

Prepared for the U.S. Army Corps of Engineers

Water-Quality Characteristics of Ledge Creek and Holman Creek upstream from Lake Rogers, Granville County, North Carolina, 2005 and 2008

Open-File Report 2008–1319

U.S. Department of the Interior
U.S. Geological Survey

Cover. Looking upstream from site L-5 on Ledge Creek, tributary to Lake Rogers, Granville County, North Carolina (*photograph taken by Stephen L. Harden, U.S. Geological Survey*).



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By Stephen L. Harden and Mary J. Giorgino

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
square mile (mi ²)	2.590	square kilometer (km ²)
Volume		
gallon (gal)	3.785	liter (L)
cubic foot (ft ³)	28.32	cubic decimeter (dm ³)
Flow rate		
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m ³ /s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (μg/L). Use of liter (L) as a special name for cubic decimeter (dm³) is restricted to the measurement of liquids and gases. No prefix other than milli should be used with liter.

SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
Volume		
liter (L)	0.2642	gallon (gal)

Water-Quality Characteristics of Ledge Creek and Holman Creek upstream from Lake Rogers, Granville County, North Carolina, 2005 and 2008

By Stephen L. Harden and Mary J. Giorgino

Abstract

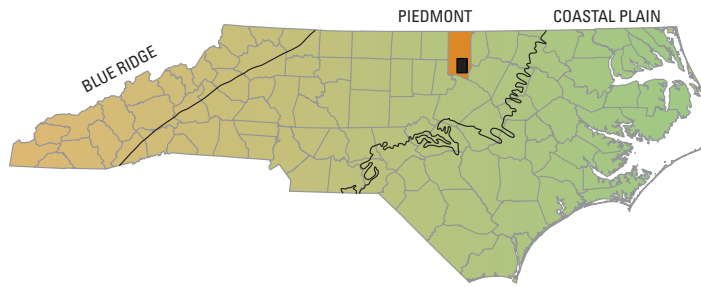
Water-quality and hydrologic data were collected during 2005 and 2008 to characterize potential source areas of nutrients and sediment within the Ledge and Holman Creek watersheds upstream from Lake Rogers in Granville County, North Carolina. Eight monitoring locations were established in all—five in Holman Creek and three in Ledge Creek—for collecting discharge and water-quality data during different streamflow conditions. Water-quality samples were collected during two sampling events in the fall of 2005 for analysis of major ions, nutrients, suspended sediment, and fecal-indicator bacteria. Water-quality samples were collected during three sampling events in the winter and spring of 2008 for analysis of nutrients and suspended sediment.

