



Cumberland Piedmont Network Water Quality Report

Guilford Courthouse National Military Park



ON THE COVER

Hunting Creek, September 10, 2001

Photograph by: Joe Meiman

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Guilford Courthouse National Military Park

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Introduction

This is the second report on water quality of Guilford Courthouse National Military Park (GUCO) generated by the Cumberland-Piedmont Network (CUPN) Water Quality Monitoring Program (contact the CUPN office for details on program design). The first report, submitted to the park in February 2005, presented the initial results of the water quality inventory, beginning in April 2004. This report will include those early findings as well as data gathered in fiscal year 2006 and display these results in graphic form (accompanied with a brief interpretation), and concludes with a water quality summary and recommendations. Water quality is measured four times per year (quarterly) on alternate years at two sites; Hunting Creek and the un-named Spring. Based upon program requirements and findings of the water quality inventory, a set of parameters were chosen for long-term monitoring; including the field measures of water temperature, specific conductance, pH, and dissolved oxygen. Samples were also collected for laboratory analysis for bacteria (*E. coli* and total coliform) and acid neutralizing capacity. An additional sample was collected from one site per round as a quality assurance – quality control provision.

Sampling Sites

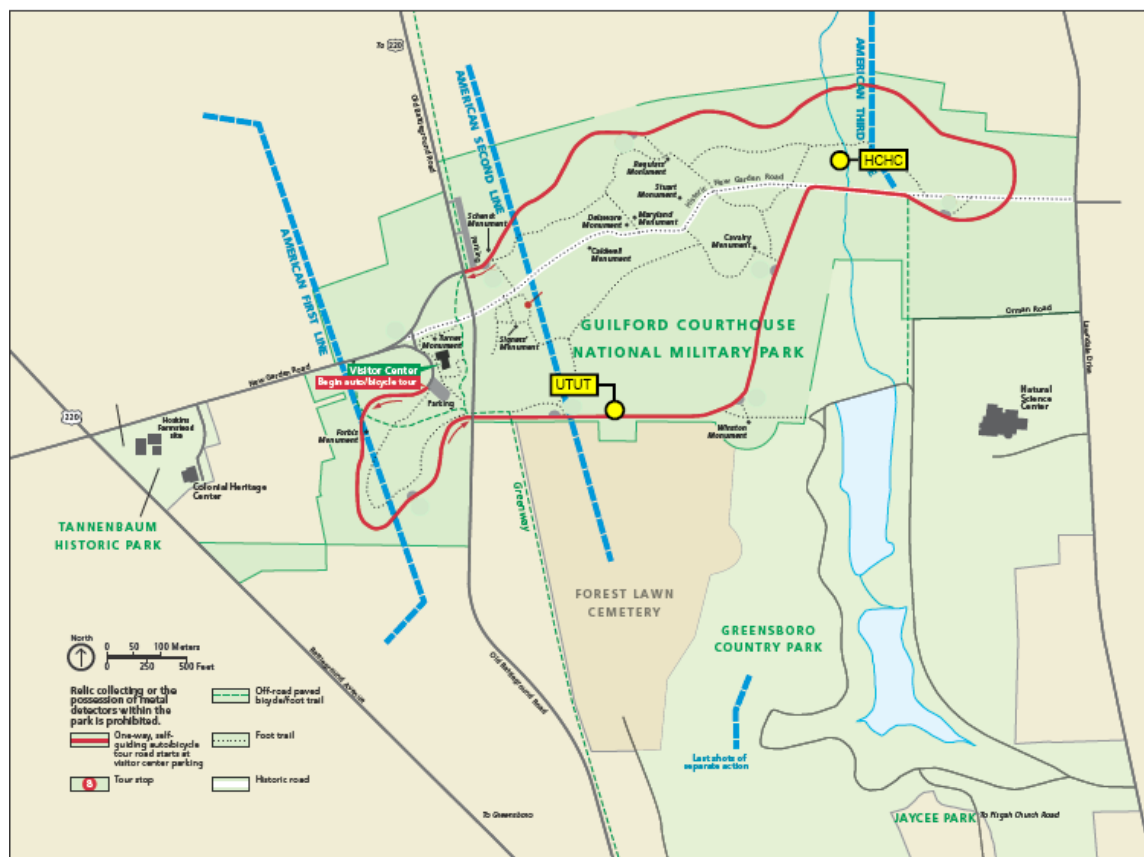


Figure 1. Map of water quality sampling sites at GUCO

Description of Sampling Sites

Hunting Creek (HCHC)

Samples may be taken at the culvert that takes Hunting Creek beneath the park's tour loop road. This site is just downstream from where the creek crosses under the trail.

