study at KIMO (Zubricki, 1994 and 1995; Taylor, 1995 and 1996) and additional water quality data contained in the 1997 baseline water quality report (National Park Service, 1997) need to be evaluated to develop a long-term monitoring program for the park. The first year of this process should be used to analyze the quality and usefulness of past information to determine its value to park management. During this time, information that should be collected includes:

- State stream classifications and associated water quality standards and other comparison benchmarks.
- Existing water quality data and site locations.
- Climate, physiography/geology, atmospheric deposition, and land use data/information.

Synthesis of this available information will provide the needed foundation for design of a park-specific water quality monitoring network. A water quality monitoring plan can then be developed for KIMO. Elements of the plan should include; decisions and rationale on location and prioritization of water quality monitoring stations, sampling frequency, parameter selection, methodology, and quality assurance/quality control procedures. Some long-term monitoring will be related to generalized status and trends, while other monitoring may be related more to regulatory issues (e.g., impacts of KIMO wastewater treatment outfall).

KIMO is in need of an inventory of aquatic macroinvertebrates in the park's springs and streams to complement the 1994-95 biological sampling efforts (Zubricki, 1994 and 1995; Taylor, 1995 and 1996). Evaluating the conditions of waterbodies by examining the resident fauna has been well established in both theory and practice for several decades (Davis, 1995). The inventory would serve as a baseline from which future biological monitoring could be measured. The park has developed a project statement (KIMO PMIS #70327) that, when funded, will inventory aquatic macrointertebrates in KIMO's waters. The scope of the investigation is designed to include Kings Creek, Clark Creek, and Stone House Branch, and other lesser watercourses. Inventory of existing Threatened and Endangered species, both flora and fauna, should also be a priority for the park.

KIMO is in the process of developing a Geographic Information System (GIS) program. The park's GIS program is working to incorporate existing GIS data layers, along with new park-specific data themes to help fuel some of the park's management needs for natural resources. For example, some of the spatial data (i.e., landuse, geology, stream classifications) generated from the GIS program can be used to fuel some of the information needs previously described for the park's water quality monitoring program. The South Carolina Department of Natural Resources maintains several GIS data themes that would apply to KIMO's natural resources (South Carolina Department of Natural Resources, 2001b). The park should inventory what GIS data sources exist before working to generate new park-specific data themes.

Minerals Extraction

KIMO is located in an area (Kings Mountain belt) that includes a variety of mineral deposits. The following minerals have been obtained in significant quantities: marble, kyanite, iron, manganese, gold, silver, barite, pyrite, spodumene, cassiterite, mica, feldspar, and clay. Pegmatites in the Kings Mountain belt contain the western world's largest reserves of lithium. Iron-ore deposits in the northern part of the belt were the principal domestic supply of iron in North Carolina for 100 years (Horton and Butler, 1977).

With the extensive mineralization in the region, minerals have been extracted in and around the park (National Park Service, 1999). Strip Mining and Stone Quarry mining are heavy in areas adjacent in the park (KIMO PMIS #40641). KIMO does have two abandoned mining sites that need to be surveyed and evaluated for historic significance, impacts to the natural environment, and safety issues. One site is a strip mine for slate and the other site is a surface operation with an open vertical shaft (National Park Service, 1999).

Activities associated with mine development could produce pollutants such as airborne particulates and runoff-related erosion, as well as the potential for discharge of solids into adjacent surface waters. Excessive sediment loading could cause an increase in turbidity and sediment deposition, which could adversely affect aquatic life. The geology in the region would allow contaminants to move quickly over the surface or along the soil-bedrock interface, making its way into surface waters. Potential contamination of the surface and ground waters during a typical mining operation can occur from three primary effluent sources: (1) excess water pumped out of the underground mine, (2) contaminated water derived from the mill, particularly from the flotation process (this water goes to the tailings pond), and (3) tailings pond effluents, derived either from surface overflow or, more likely, from seepage loss. Mine effluent may be somewhat acidic and contain dissolved salts (i.e., calcium, magnesium, sodium) and traces of heavy metals (i.e., copper, iron, lead, zinc) (Davis *et al*., 1994). Even though mining is a highly regulated industry, the NPS's best means of protecting park resources from potentially adverse mining effects is to stay informed and involved. Mining activities within the State are permitted by the Mining and Reclamation Division of the Department's Bureau of Land and Waste Management.

Fish and Fisheries

KIMO does not have a comprehensive inventory of fish species residing within park waters. Three streams (Kings Creek, Clarks Fork, Long Branch) in or near KIMO were surveyed for fish in 1973-74. A sample of 11 to 12 fish species is common from *Piedmont* streams. Some of the surveyed sites had considerably more species which indicates a better than average aquatic habitat. A comparison of this information with new stream survey data would assist the NPS in better evaluating aquatic health of these streams. In a February 2000 letter to KIMO from South Carolina Department of Natural Resources, it was suggested that Dr. Bill Rogers (Winthrop University) would be interested in conducting a fish survey at KIMO (Christie, 2000). In response to this interest, the park is funded to inventory fish species within park waters (PMIS # 59018). The research will be conducted through a cooperative agreement with Winthrop University working with the South Carolina Department of Natural Resources. The project will involve field sampling and inventory for approximately two years. A database will be created to indicate species frequency and abundance throughout the year at selected locations that represent the diversity of KIMO's ecosystem.

