



Cumberland Piedmont Network Water Quality Report: Third Serial

Guilford Courthouse National Military Park



ON THE COVER

Hunting Creek, August 25, 2004

Photograph by: Shepard McAninch

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Guilford Courthouse National Military Park

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Introduction

This is the third serial report on water quality of Guilford Courthouse National Military Park (GUCO) generated by the Cumberland-Piedmont Network (CUPN) Water Quality Monitoring Program. The first report, submitted to the park in February 2005, presented the initial results of the water quality inventory, beginning in April 2004. The second report (January 2007) included those early findings as well as data gathered in fiscal year 2006. This report will include those early findings as well as data gathered in fiscal year 2008 and display these results in graphic form (accompanied with a brief interpretation), and concludes with a water quality summary and recommendations. All data presented in this report were generated by CUPN Ecologist/Data Manager Shepard McAninch.

Water quality is measured four times per year (quarterly) on alternate years at two sites; Hunting Creek and Blood Run. 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 analysis for *Escherichia coli* and acid neutralizing capacity (ANC). An additional sample is collected from one site per round for quality assurance/quality control.

Sampling Sites

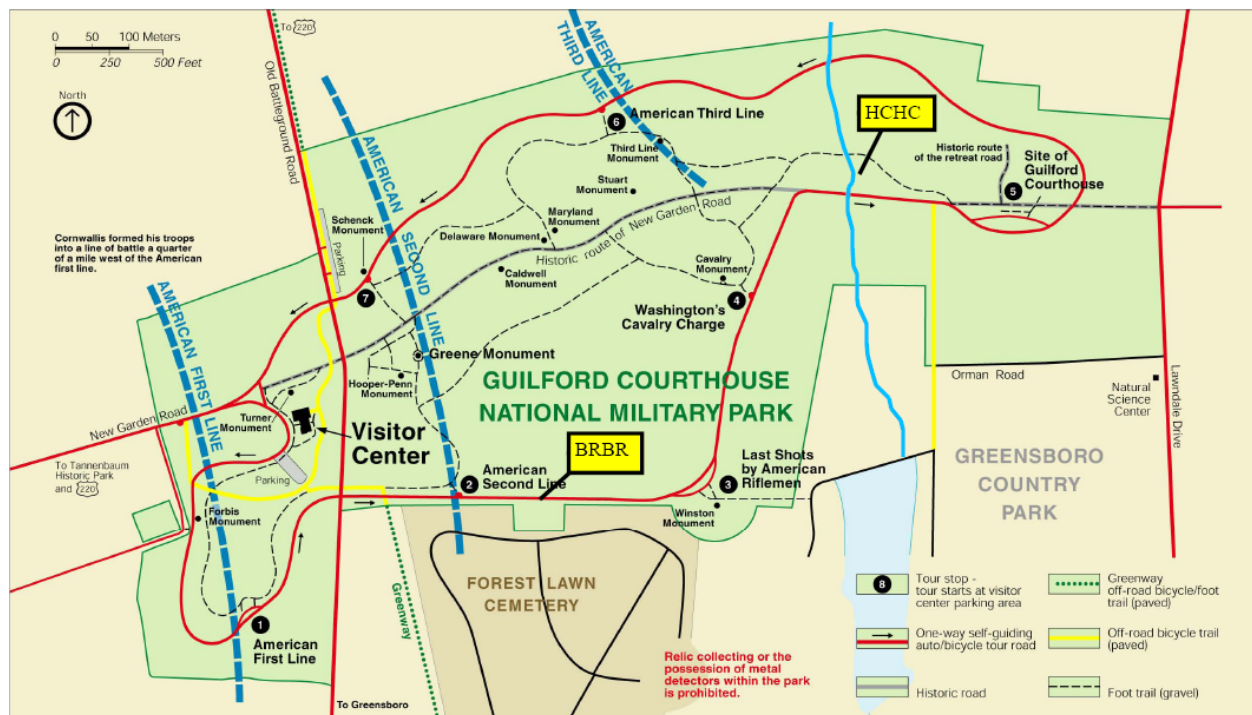


Figure 1. Map of water quality sampling sites at GUCO

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.