Introduction

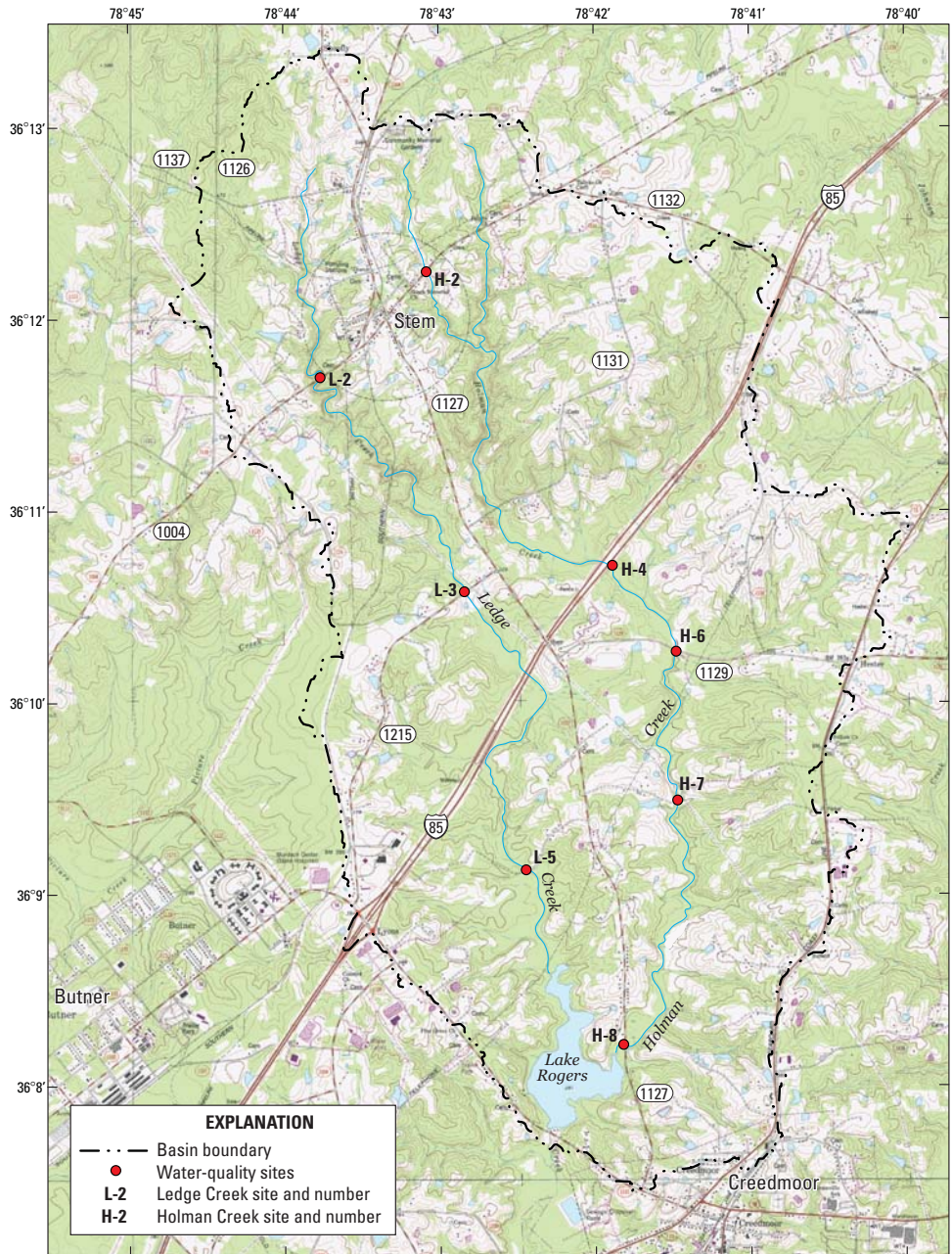
Lake Rogers serves as the primary source of drinking water to the city of Creedmoor, North Carolina (fig. 1), which had an estimated population of approximately 2,700 people in 2006 (North Carolina Office of State Budget and Management, 2006). In addition, Lake Rogers is an important recreational asset to the city, supporting fishing, boating, and picnicking.

Since Lake Rogers was constructed in 1939, the storage volume of the lake has decreased approximately one-third because of sedimentation, and eutrophic conditions have developed (Tetra Tech, 2003). Algal blooms and elevated concentrations of manganese and turbidity have resulted in high costs for drinking-water treatment and frequent customer complaints regarding taste and odor problems.

The city of Creedmoor initiated dredging of Lake Rogers in August 2008 to remove accumulated sediments and restore some lost storage capacity. The U.S. Army Corps of Engineers (USACE), in partnership with Creedmoor, is developing a watershed-management plan to reduce future nutrient and sediment inputs to Lake Rogers. To accomplish this plan, a scientific investigation of nutrient and sediment concentrations within the watersheds of Ledge and Holman Creeks upstream from Lake Rogers (fig. 1) is needed. In cooperation with the USACE, the U.S. Geological Survey (USGS) has conducted two phases of study, one in 2005 and one in 2008, to obtain relevant water-quality data to assist the USACE in evaluating nutrient and sediment characteristics at multiple locations in Ledge Creek and Holman Creek during various streamflow conditions.



LOCATION OF PHYSIOGRAPHIC PROVINCES AND STUDY SITE IN GRANVILLE COUNTY, NORTH CAROLINA



Base from digital files of:
 Digital raster graph, topographic map series
 Lake Michie, Stem, and Creedmoor Quadrangles
 North Carolina State plane feet,
 NAD 1983, U.S. Geological Survey, 1:24,000 scale

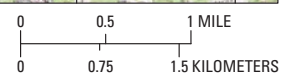


Figure 1. Data-collection sites on Ledge Creek and Holman Creek in the Lake Rogers drainage basin, Granville County, North Carolina.