Spring (UTUT)

The unnamed spring that perennially discharges in the park as an unnamed tributary of Hunting Creek adjacent to the Forest Lawn Cemetery can be accessed from the tour loop road.

Stream Designated Uses

Each water body sampled within the CUPN has either been assigned a designated use by the state, or, by using the same ranking criteria, by this author. The USEPA, besides mandating these rankings, also directed the states to develop water quality standards for each designated use. We can use these water quality standards as a minimum to track water quality trends in CUPN parks. By adapting the state standards, we can also track park water quality trends within the states, regions, or watersheds. New NPS nationwide GPRA goals are now tied to state water quality standards and designated uses. For more information on North Carolina water quality standards, please see:

North Carolina: Subchapter 2B – Surface Water and Wetland Standards, 15A NCAC 02B .0100 - .0510.

Table 1. The table below shows that none of the park's two sites are officially listed – a state is not required to list designated uses for all waters. The author, using the same criteria used by the state process, “listed” designated uses for each site for purposes of water quality comparison.

<i>Park</i>	<i>Code</i>	<i>Site</i>	<i>State</i>	<i>Designated Use</i>
GUCO	HCHC	Hunting Creek	NC	Class WS-IV
GUCO	UTUT	Unnamed tributary	NC	Class WS-IV

Results

Quarterly sampling commenced in April 2004 and continued until January 2005. Regular FY04 sampling schedule was postponed one quarter (and thus extended one quarter into FY05) due to an injury of Mr. McAninch. After a ten-month hiatus four more rounds were collected between October 2005 and July 2006, for a total of 8 sampling events.

Water quality results are displayed in time series graphs showing all data for each site for a given parameter. The data gap in the center of the graph is caused by the planned one-year pause in sampling. As the Water Quality Program continues, trends may emerge from these time series graphs. It is anticipated that there will be enough data by the end of the next sampling round (September 2008) for statistical trend analysis.

If state standards exist for a particular parameter they will be displayed. In addition, in a cursory attempt to show an element of data error, each plot is assigned error bars, representing the minimum potential error associated with the measurement.

Water Temperature

Water temperatures at GUCO are considered to be within range to support native aquatic life. The slightly compressed temperature range at the Unnamed tributary (UTUT) is a function of longer retention times of groundwater recharging the spring. North Carolina designated use standards for WS-IV waters state that temperature cannot exceed natural conditions by more than 2.8°C. Although it will take time to establish “natural conditions” for these waters, there is no reason to believe that temperature is an issue with respect to compliance.