Bloody Run (BRBR)

This site, referred to as "Un-named Tributary" (UTUT) in previous reports, is a small spring at the edge of Forest Lawn Cemetery. Although reduced to a mere trickle, the spring still flowed through the drought of 2007-2008. Bloody Run, a place name for this stream found on an old map, eventually flows into Hunting Creek.

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 US Environmental Protection Agency, 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. 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	BRBR	Bloody Run	NC	Class WS-IV

Results

Quarterly sampling commenced in April 2004 and continued until January 2005. Regular fiscal year 2004 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. Following a biennial pause, collection resumed with quarterly sampling from October 2007 through July 2008, for a total of 12 sampling events.

Water quality results are displayed in time series graphs showing all data for each site for a given parameter. The data gaps are caused by the planned one-year pause between sampling series. As the Water Quality Program continues, trends may emerge from these time series graphs.

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.

It is important that the reader know that much of the Carolina Piedmont has experience drought conditions through 2007 and 2008. Flow conditions for every month except February 2008 were very low.

Water Temperature

Water temperatures at GUCO are considered to be within range to support native aquatic life. The slightly compressed temperature range at the Bloody Run (BRBR) 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.

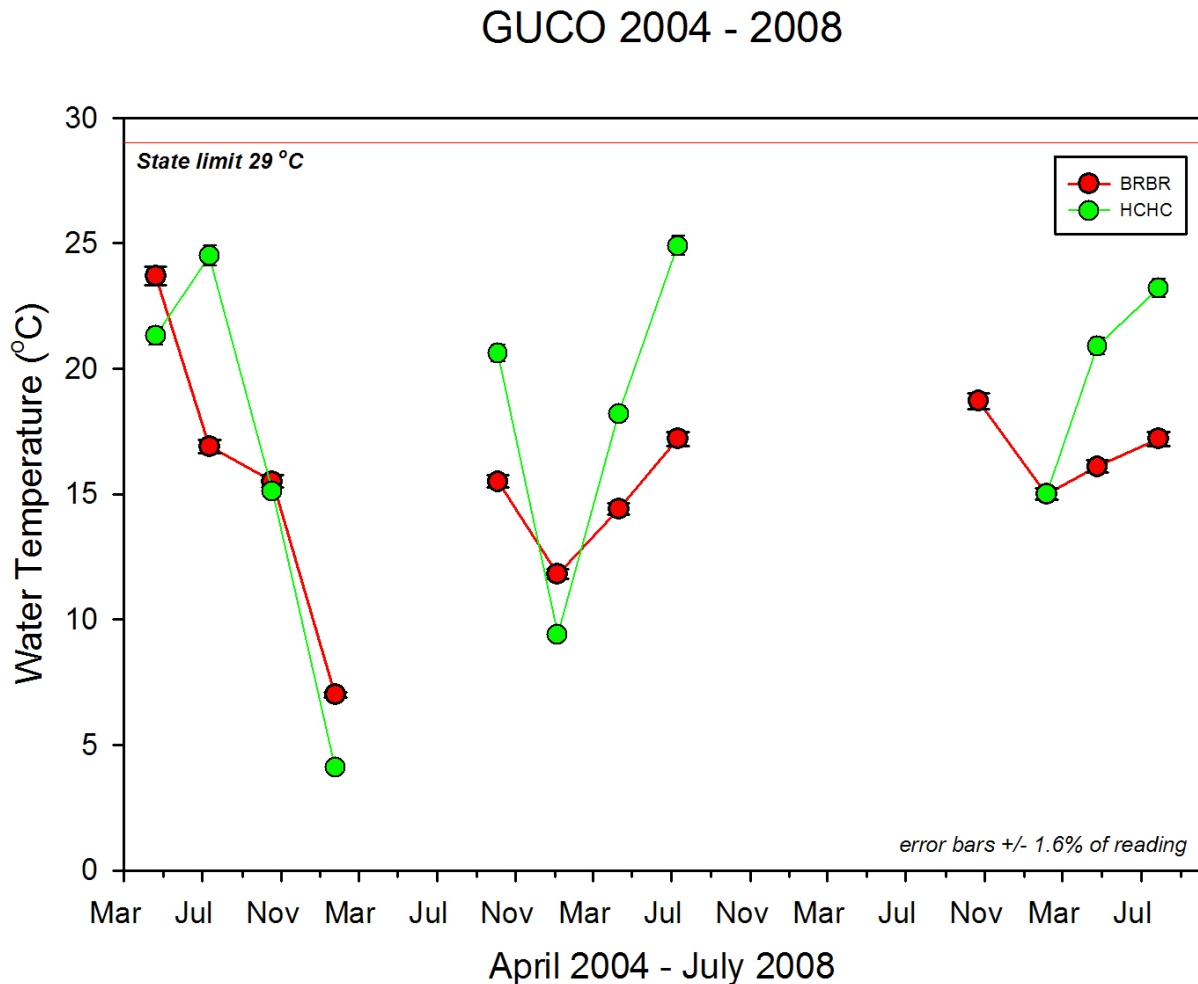


Figure 2. Water Temperature at GUCO

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 . The lowest SpC was found during the February 2008 sampling, a few days after 3.8 cm rain. There are no state standards for SpC.

GUCO 2004 - 2008

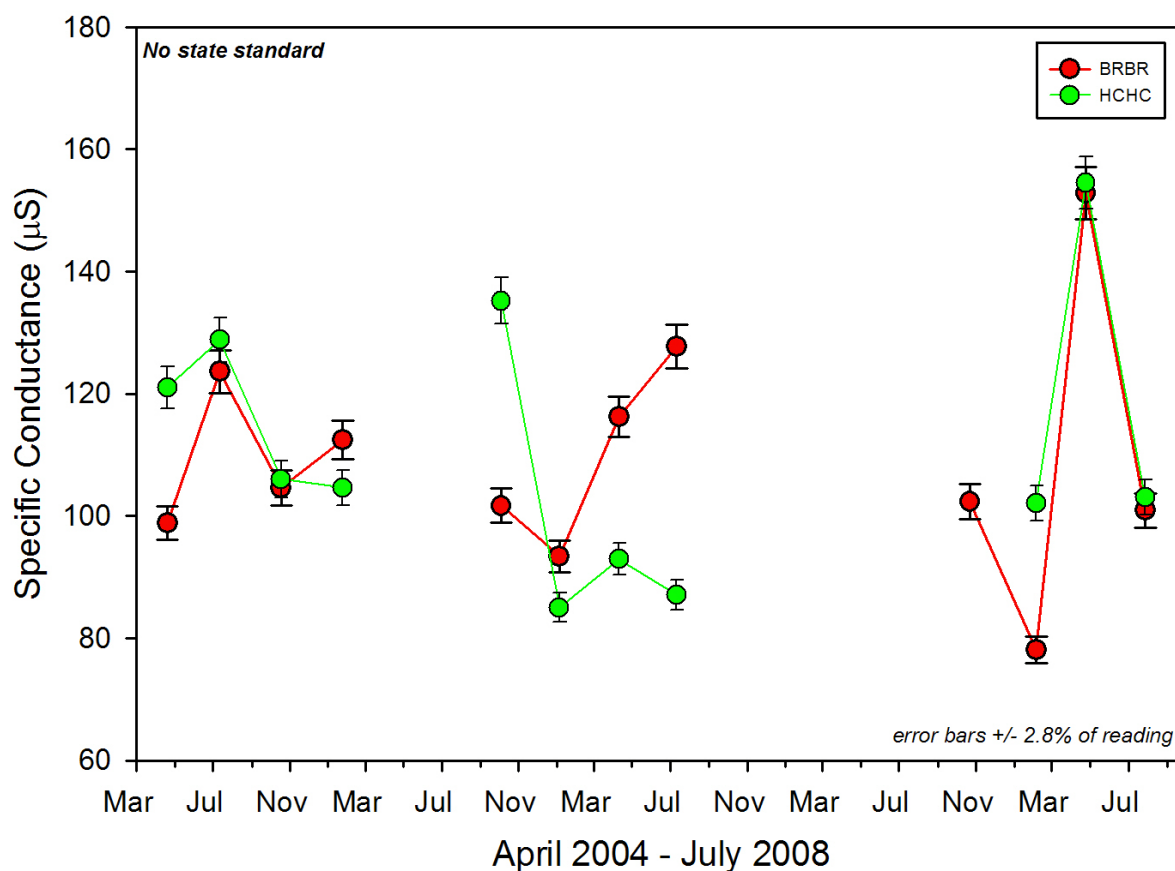


Figure 3. Specific Conductance at GUCO

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. pH values for Bloody Run are more compressed, a result of long retention times (less affected by rain or drought) before it emerges from the spring.