Atmospheric Deposition

At this time it is unknown whether the streams in the park are impacted by, or sensitive to atmospheric deposition. However limited stream chemistry collected from the park in 1994-95 indicates several low conductivity streams (< 100µS/cm) (Zubricki, 1994 and 1995; Taylor, 1995 and 1996). In locations where these streams combine with bedrock geology that weathers slowly, such as granite and quartzites, and therefore provide limited buffering to any acidic deposition, the possibility of surface water impacts from acidic deposition exists. In addition, data from the National Acidic Deposition Program

(NADP) show elevated levels of nitrogen and sulfur deposition along the North Carolina/South Carolina border (Blett, pers. comm., 2001).

Additional stream chemistry analytical parameters would help to better evaluate the sensitivity of KIMO's water resources to acidic deposition. Acid Neutralizing Capacity (ANC) lab data from the currently monitored streams can be easily obtained and would be particularly useful in determining how much acidic deposition buffering ability is contained within these streams. If ANC is near 0, then additional acid deposition can easily affect pH and produce conditions toxic to aquatic life. Additional stream chemistry data useful in assessing acidic deposition impact include the major cations (Ca, Mg, K, Na, NH_4, and H) and major anions (SO_4, NO_3, Cl), along with dissolved organic carbon (DOC) (Blett, pers. comm., 2001)(Turk, 2001). It may be necessary to inventory systems that are potentially sensitive to acid deposition before finalizing a water quality monitoring plan. KIMO should seek assistance from NPS Air Resources Division for assistance in evaluating atmospheric deposition and water quality data, identifying air pollution-sensitive aquatic systems, and implementing air pollution-related water monitoring protocols, if warranted.

Recreational Management

In 2000, KIMO reported a total of 506,662 visitors, with 257,499 defined as recreation visits. The park maintains both hiking and horse trails for visitors. Excluding the 1.5-mile Battlefield Trail located at KIMO's visitor center, these trails run continuously between KIMO and Kings Mountain State Park. Two primary water quality concerns related to these recreation trails are; 1) accelerated sediment yields from trail erosion and 2) bacteria contamination from horse and human sources.

Over time, many trail segments in a mountainous terrain deteriorate by natural processes and by wear from recreation traffic (Summer 1986, Tinsley and Fish 1985). The magnitude of trail deterioration is determined by characteristics of the trail, its environment, and the recreation use that the trail receives (Cole, 1987). On a trail in Great Smoky Mountains National Park, Whittaker (1978) found that horse use caused more pronounced increases in trail width, trail depth, and litter loss than hiker use. In a study of impact to existing recreational trails, Wilson and Seney (1994) measured the effect of user impacts, including hiker and horse traffic, on sediment yield following simulated rainfall. In the study, sediment yield following horse use was found to be significantly greater than hiker use. This is explained by the simple fact that horses are heavier and their weight is carried on a shoe with a small weight-bearing surface, thus soil displacement is greater. The increased sediment yields from trail use, under the right conditions, can enter a waterbody and degrade water quality through increased turbidity and total dissolved solids, and degrade aquatic habitat by covering the natural substrate through increased sediment deposition. In contrast, Summer (1980) was unable to detect differences in erosion rates between trails in Rocky Mountain National Park used by hikers and those used by horses, suggesting that trail characteristics and/or environment, contribute to the cumulative outcome on trail impacts.

The trails in KIMO cross several streams (Garner Branch, Stonehouse Branch, Long Branch) and unnamed tributaries. These stream crossings are particularly sensitive to bacteria contamination from horse and human sources. At these locations, management to buffer these areas may be warranted, in order to minimize the potential of animal or human wastes entering directly or within close proximity of a waterbody.

Equestrian use at the park has increased by more than 100% over the past seven years, with a continued increase expected. KIMO has developed a project statement (KIMO PMIS #50614) to address some of the issues described above. The currently unfunded project is designed to restore 5 miles of horse trail by improving drainage with culverts and water bars, repair eroded areas, erection of retaining walls at stream crossings, and placing crusher-run on badly deteriorated sections of the trail.

Wastewater Treatment

Due to the lack of good soils for accommodating septic leach fields, a sewage treatment plant was constructed (1975) in KIMO to treat domestic wastes generated in the visitor center. The treated discharge from the sewage treatment plant is permitted (NPDES permit) to discharge to a local tributary, Clark Fork Creek, according to Stoneburner (1976). Based on my observation of the sewage treatment plant location, the closest down-gradient stream is Long Branch, a tributary of Clark Fork Creek.

In 1976, six months after the treatment plant had been in operation, sampling of Clark Fork Creek was conducted to determine if treated discharge from the plant was influencing the aquatic biota and water chemistry of the creek. Based on this assessment, there was a minor increase in nitrogen as nitrate, nitrite, and ammonia, and no discernable impact on other basic water quality parameters or macroinvertebrates (Stoneburner, 1976). There was no water quality or biological sampling of Long Branch and there have been no studies since 1976 to further evaluate treated discharge impacts to stream health. In May 2001, all park buildings (headquarters, residential area, and maintenance area) were connected to KIMO's sewage treatment plant, except for one park house (Quarters 5), increasing domestic waste loading at the plant (KIMO PMIS #37414). The need for assessing the influence of the treated sewage outfall on stream health and comparing with the 1976 data is warranted.