Purpose and Scope

This report summarizes the hydrologic and water-quality data collected at Ledge and Holman Creeks during 2005 and 2008. In the initial study phase, discharge and water-quality data were collected by the USGS during two sampling events in the fall of 2005 (Douglas Smith, U.S. Geological Survey, written commun., 2005; table 1). Three sites on Ledge Creek (sites L2, L3, and L5) and five sites on Holman Creek (H2, H4, H6, H7, and H8) were sampled in 2005 (fig. 1). Additional discharge and water-quality data were obtained during three sampling events in winter and spring 2008 at sites L2, L3, and L5 on Ledge Creek and at sites H2, H4, and H8 on Holman Creek (fig. 1; table 1).

The data presented in this report are intended to assist the USACE in locating potential source areas of nutrients and sediment to Lake Rogers. This information, in turn, can aid in the development of effective, targeted watershed-management alternatives for improving the water quality of Lake Rogers and ensuring its continued use as a drinking-water supply.

Description of Study Area

Lake Rogers is located near Creedmoor in Granville County, North Carolina, in the Piedmont Physiographic Province (fig. 1). In 2002, the average daily water withdrawal from Lake Rogers was about 0.28 million gallons per day (North Carolina Division of Water Resources, 2002). Lake Rogers is a shallow reservoir, with a surface area of approximately 175 acres and a drainage area of 17.8 square miles (mi²).

Ledge Creek and Holman Creek are the two main tributaries to Lake Rogers. Land-use information compiled from the 2001 National Land Cover Database (NLCD; U.S. Geological Survey, 2001) for the 5.77-mi² drainage of site L-5 on Ledge Creek and the 9.59-mi² drainage of site H-8 downstream on Holman Creek is summarized in table 2. Land use within the Ledge and Holman Creek tributaries primarily consists of forest (about 54 percent) and pasture and grasslands (about 25 percent). Developed land in Ledge Creek (12.5 percent) and Holman Creek (9.9 percent) is predominantly open space and low-intensity development.

A reconnaissance of Ledge and Holman Creeks by the USGS (Douglas Smith, U.S. Geological Survey, written commun., 2005) indicated the presence of culverts and beaver dams in the two tributaries. Culverts are present at sampling sites L-2, L-3, and L-5 on Ledge Creek and at sites H-2, H-4, and H-6 on Holman Creek (fig. 1). During the study, no debris dams associated with beaver activity were noted at sites L-2 or H-2. The flow of water at sites L-3, L-5, H-4, and H-6 was impeded by the presence of debris that beavers had placed within the culvert or across the stream channel near the culvert. Site H-8 is located at the Secondary Road 1127 bridge that crosses Holman Creek next to Lake Rogers. Flow at this site is affected by backwater from the lake.

Table 1: Sampling-site characteristics and sampling dates related to hydrologic and water-quality data collection at Ledge Creek and Holman Creek, tributaries to Lake Rogers, Granville County, North Carolina.

[USGS, U.S. Geological Survey; NGVD 29, National Geodetic Vertical Datum of 1929; mi², square miles; SR, secondary road; --, not applicable]

Site (fig. 1)	USGS site number	USGS station name	Altitude of land surface (feet above NGVD 29)	Drainage area (mi ²)	Sampling dates				
					September 2005	December 2005	February 2008	March 2008	April 2008
L-2	0208701450	Ledge Creek at SR 1004 at Stem	390	1.88	X	X	X	X	X
L-3	0208701500	Ledge Creek at SR 1215 near Stem	309	3.28	X	X	X	X	X
L-5	0208701550	Ledge Creek near Butner	290	5.77	X	X	X ^a	X ^a	X ^a
H-2	0208701630	Holman Creek tributary at SR 1132 at Stem	420	0.42	X	X	X	X	X
H-4	0208701660	Holman Creek at I-85 near Stem	310	3.09	X	X	X	X	X
H-6	0208701710	Holman Creek at SR 1129 near Stem	298	6.24	X	X	--	--	--
H-7	0208701730	Holman Creek near Creedmoor	295	7.20	--	X	--	--	--
H-8	0208701800	Holman Creek at SR 1127 at Creedmoor	285	9.59	X	X	X	X	X ^a

^a Unable to measure discharge during this sampling event.

Table 2. Land-use characteristics in drainage areas upstream from site L-5 on Ledge Creek and site H-8 on Holman Creek in the Lake Rogers watershed, Granville County, North Carolina, 2001.