GUCO 2004 - 2008

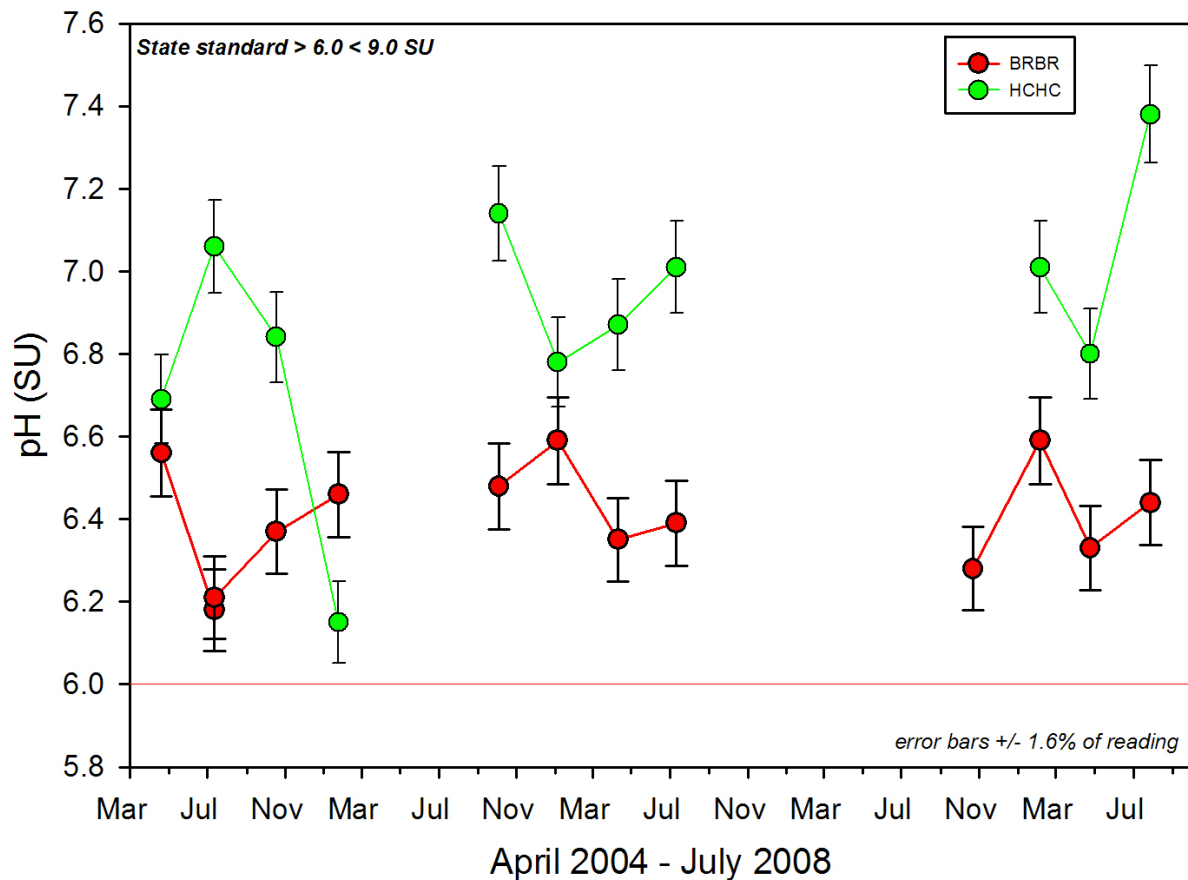


Figure 4. pH at GUCO

Dissolved Oxygen

Dissolved oxygen (DO) in most samples was at or above the state limit of 4.0 mg/l. Two times Blood Run exceeded the limit. It must be noted that these values are coincidental with a regional drought. During October 2008, flow at the stream was meager seep, measured at 0.02 l/s – 40 times lower than normal. In July 2008 flow had increased slightly, but was still very low. Typically the lowest dissolved oxygen levels occur in the warmer months as warm water cannot hold as much oxygen as cold water.