Age is also taking its toll on the 26-year-old clay pipe that transfers sewage 1400 feet from the visitor center to the sewage treatment plant. The clay pipe is currently being infiltrated by groundwater, especially during wet periods. This infiltration increases flow rates, causing handling problems for the normal operation of the sewage treatment plant and increased discharge into Clark Fork Creek. This will obviously increase the potential for localized soil and groundwater contamination. KIMO has developed a project statement (KIMO PMIS #50646), currently unfunded, to replace this deteriorating sewage pipe.

The "Quarters 5" house (Mary Morris House) is still plumbed to a 60-year-old septic tank system that is in desperate need of replacement. Roots from a large oak tree have penetrated the lines causing the system to back up, creating health problems for temporary residents, which was noted by a Public Health Inspection (01/31/00). Also, the potential for local environmental contamination problems (e.g., elevated bacteria and/or nutrient contamination) originating from this deteriorated septic system exists. KIMO has developed a project statement (KIMO PMIS #56772), currently unfunded, that includes installing a new septic tank, drain field lines and supply lines from the house to the new tank. All components of the old system, including the old tank, would be removed and properly disposed.

Wetlands Management

NPS units are required to preserve natural wetland characteristics and functions, minimizing wetland degradation and loss, and avoiding new construction in wetlands. The NPS implements a “no net loss of wetlands” policy. *Executive Order 11990* directs the NPS: 1) to provide leadership and to take action to minimize the destruction, loss, or degradation of wetlands; 2) to preserve and enhance the natural and beneficial values of wetlands; and 3) to avoid direct or indirect support of new construction in wetlands unless there are no practicable alternatives to such construction and the proposed action includes all practicable measures to minimize harm to wetlands (National Park Service, 1998).

As stated earlier in the report, there are no wetlands identified in KIMO based on the current National Wetland Inventory (NWI) maps (1:24,000). But smaller wetlands (<0.5 acres) are typically not captured on the NWI maps. Therefore, KIMO should survey the park for wetlands, to determine if any exist as defined by the Cowardin classification system (Cowardin et al., 1979).

Hazardous Waste Management and Spill Contingency Planning

For most NPS units like KIMO, internal NPS operations require that hazardous substances, such as petroleum products used by maintenance operations, be stored and handled on a routine basis. Although it is the goal of the NPS to minimize releases of these substances into the environment, accidental releases still occur. The action of those employees who first encounter contamination in the park could well determine the severity of the impact(s) on human health and the environment. Therefore it is important for NPS staff to understand the basic requirements for response to hazardous substance spills.

An even greater concern for hazardous spills in the park exists from external operations. A number of transportation corridors such as state and county highways, as well as active pipelines, can be found within or adjacent to the park. Trucks carry fuel oil, diesel fuel, gasoline, and a variety of agricultural and industrial chemicals along these corridors. The Colonial pipeline, located immediately northwest of the park’s boundary, transports diesel and gasoline (Revels, pers. comm., 2001). Given the potential pollution pathways, accidental release of hazardous materials is a continuous threat to KIMO’s natural resources.

The NPS is severely limited in qualified personnel, spill response equipment, and baseline natural resource information to effectively respond to and evaluate impacts from hazardous spills in KIMO. Emergency response to a major spill requires expertise and field equipment that extends beyond the capabilities of the NPS. In accordance with the National Contingency Plan established under the Clean Water Act, federal agencies are required to have a Spill Contingency Plan (SCP) for emergency response to any spill of oil or hazardous substances for which they are responsible. Furthermore, a Spill Prevention Control and Countermeasure Plan (SPCCP) is required for the NPS to maintain compliance with 40 CFR 112 (EPA Regulations on Oil Pollution Prevention).

Currently, KIMO does not have a SCP or SPCCP. The park manages aboveground petroleum tanks (diesel, gasoline, fuel oil) to fuel NPS equipment and park housing. It is important for the park to establish an internal communication process through planning documents (i.e., SCP and SPCCP) to maintain compliance with hazardous waste management and spill contingency planning. The result is a safer environment created for park staff and visitors.

The Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Act Amendments of 1984 and Title III of the Superfund Amendment Reauthorization Act (SARA Title III) require hazardous waste reduction programs. Executive Order 12873 establishes the goal for federal agencies to reduce their input into the waste stream by 40%. KIMO has initiated a recycling program to reduce solid waste flow from the park by 30-40%. Seven recycling bin sets have been installed in the park. Interpretive signs and brochures are being used by KIMO to educate visitors and promote recycling.

An environmental audit was completed at KIMO in 2001 as part of a Service-wide program that requires all NPS facilities to receive an environmental audit by the end of FY2002. A comprehensive list of compliance needs, generated by this audit, are presented in Appendix C.