[USGS, U.S. Geological Survey; SR, secondary road]

Site (fig. 1)	USGS station name	Land use (in percent) ^a							
		Forest	Pasture and grassland	Developed	Shrub and scrub lands	Wetlands	Cultivated crops	Water	Barren lands
L-5	Ledge Creek near Butner	53.9	24.9	12.5	2.7	2.5	2.0	1.3	0.2
H-8	Holman Creek at SR 1127 at Creedmoor	54.9	25.6	9.9	1.6	3.7	2.9	0.8	0.6

^aSource: National Land Cover Database 2001 (U.S. Geological Survey, 2001).

Methods

The surface-water sampling network for the study included three sites on Ledge Creek and five sites on Holman Creek (fig. 1). Hydrologic and water-quality data were obtained at sites L2, L3, L4, H2, H4, and H8 during all five sampling events (table 1). Holman Creek site H6 was sampled only in September and December 2005, and site H7 was sampled only in December 2005. These two sites were not included in the sampling network as part of the 2008 study. The 2008 sampling was conducted to supplement nutrient and sediment data from 2005, which were collected during a dry period.

Water-quality samples collected in 2005 were analyzed for major ions (calcium, magnesium, potassium, sodium, bicarbonate, chloride, fluoride, silica, sulfate, iron, and manganese), nutrients (dissolved ammonia, dissolved nitrite plus nitrate, total nitrogen, dissolved orthophosphate, and total phosphorus), and suspended sediment. Microbial analyses included measurement of fecal indicator bacteria, including total coliform, *Escherichia coli* (*E. coli*) and *enterococci* bacteria. Water-quality samples collected in 2008 were analyzed only for nutrients and suspended sediment. For all samples, specific conductance, pH, water temperature, and dissolved-oxygen (DO) concentrations were measured in the field at the time of sampling.

Established, documented protocols for collecting and processing samples for chemical analyses were followed (U.S. Geological Survey, variously dated; U.S. Geological Survey, 2007). Depth- and width-integrated samples were collected at sites where water was flowing. Grab samples were collected at sites when conditions did not allow depth-integrated samples to be collected, such as during no- to low-flow conditions. Water-quality samples were processed in the field and shipped on ice overnight to the USGS National Water Quality Laboratory in Denver, Colorado. Bacteria samples were analyzed at the USGS North Carolina Water Science Center laboratory in Raleigh. Quality-control samples, including blanks and replicates, were collected and processed during each sampling event in order to validate results from the environmental samples. Suspended-sediment samples were analyzed at the USGS Kentucky Water Science Center sediment laboratory in Louisville. When possible, instantaneous stream discharge was measured to document flow conditions during each sampling round. Standard USGS methods were used for measuring stream discharge (Rantz and others, 1982).

The sample analytical results were compared to applicable water-quality standards for freshwater classifications (North Carolina Department of Environment and Natural Resources, 2007; table 3). *Enterococci* and *E. coli* bacteria densities measured in water samples from Ledge and Holman Creeks were compared to U.S. Environmental Protection Agency (USEPA) ambient water-quality criteria for fresh recreational waters (U.S. Environmental Protection Agency, 1986; table 3). The USEPA criteria are based on a statistically sufficient number of samples, generally no less than five samples, collected at equal intervals over a 30-day period. Note that the instantaneous sampling conducted in this study does not meet the USEPA-defined sampling frequency for bacteria; however, the sample results are compared to the bacteria criteria for informational purposes. More frequent sampling of bacteria would be required to specifically determine if bacteria densities in Ledge and Holman Creeks meet the USEPA ambient water-quality criteria for bacteria in fresh recreational waters.

Table 3. Summary of State and Federal water-quality criteria applicable to constituents measured in Ledge and Holman Creeks, 2005 and 2008.

[Unless noted otherwise, values refer to maximum allowable concentrations. NC, North Carolina; \geq , greater than or equal to; mg/L, milligrams per liter; $\mu\text{g/L}$, micrograms per liter; USEPA, U.S. Environmental Protection Agency; mL, milliliter]

Constituent	Water-quality standard (unit)
NC standards for class C waters (fresh surface water) ^a	
Dissolved oxygen	≥ 4.0 mg/L
Fluoride	1.8 mg/L
pH	6.0–9.0 standard units
NC standards for class WS-II waters (water-supply watersheds) ^a	
Hardness, total	100 mg/L as CaCO_3
Manganese	200 $\mu\text{g/L}$
Sulfate	250 mg/L
Nitrate	10 mg/L as N
NC standards for toxic substances ^a	
Chloride	230 mg/L
Iron	1,000 $\mu\text{g/L}$
USEPA criteria for bacteria ^b	
<i>Enterococci</i> bacteria	33 per 100 mL
<i>Escherichia coli</i> (<i>E. coli</i>)	126 per 100 mL

^a North Carolina Department of Environment and Natural Resources, 2007.