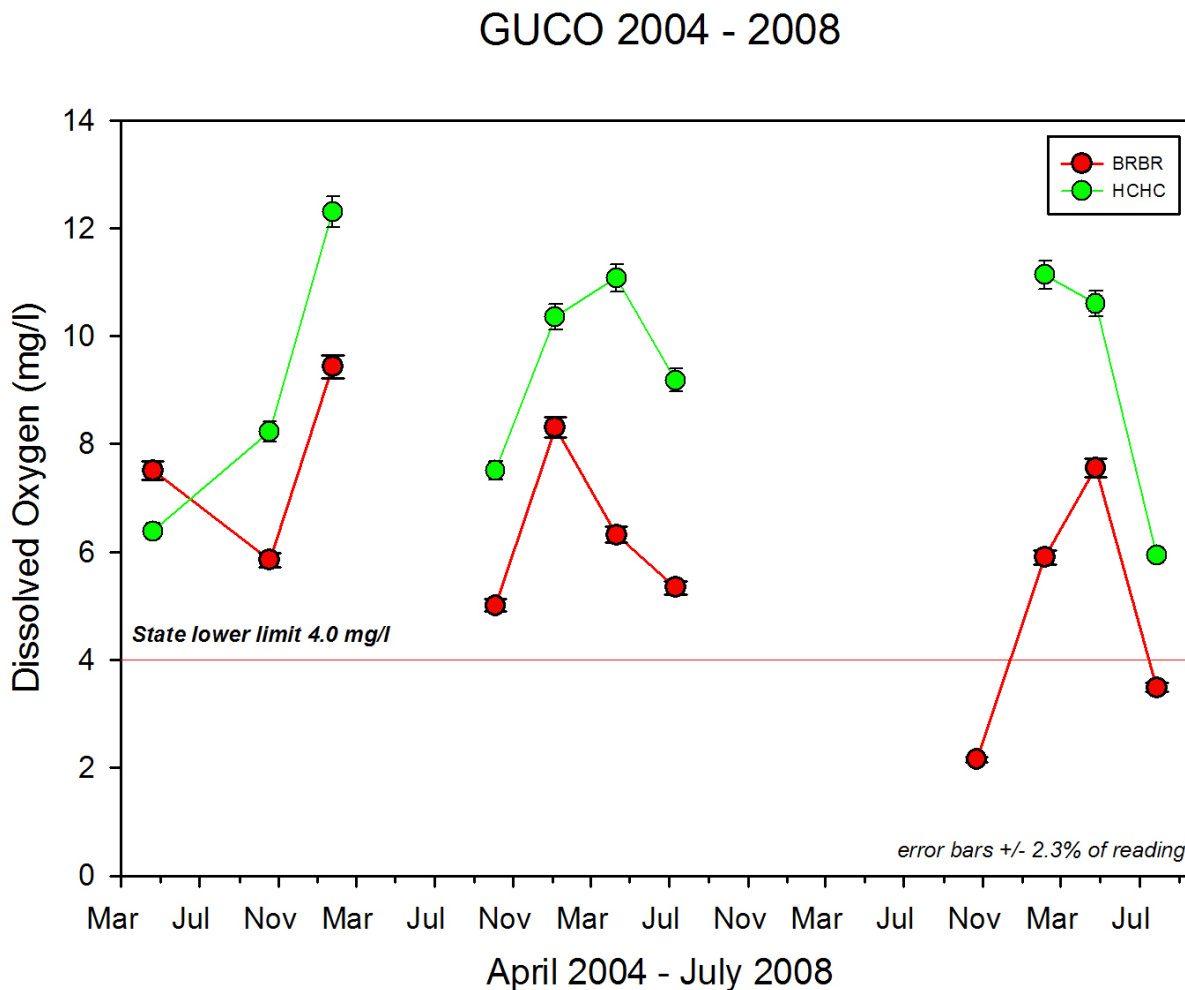


Figure 5. Dissolved Oxygen at GUCCO

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. The ANC values at GUCO show an inverse relationship with discharge – the higher or lower the flow, the lower or higher the ANC. The rains of February 2008 depress a high year for ANC, which is caused by the drought (extremely low flows).