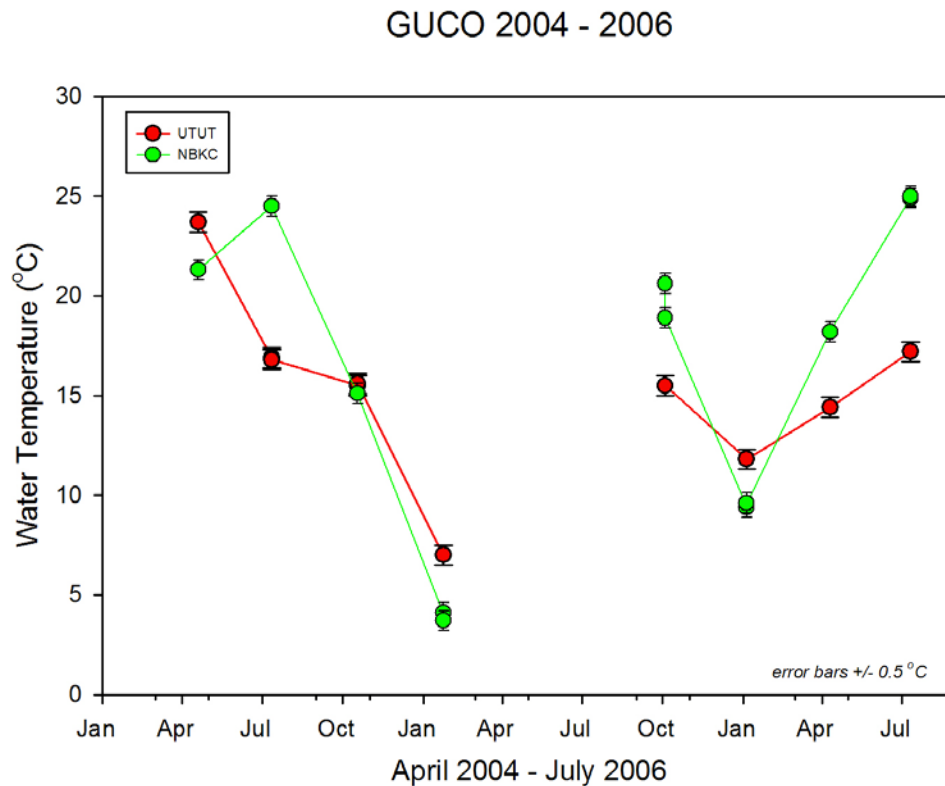


Figure 2. Water Temperature at GUCO

Specific Conductance

The value of specific conductance (SpC) at GUCO, like anywhere, is a function of the amount of dissolved ions in the water. These two sites contain a moderate amount of dissolved ions – some parks (CARL) have SPC values an order of magnitude lower than found here, while others (STRI) may exceed 400 μS . There are no state standards for SpC.

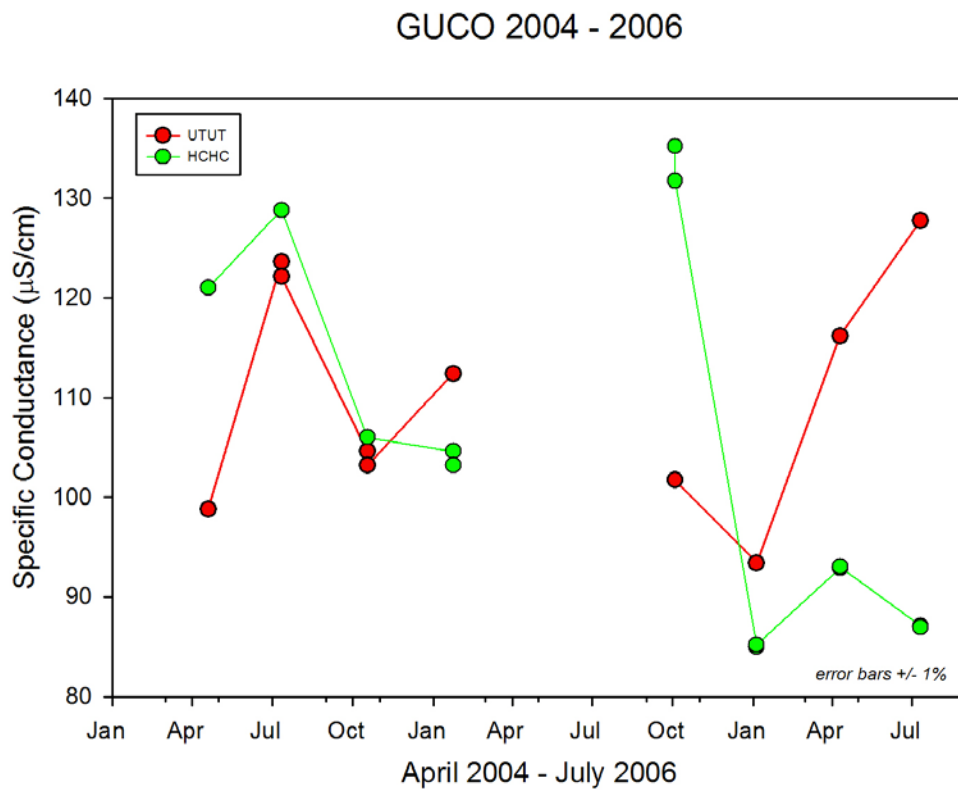


Figure 3. Specific Conductance at GUCO

pH

Waters of GUCO are slightly to moderately acidic. State standard for freshwater pH is between 6.0 and 9.0 SU. Hunting Creek shows a wider range of pH, and one sample exceeded the lower limit. The Hunting Creek sample of January 2005 may be the result of equipment/operator error. Note the duplicate (QA/QC) sample was above the state standard – with a variance of about 0.3 SU. All other samples taken were within standards.