^b U.S. Environmental Protection Agency, 1986.

Data Summary

Information on water-quality sampling events, discharge data, and analytical results for Ledge Creek and Holman Creek upstream from Lake Rogers is summarized in this section. The climatic and hydrologic conditions present during the sampling events are described. Discharge data and analytical results of the major ion, nutrient, bacteria, and suspended-sediment samples collected in 2005 and 2008 are presented separately for Ledge and Holman Creeks.

Hydrologic Conditions during Sampling Events

Five sampling events were conducted for Ledge and Holman Creeks (table 1). Water-quality samples were collected during September and December 2005 and during February, March, and April 2008. The climatic and hydrologic conditions varied among the sites and events. Continuous monitoring

data for precipitation and streamflow are not available for the Lake Rogers watershed. Consequently, daily precipitation recorded at a USGS raingage in Wake County (USGS site ID 02087182, Falls Lake above dam near Falls, NC, approximately 14 miles from the Lake Rogers dam) and continuous discharge recorded at a USGS streamgage in Durham County (USGS site ID 0208524090, Mountain Creek at SR1617 near Bahama, NC, approximately 11 miles from the Lake Rogers dam) are presented to provide general information about rainfall conditions and stream hydrologic response during the time samples were collected. The sampling events in 2005 and 2008 are noted on the discharge plots in figures 2 and 3, respectively.

To the extent possible, stormwater-runoff events were targeted for the sampling rounds to maximize the collection of samples during normal- to high-flow conditions. In general, conditions at the monitoring sites were not conducive for making discharge measurements and collecting water samples at the highest stream stages because peak flows during runoff events in small stream drainages are flashy and short lived, as illustrated by Mountain Creek with a drainage area of 8.0 mi² (figs. 2, 3).

Dry climatic conditions and the magnitude and timing of rainfall events also influenced the collection of samples. During 2005, drought-like conditions occurred in the study area throughout most of the year. During the first sampling in September 2005, most of the samples were collected from isolated pools of standing water. Samples were collected during December 2005 following rainfall when most sites had flowing stream conditions; however, the rainfall was preceded by a prolonged dry period in which there was no streamflow (Douglas Smith, U.S. Geological Survey, written commun., 2005). The sampling conducted in 2008 also was preceded by unusually dry conditions. An extreme drought was present throughout the region during the summer and fall of 2007. The sampling conducted in February, March, and April 2008 coincided with increased rainfall conditions when streams near the study area started returning to normal-flow conditions (fig. 3).

The sampling periods in 2005 and 2008 both were preceded by periods of below-normal precipitation in which Ledge and Holman Creeks stopped flowing. Consequently, the drainage basins of Ledge and Holman Creeks were not subject to periodic flushing by precipitation. Based on the available data, it is not known whether the constituent concentrations measured in samples collected in 2005 and 2008 are representative of those that might otherwise be measured in samples collected during periods with more normal amounts of rainfall, higher streamflows, and more frequent flushing of the watershed.

The beaver dams and pooled backwater conditions observed in the lower reaches of Ledge and Holman Creeks likely increased the residence times of surface water and associated constituents in the tributaries draining to Lake Rogers. It is not known how the instantaneous discharges measured during 2005 and 2008 compare with normal to high flows for the Ledge and Holman Creek tributaries. Additional data or modeling would be required to document the hydrology of the Lake Rogers watershed. The reader is advised to consider the limitations of the data and use the compiled discharge and concentration data with judgment.