A new, more accurate protocol was used beginning in October 2005. Prior ANC data are not displayed. There is no state standard for ANC.

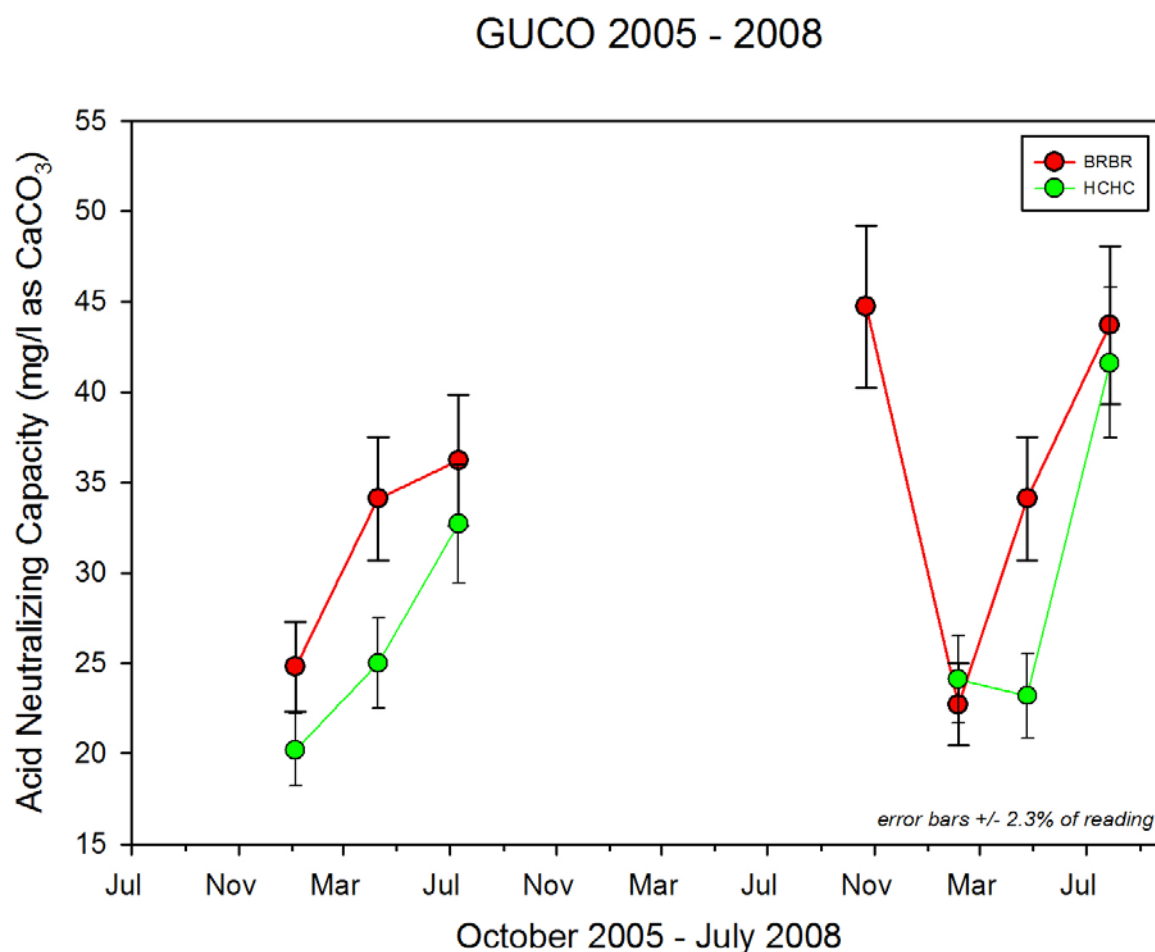


Figure 6. Acid Neutralizing Capacity at GUCO

Bacteria

In general, *Escherichia coli* bacteria levels at GUCO fairly high. Although there is no known recreation in the waters of GUCO, the USEPA single sample standard for infrequent recreational contact is displayed in the graph. Likely sources of this indicator bacterium are wildlife. This may be especially true during drought conditions, where local water sources are limited and wildlife visit the few remaining streams, where they are easily contaminated.