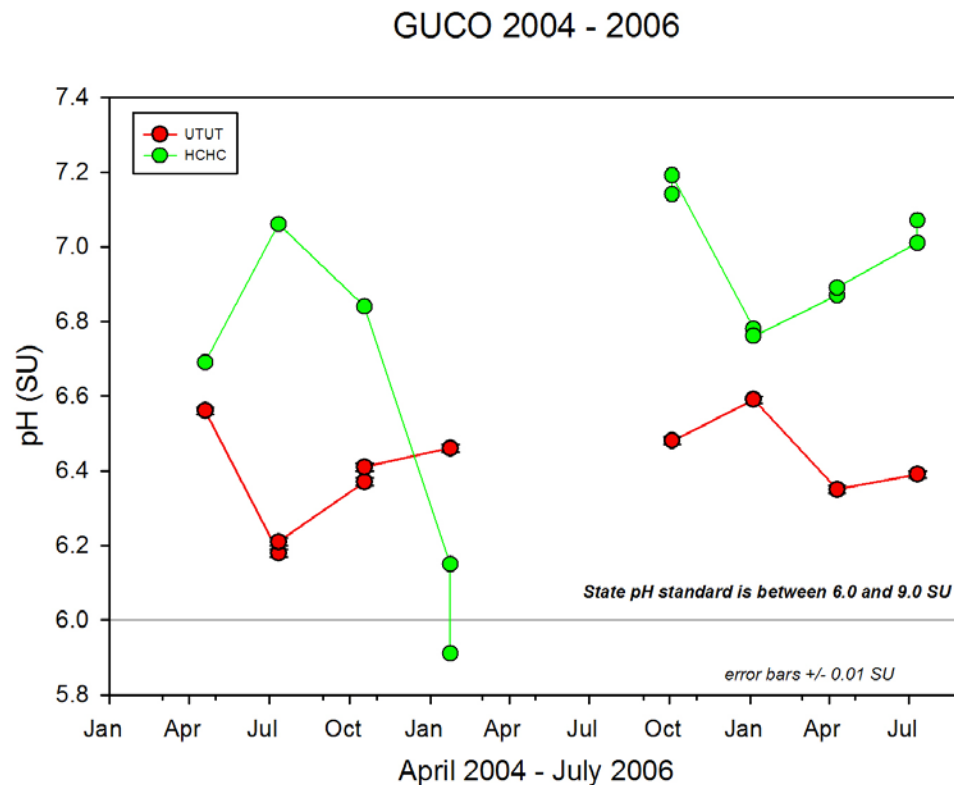


Figure 4. pH levels at GUCO

Dissolved Oxygen

Dissolved oxygen (DO), in all samples, was at or above the state limit of 5.0 mg/l. The fairly low DO values at the Unnamed tributary (UTUT) may reflect normal conditions. It is common that small springs have low DO as there may be little aeration within the groundwater environment. It should be noted that due to a malfunction of the DO sensor, no reading were taken during the July 2004 round. Typically the lowest dissolved oxygen levels occur in the warmer months as warm water cannot hold as much oxygen as cold water.