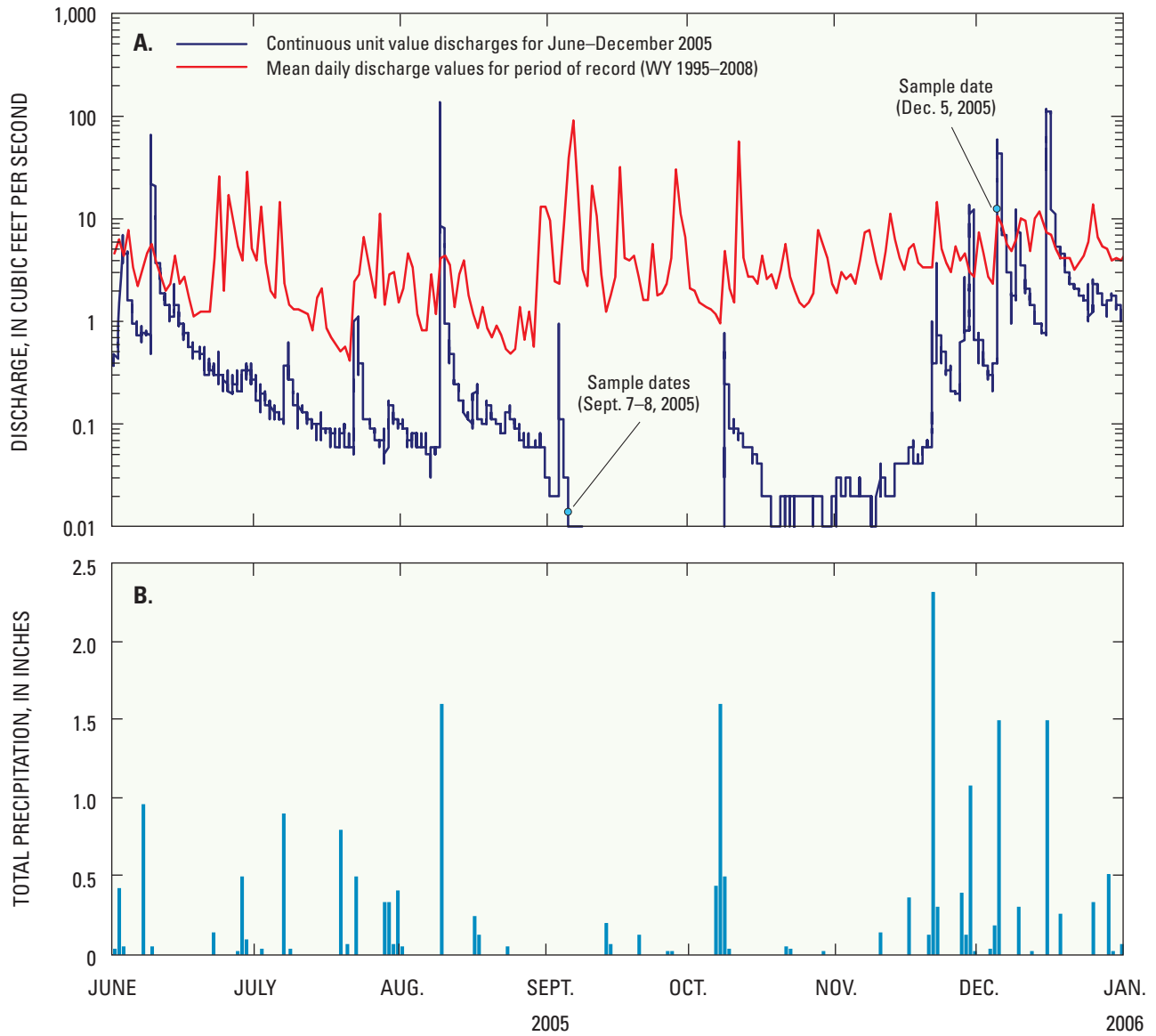


Figure 2. (A) Continuous unit value discharges for June–December 2005 and mean daily discharge values for the period of record (water years 1995–2008) at USGS streamgaging station 0208524090 on Mountain Creek at SR 1617 near Bahama, North Carolina, and (B) daily total precipitation for June–December 2005 at USGS raingage 02087182 at Falls Lake above dam near Falls, North Carolina.