Coordination

Activities that take place outside park boundaries and not under NPS control sometimes have a profound effect on the ability to protect park water resources and values. In recognition, the NPS is committed to working cooperatively in the management of natural resources with federal, state, and local agencies; user groups; adjacent landowners; and others. The NPS will seek to establish communication and consultation to better achieve park management objectives and protection of natural systems and values (National Park Service, 2000). Recognizing that cooperation with other land managers can accomplish ecosystem stability and other resource management objectives when the best efforts of a single manager might fail, KIMO should develop agreements with other land managers when appropriate to coordinate natural resource management activities in ways to improve, not compromise, park resources.

Communication and coordination with the U.S. Geological Survey are critical components of NAWQA. Study-unit liaison committees have proved highly effective and consist of representatives from Federal, State, and local agencies; universities; and the private sector who have water-resources responsibilities or interests in the region. According to Hughes (2001), specific activities of each liaison committee include:

1) Exchange of information and prioritization of water-quality issues of regional local interest.
2) Identification of sources of water-quality data and other information.
3) Assistance in design and scope of project elements.
4) Review of project planning activities, findings, and interpretations, including reports.

Seeking support from local universities and other academic programs can provide local expertise to support natural resource management at KIMO. For example, Winthrop University has agreed to conduct a fish survey in the park. This survey data will be compared with 1973-74 fish-survey data, and current water chemistry data, to better evaluate stream health. The park has even found valuable assistance from Kings Mountain and Clover high schools. Biology students have volunteered their time to inventory macroinvertebrates in KIMO's streams, under park supervision, to complement water quality data collected in 1994-95.

Internal NPS coordination should also be considered by the park. For example, seeking technical assistance from the NPS Air Resources Division for support in evaluating atmospheric deposition and associated water quality impacts, identifying air pollution-sensitive aquatic systems, and implementing air pollution-related water monitoring protocols, if warranted. KIMO has demonstrated cooperation between local NPS units. A two-year cooperative agreement between KIMO and Cowpens National Battlefield was used to update both park Resource Management Plans and resource management project statements (KIMO PMIS #57415).

RESOURCES MANAGEMENT STAFFING

The KIMO Resource Management Division staff is currently comprised of permanent positions as indicated in the organizational chart presented in Figure 8. Due to the lack of park staff, these positions must serve multiple disciplines at KIMO (i.e., resource management, interpretation, law enforcement). The Chief of Resource Management Division reports directly to the Superintendent.

The need for resource management assistance at small parks is well documented in the Natural Resource Management Assessment Program (NRMAP), which evaluates the workload of a NPS unit with respect to natural resources. Under the NRMAP calculations and regional prioritization of 1995, Kings Mountain was in the top 30 for full-time equivalent (FTE) allocations. In 1996, the Appalachian Cluster Strategic Plan for Resource Management recognized this lack of staff and the need to coordinate efforts between cluster parks. In view of the success of cluster driven multi-park projects such as the small parks exotics program, KIMO recognizes the need to share resources between NPS units, as demonstrated with a two-year cooperative agreement (funded through FY02) between KIMO and Cowpens National Battlefield to hire a term Biological Technician position. This shared position will be used to update both park Resource Management Plans and resource management project statements.

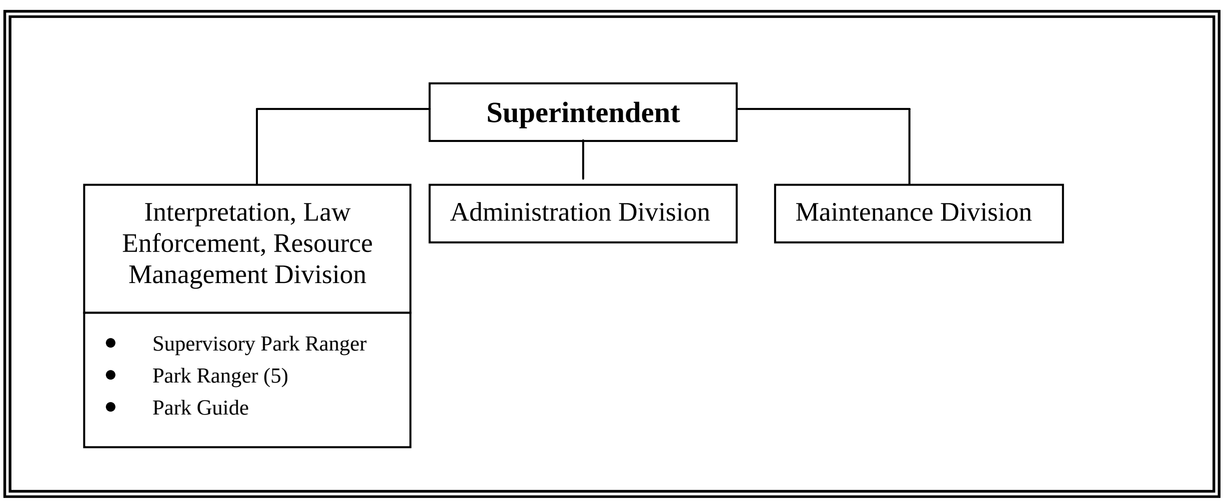


Figure 8. Kings Mountain National Military Park, Resource Management Program: Organizational Chart.