GUCO 2005 - 2008

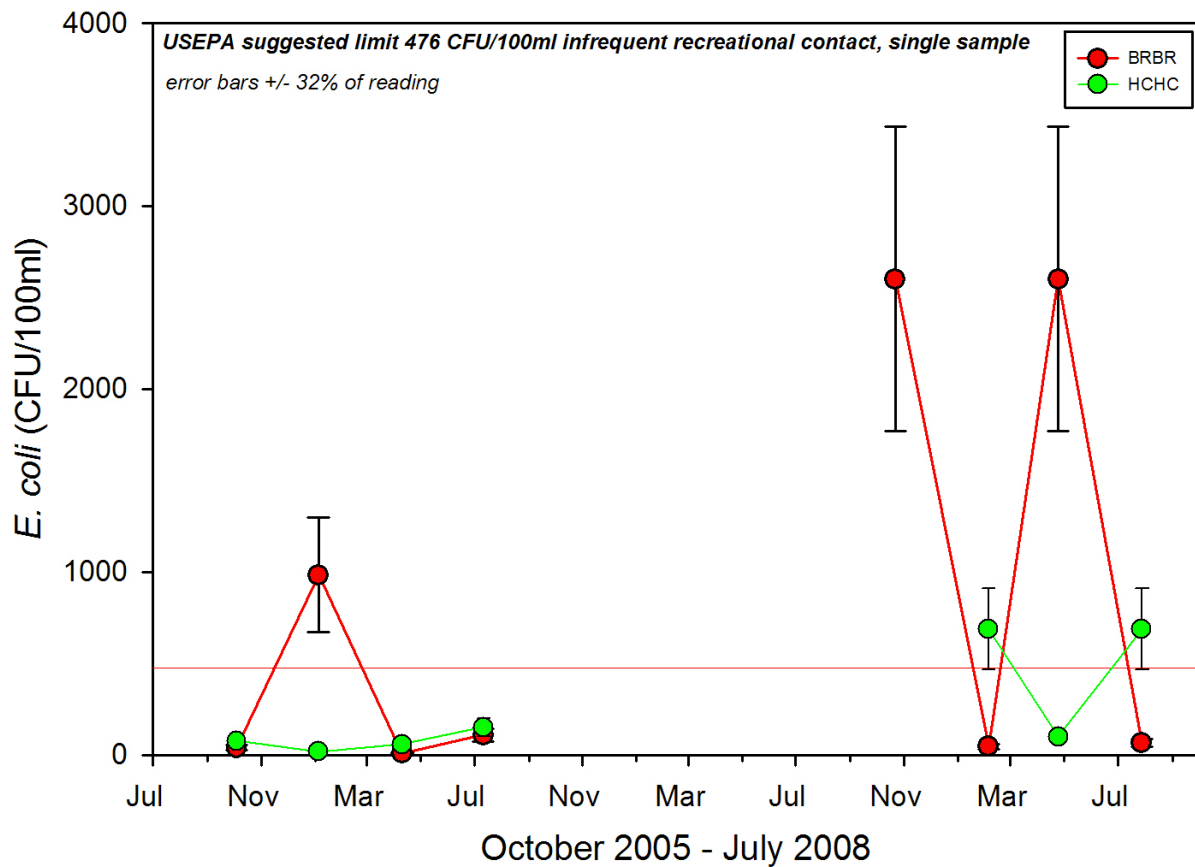


Figure 7. Bacteria at GUCO

General Water Quality Status

The water quality of the two sites sampled at GUCO is good, or perhaps fair in the strictest sense. The only times where there appears to be low quality water is directly attributable to the drought. Drought conditions obviously resulted in low dissolved oxygen in Bloody Run (at times flow was 40 times lower than normal). It also appears that high bacterial values are attributable to wild life sources – especially during drought conditions when animals are concentrated to the few remaining water bodies.

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. It appears that there is sufficient acid neutralizing capacity in GUCO waters and a solid relationship between flow and ANC has been made. There is little need to continue routine ANC monitoring at GUCO. Additionally, it appears that the park is in the process of acquiring Tannenbaum Historical Park. This parcel contains a spring that will be included in routine monitoring. *Escherichia coli* monitoring will continue until this spring can be sufficiently characterized. GUCO will be re-sampled in FY 2010 in accordance with the CUPN Water Quality Monitoring Program.