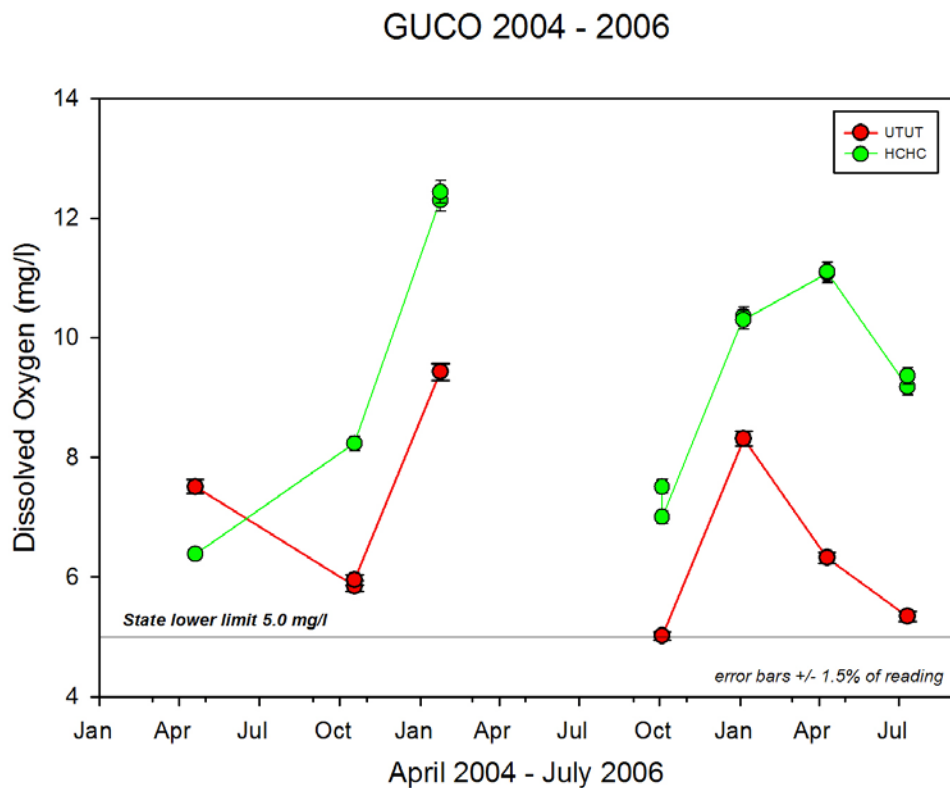


Figure 5. Dissolved Oxygen levels at GUCO

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) of GUCO waters is moderately low, indicating limited contact with carbonate strata or other sources of the bicarbonate ion. Low ANC levels make waters more susceptible to acid precipitation as there are limited amounts of bicarbonates available to counter additional acids. There is no state standard for ANC.

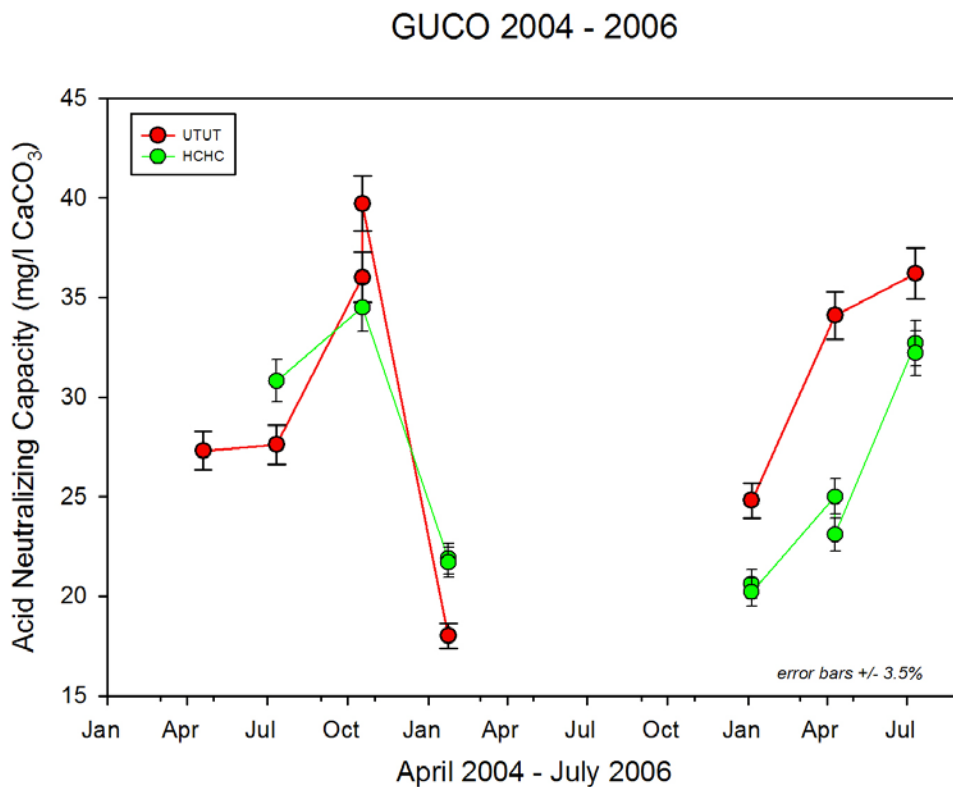


Figure 6. Acid Neutralizing Capacity at GUCO

Bacteria

Unfortunately the graph below is confusing. Fecal coliform bacteria were measured during the first round of sampling, while total coliform and *Escherichia coli* were used for the second round. All three bacteria are members of the coliform group and are found in the gastrointestinal track of warm-blooded animals; *E. coli* is the most common member of fecal coliform, and fecal coliform a subset of total coliform. While *E. coli* is a more reliable test of fecal contamination, there is no current state standard. There are no North Carolina standard for WS-IV waters for fecal coliform, however we can use the standards for most freshwaters as a guide: a geometric mean of 200 colonies/100 ml of not less than 5 samples taken within a 30 day period.