RECOMMENDATIONS

The water-related issues and natural resource data presented in this report are supported, in part, through regional and local inventories, research, and monitoring efforts. Identification of available water resource information (i.e., what has or has not been done at KIMO) has also contributed toward exposing the "data gaps", which translates to natural resource needs for KIMO. Some of the water-related needs captured in this report are summarized below:

- Baseline Inventory and Monitoring
  - In general; define, assemble, and synthesize baseline inventory data describing the park's water resources and monitor key aspects of these resources, including interrelationships with visitor carrying capacities at regular intervals to detect changes that may require intervention, and to provide reference points for comparison with other environments.
  - Develop a long-term water quality monitoring program that evaluates status and treads of KIMO's stream health, and regulatory issues.
  - Complete data-layers for KIMO GIS to fuel some of the park's data management needs for water resources.
  - Inventory of aquatic macroinvertebrates in KIMO's waters.
  - Inventory of Threatened and Endangered flora and fauna in KIMO.

- Minerals Extraction
  - Survey the two abandoned mining sites in the park for safety issues, impacts to the natural environment, and historic significance.
  - KIMO should stay informed and involved with active mining operations in the area and seek technical assistance when park resources appear to be threatened.

- Fish and Fisheries
  - Support funded efforts to inventory fish species within KIMO waters.

- Atmospheric Deposition
  - Additional stream chemistry analysis is needed to better evaluate the sensitivity of KIMO's water resources [Acid Neutralizing Capacity (ANC), Ca, Mg, K, Na, NH_4, H, SO_4, NO_3, CL, and dissolved organic carbon (DOC)]. The park should seek assistance from NPS Air Resources Division for assistance in evaluating atmospheric deposition and water quality data, identifying air pollution-sensitive aquatic systems, and implementing air pollution-related water monitoring protocols, if warranted.

- Recreational Management
  - Assess water quality at trail (horse and hiking trails) stream crossings in KIMO for elevated bacteria and turbidity concentrations. Based on water quality analysis, develop management strategies, as warranted, to improve degraded conditions (i.e., establish buffer areas around stream crossings).
  - Improve drainage along KIMO trails to reduce accelerated sediment yields from trail erosion. Harden trail surfaces on badly deteriorated sections.
  - Incorporate environmental education into KIMO's interpretive program (e.g., provide educational brochures to visitors and local residents that communicate park management objectives, priority issues (including understandable data that supports the issues), and, if possible, alternatives for reducing environmental threats).

- Wastewater Treatment
  - Assess the influence of KIMO's treated sewage outfall on stream health and compare with Stoneburner (1976) data.
  - Install new septic tank, drain field lines and supply lines at Quarters 5 (Mary Morris House).
  - Replace deteriorating clay sewage pipe that transfers sewage 1400 feet from KIMO's visitor center to the sewage treatment plant.

- Wetlands Management
  - Inventory wetlands in the park at greater resolution (larger scale) than the current 1:24,000 National Wetlands Inventory (NWI) maps.

- Hazardous Waste Management and Spill Contingency Planning
  - Incorporate the "recommended corrective actions" identified during the 2001 Environmental Audit at KIMO. The corrective actions are listed in Appendix C.

- Coordination
  - Continue to develop cooperative relationships with other land managers, when appropriate, to coordinate natural resource management activities including; U.S. Geological Survey (Santee River Basin studies), Kings Mountain State Park (recreational/natural resource management), Winthrop University (fisheries), NPS Air Resources Division (atmospheric deposition), U.S. Environmental Protection Agency (Upper Broad River Basin studies), and South Carolina Department of Natural Resources (surface water-ground water-fisheries).

Based upon KIMO's water resources and associated issues, this Water Resources Scoping Report will meet the park's water resource management needs over the next several years. Components of this scoping report should be used in the development of time-sensitive management strategies and priority project statements relating to park-specific water resource issues. The park is encouraged to work through the NPS technical assistance process, or with other agencies (i.e., USGS, SCDNR), as needed, to prepare discipline-specific project statements to compete for internal and/or external funding sources.

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Appendix A. South Carolina Rare, Threatened & Endangered Fauna Species for York County (South Carolina Department of Natural Resources, 2001a).

Scientific Name	Common Name	Global Rank	State Rank	Legal Status
Acris crepitans crepitans	Northern Cricket Frog	G5T5	S5	SC
Etheostoma collis	Carolina Darter	G3	S?	SC
Haliaeetus leucocephalus	Bald Eagle	G4	S2	FT/SE
Rana palustris	Pickerel Frog	G5	S?	SC

Explanation of Global, State and Federal Species Ranks for Appendix A and B

The Nature Conservancy rating of degree of endangerment world-wide:

G1 - Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction
G2 - Imperiled globally because of rarity or factor(s) making it vulnerable
G3 - Either very rare throughout its range or found locally in a restricted range, or having factors making it vulnerable
G4 - Apparently secure globally, though it may be rare in parts of its range
G5 - Demonstrably secure globally, though it may be rare in parts of its range
GH - Of historical occurrence throughout its range, with possibility of rediscovery
GX - Extinct throughout its range
G? - Status unknown

The Nature Conservancy rating of degree of endangerment in South Carolina:

S1 - Critically imperiled state-wide because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation
S2 - Imperiled state-wide because of rarity or factor(s) making it vulnerable
S3 - Rare or uncommon in state
S4 - Apparently secure in state
S5 - Demonstrably secure in state
SA- Accidental in state (usually birds or butterflies that are far outside normal range)
SE - Exotic established in state
SH - Of historical occurrence in state, with possibility of rediscovery
SN - Regularly occurring in state, but in a migratory, non-breeding form
SR - Reported in state, but without good documentation
SX - Extirpated from state
S? - Status unknown

SATUS - legal status:

FE - Federal Endangered
FT - Federal Threatened
PE - Proposed for Federal listing as Endangered
PT - Proposed for Federal listing as Threatened
C - Candidate for Federal listing
NC - Of Concern, National (unofficial - plants only)
RC - Of Concern, Regional (unofficial - plants only)
SE - State Endangered (official state list - animals only)
ST - State Threatened (official state list - animals only)
SC - Of Concern, State
SX - State Extirpated

Appendix B. South Carolina Rare, Threatened & Endangered Flora Species for Cherokee and York Counties (South Carolina Department of Natural Resources, 2001a).

Scientific Name	Common Name	Global Rank	State Rank	Legal Status
Agalinis auriculata[1]	Earleaf Foxglove	G3	S1	SC
Agrimonia pubescens[1]	Soft Groovebur	G5	S1	SC
Allium cernuum[2]	Nodding Onion	G5	S?	SC
Amphianthus pusillus[1]	Pool Sprite	G2	S1	FT/ST
Aster georgianus[3]	Georgia Sprite	G2G3	S?	SC
Aster laevis[1]	Smooth Blue Aster	G5	S?	SC
Camassia scilloides[1]	Wild Hyacinth	G4G5	S2	RC
Carex scabrata[2]	Rough Sedge	G5	S?	SC
Cyperus granitophilus[1]	Granite-Loving Flatsedge	G3Q	S?	SC
Dasistoma macrophylla[1]	Mullein Foxglove	G4	S?	SC
Eleocharis palustris[1]	Spike-rush	G5	S?	SC
Elimia catenaria[1]	Gravel Elimia	G4	S?	SC
Elymus riparius[1]	Wild-Rye	G5	S?	SC
Eupatorium sessilifolium var vaseyi[1]	Thoroughwort	G5T?	S?	SC
Helianthus laevigatus[3]	Smooth Sunflower	G4	S?	SC
Helianthus Schweinitzii[1]	Schweinitz's Sunflower	G2	S1	FE/SE
Hexastylis naniflora[2]	Dwarf-Flower Heartleaf	G2	S2	FT/ST
Hydrangea cinerea[2]	Ashy-Hydrangea	G4	S?	SC
Hymenocallis coronaria[1]	Shoals Spider-Lily	G2Q	S2	NC
Isoetes piedmontana[1]	Piedmont Quillwort	G3	S2	SC
Juncus georgianus[1]	Georgia Rush	G4	S?	SC
Lilium canadense[1]	Canada Lily	G5	S1?	SC
Lipocarpha micrantha[1]	Dwarf bulrush	G4	S2	SC
Melanthium virginicum[1]	Virginia Bunchflower	G5	S?	SC
Menispermum canadense[3]	Canada Moonseed	G5	S?	SC
Minuartia uniflora[1]	One-Flower Stitchwort	G4	S?	SC
Manadnock[3]		G?	S?	SC
Myotis austroriparius[2]	Southeastern Myotis	G3G4	S1	ST
Najas flexilis[1]	Slender Naiad	G5	S?	SC
Oxypolis canbi[1]	Canby's Dropwort	G2	S1	FE/SE
Panax quinquefolius[1]	American Ginseng	G3G4	S2S3	RC
Poa alsodes[1]	Blue-Grass	G4G5	S?	SC
Quercus bicolor[1]	Swamp White Oak	G5	S1	SC
Quercus oglethorpensis[1]	Oglethorpe's Oak	G3	S3	SC
Ranunculus fascicularis[1]	Early Buttercup	G5	S?	SC
Ratibida pinnata[1]	Gray-Head Prairie Coneflower	G5	S?	SC
Rudbeckia heliopsidis[1]	Sun-Facing Coneflower	G2	S1	NC
Scutellaria parvula[1]	Small Skullcap	G4	S?	SC
Silphium terebinthinaceum[1]	Prairie Rosinweed	G4G5	S1	SC
Solidago ptarmicoides[1]	Prairie Goldenrod	G5	S?	SC
Solidago rigida[1]	Prairie Goldenrod	G5	S1	SC
Thermopsis mollis[1]	Soft-Handed Thermopsis	G4?	S?	SC
Tiarella cordifolia var cordifolia[1]	Heart-Leaved Foam Flower	G5T5	S?	SC
Torreyochloa pallida[1]	Pale Mana Grass	G5?	S?	SC
Verbena simplex[1]	Narrow-Leaved Vervain	G5	S?	SC
Veronicastrum virginicum[1]	Culver's-Foot	G4	S?	SC
Xerophyllum asphodeloides[2]	Eastern Turkeybeard	G4	S1	SC

NOTE: [1] Species found in York County, [2] Species found in Cherokee County, [3] Species found in York and Cherokee counties

Appendix C. KIMO Audit Finding Summary Report (Prizim Inc., 2001).