In general, coliform bacteria levels at GUCO are reflective of an urban watershed. At times levels are elevated. Although there is no recreational activity in GUCO waters, bacteria monitoring is important to demonstrate influences from the urban portions of its watersheds. While total coliform levels were fairly high (600 – 2400 colonies per 100 ml), they are not a reliable indicator bacterium.

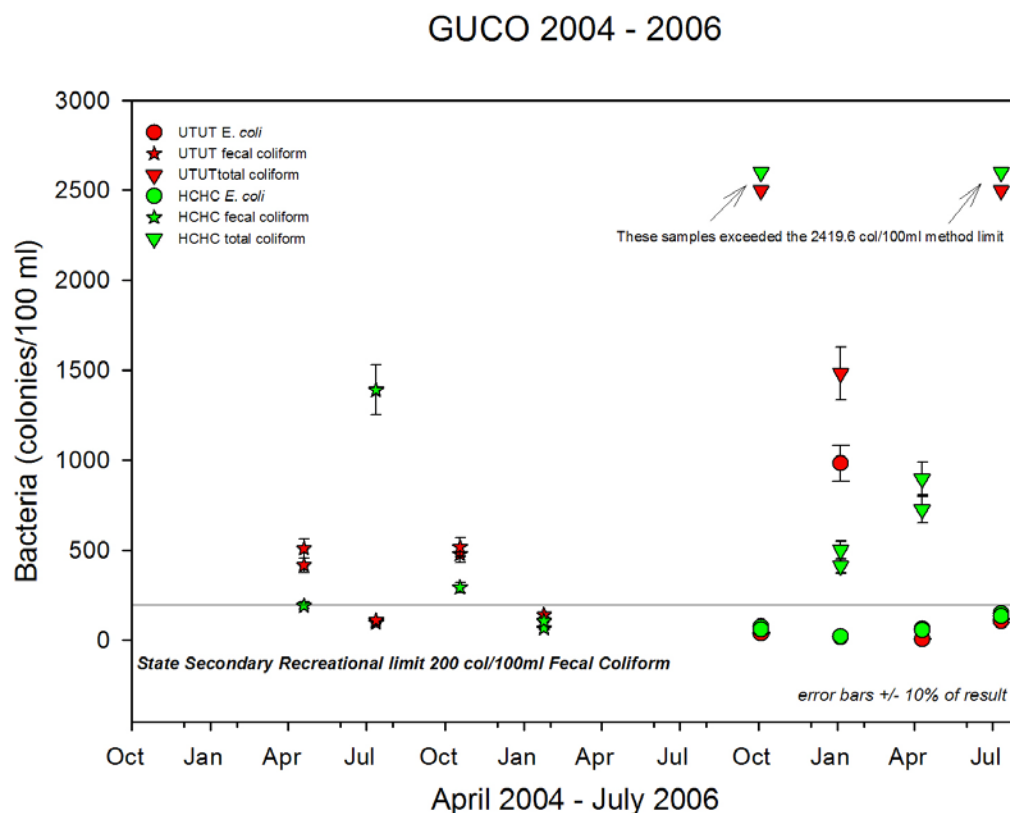


Figure 7. Bacteria levels at GUCO

General Water Quality Status

The water quality of the two sites sampled at GUCO is good and supportive of aquatic life. There is an obvious influence from the urban land use of its watersheds as bacteria counts can, at times, be elevated. There may not be a critical management issue as these levels are not exceptionally high nor does the park permit any aquatic recreational activities.

Future Water Quality Monitoring Recommendations

The CUPN is required in accord with the national water quality program to monitor water temperature, specific conductance, pH, and dissolved oxygen. This group of parameters should be sufficient to monitor the general water quality of GUCO.