Finding Description	**Recommended Corrective Action**	**Finding Citation**
Adequate emergency spill response clean-up equipment was not provided.	Obtain emergency spill response clean-up equipment for the areas listed.	29 CFR 1910.120(I)(1)(vii)
A plan to respond to non-incidental spills or releases of hazardous materials was not developed and implemented.	If KIMO determines that employees are not to engage in clean-up operations but has the potential for a hazardous material release, KIMO must develop an Emergency Action Plan. This plan should include the following elements: a. Evacuation plan for KIMO personnel, including signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes. b. Procedures to notify local spill response and clean-up agencies. c. Clear specification that KIMO employees are not to engage in clean-up activities unless they are authorized under an Emergency Response Plan.	29 CFR 1910.38(a)
Above-ground storage tanks were not equipped with leak detection systems inside the secondary containment.	Install liquid sensor with the secondary containment to detect liquid.	NFPA 30A, 2-4.4(g)
Above-ground storage tank's liquid level gauge was destroyed by the elements and illegible. Means were not provided to sound an audible alarm when the liquid level in the tank reached 90% capacity. Means were not provided to automatically stop the flow of liquid into the tank when the liquid level reached 95% capacity.	Replace the liquid level gauge and cover to protect from the elements. Obtain an alarm that signals the fueler when the tank reaches 90% capacity, along with a means to stop flow when the liquid level reaches 95%.	NFPA 30A, 2-4.6.1
Piping from the heating fuel oil tanks was not protected from soil chemistry's corrosion. Quarters #5 encountered a line leakage as a result of substantial corrosion of the boiler's feed line. Other private residences in the area had experienced similar problem.	Protect the feed and return lines with plastic secondary containment piping. Ensure that all joints of the plastic piping are encased in a secondary containment basin that can be monitored for any leaks in the line.	29 CFR 1910.106 (c) (5), NFPA 30A, 2-4.6.7
A comprehensive Hazard Communications (HAZCOM) Plan was not developed and implemented.	Develop a comprehensive HAZCOM Plan that includes Park-wide operations and is made available to all employees of the Park. Components of a complete HAZCOM Plan include: ▪ Inventory of all hazardous chemicals/materials in the Park (update annually or semi-annually); ▪ Complete an accessible (central location that employees are aware of) collection of MSDSs (update MSDSs as inventory changes); ▪ HAZCOM training schedule and training records for all Park employees; ▪ A universal labeling system for containers used to store/apply hazardous chemicals; and ▪ Accident response procedures with emergency contacts. • MSDS = Material Safety Data Sheets	29 CFR 1910.1200 (e)(1)(I) 29 CFR 1910.1200 (g)(8)

Finding Description	Recommended Corrective Action	Finding Citation
Hazard communications training for all permanent and seasonal staff was not provided by KIMO. Procedures designed to inform staff of potential hazards resulting from non routine KIMO activities were not developed and implemented.	Ensure that all employees receive HAZCOM training. Training topics include: ▪ MSDSs ▪ Detecting the presence or releases of hazardous materials; and ▪ Utilization of the labeling system implemented throughout KIMO. Note: this is contingent upon the implementation of a HAZCOM Plan. Develop an SOP for relaying information to staff about the occurrence of and potential hazards resulting from non-routine activities in KIMO.	29 CFR 1910.1200 (h)(1-3)
Incompatible materials were stored next to each others (i.e., muriatic acid stored with flammables in gas house).	Separate all incompatibles. Store all pesticides together in an approved storage cabinet, keeping like pesticides on the same shelf. Store acids and corrosives in an approved corrosives storage cabinet. Ensure that only flammable and combustible material is stored in flammable cabinets or sheds.	29 CFR 1910.176(c)
KIMO stored leaking, orphaned and expired products that were not managed as hazardous wastes. Note: orphaned hazardous substances, no longer used for their intended purpose are considered hazardous waste.	Survey dated/unused/orphaned materials. Disposed of identified materials as wastes in accordance with the characteristics of each waste material. Track generation and disposal of the hazardous wastes. Implement a policy to dispose of wastes identified during periodic surveys.	40 CFR 262.11(a-d)
Air vents in the Flammables Building (Maintenance area) were at floor level, which would allow for any spills to discharge outside.	Provide containment (i.e., absorbent sock) around the vent to prevent discharged oil from reaching outside in case of a spill.	40 CFR 112.7 (e)(2)(ii)
A Spill Prevention Control and Countermeasure (SPCC) Plan was not developed. Note: over 1,320 gallons of petroleum product were stored above ground which triggers KIMO's applicability to SPCC regulations.	Develop a plan that includes the following elements: ▪ Explanation of regulatory applicability; ▪ General KIMO description including name, function, and park drainage patterns; ▪ Facility diagram which indicates the locations of oil storage and handling; ▪ Description of oil storage and handling areas; ▪ Description of past spill events; ▪ Analysis of potential spill scenarios including predictions of direction and rate of flow and total quantities of oil that could be released; ▪ Description of SPCC responsibilities including a KIMO Spill Coordinator; ▪ Description of spill containment and drainage control structures and equipment for oil storage and handling facilities; ▪ Description of emergency response equipment; ▪ Description of spill notification procedures; ▪ Oil Spill Contingency Plan describing spill response and clean-up procedures including coordination with concessionaires/contractors, local authorities and spill response training and exercises and security measures; ▪ Spill Prevention Plan including inspection and monitoring program, tank integrity testing procedures, preventive maintenance and housekeeping procedures, formal spill response training and exercises and security measures; Review and update of procedures and documentation;	40 CFR 112.1 (d)(2)

Finding Description	Recommended Corrective Action	Finding Citation
Continued from previous page	▪ Certification that a Substantial Harm Analysis has been conducted for KIMO; ▪ Professional engineer's certification; and ▪ Management approval.	
An environmental training program for all employees did not exist. A training needs assessment had not been conducted to evaluate the environmental aspects of each job function and determine required training.	Conduct a training needs assessment to identify training needs of all employees whose work requires environmental training or may impact the environment. Develop environmental awareness training for all employees and job specific training based on compliance and pollution prevention aspects of job operations. Note: Required training may include: ▪ Hazardous materials communication; ▪ Hazardous waste awareness; ▪ Respiratory protection; and ▪ Green procurement	BMP
No procedures were in place to review current Federal, state, and local laws and regulations, and Executive orders, to receive updates on new requirements, or determine the applicability of requirements to specific operations and assure that facility staff are aware of requirements.	Develop and implement a plan to assure KIMO stays abreast of all environmental regulations that have an affect on the operations occurring in the Park. Ensure these changes reach all workers through training, a newsletter, or other type of communication system.	BMP
A documented environmental management system (EMS) was not initiated nor was staff aware that a system was required by 12/31/05.	An EMS is unique to each park unit and represents the priority, scope and values each gives to environmental management. It is recommended that the NPS establish and document an approach for establishing a documented EMS as a near-term corrective action.	BMP
There was no inventory of all fuel tanks.	Develop an inventory of all regulated and unregulated USTs and ASTs. The inventory should include the following information: ▪ Tank type (AST/UST); ▪ Size; ▪ Contents; ▪ Age; ▪ Construction; ▪ Use (e.g., vehicle fueling, heating, etc.); ▪ Leak detection; ▪ Corrosion protection; ▪ Spill control; and ▪ Overfill equipment (including secondary containment). Note: this information will also be needed in the SPCC Plan.	BMP
Hazardous waste inventories, generation logs, or other documentation to confirm the Park's hazardous waste generator status (e.g., Conditionally Exempt Small Quantity Generator (CESQG), Small Quantity Generator (SQG), or Large Quantity Generator (LQG) were not maintained. Note: Based on the amount of hazardous waste on-hand at the time of the audit site visit and information provided by KIMO staff concerning estimated generation rates, KIMO is likely to be a CESQG. However, episodic hazardous waste generation (e.g., on-time clean-ups, lead-based paint abatement) could result in hazardous waste generation rates above CESQG thresholds.	Develop procedures for and implement a Park-wide inventory and tracking process for monthly generation and cumulative storage of all hazardous waste to confirm and continuously document the Park's hazardous waste generator status. Document procedures in a Hazardous and Solid Waste Management Plan and train applicable staff on tracking procedures.	BMP

Finding Description	Recommended Corrective Action	Finding Citation
Procedures were not in place to assure that universal waste (e.g., used batteries, expired pesticides, used florescent lamps) was not stored for longer than one year. Note: KIMO may store waste batteries and fluorescent lamps for longer than one year if the park can demonstrate that longer accumulation is necessary to generate sufficient quantities to meet hauler requirements. However, if the park needs to accumulate waste for longer than one year, it must document that the hauler requires larger quantities of universal waste before the hauler will accept the park's universal wastes. EPA requirements limit small quantity handlers (those that accumulate < 5000 kg of universal waste at any one time to one year storage time. Universal waste was not labeled as "Universal Waste".	Develop procedures, checklists, or storage area inventory sheets to monitor accumulation of universal waste. KIMO may demonstrate it meets the one-year storage time by any of the following: ▪ Placing the universal waste in a container and marking or labeling the container with the earliest date that any universal waste in the container became a waste or was received; ▪ Marking or labeling each individual item of universal waste with the date it became a waste or was received; ▪ Maintaining an on-site inventory system that identifies the date each universal waste became a waste or was received; ▪ Maintaining an on-site inventory system that identifies the earliest date that any universal waste in a group of universal waste items or a group of containers of universal waste became a waste or was received; ▪ Placing the universal waste in a specific accumulation area and identifying the earliest date that nay universal waste in the area became a waste or was received; or ▪ Any other method that clearly demonstrates the length of time that the universal waste has been accumulated from the date it becomes a waste or is received. Note: Label universal waste as "Universal Waste".	BMP
Records of off-site shipments of used oil, batteries, fluorescent tubes, and other maintenance wastes were not available.	Develop and implement a record keeping system for the shipment of all used oil and other recyclable materials. Include the quantity shipped, date of shipment, and the name of the facility in which the waste was recycled.	BMP

Appendix D. List of Reviewers

The following individuals provided valuable input during the review process of this report.

Participant	Representing
Mark Flora	NPS-Water Resources Division
Barry Long	NPS-Water Resources Division
Chuck Pettee	NPS-Water Resources Division
Chris Revels	Kings Mountain National Military Park
David Vana-Miller	NPS-Water Resources Division

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS D-27, January 2002