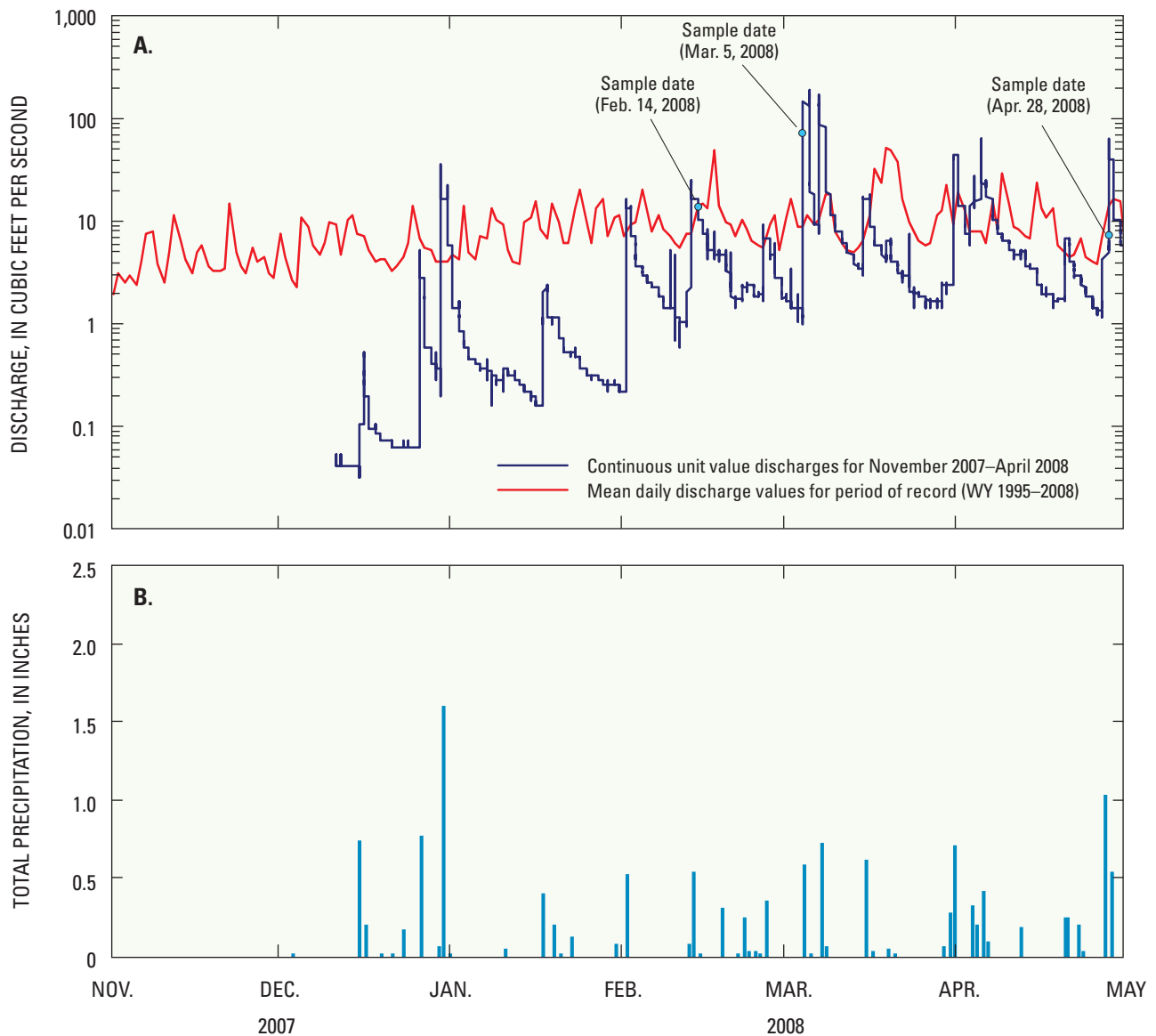


Figure 3. (A) Continuous unit value discharges for November 2007–April 2008 and mean daily discharge values for the period of record (water years 1995–2008) at USGS streamgaging station 0208524090 on Mountain Creek at SR 1617 near Bahama, North Carolina, and (B) daily total precipitation for November 2007–April 2008 at USGS raingage 02087182 at Falls Lake above dam near Falls, North Carolina.

Ledge Creek Water-Quality Data

The analytical results for the water-quality samples collected in 2005 and 2008 are summarized for sites L-2, L-3, and L-5 on Ledge Creek (table 4; back of report). Concentration data are presented for both regular environmental samples and quality-assurance samples, including sample replicates and field blanks. Excluding the September 7, 2005, sampling, when samples were collected under stagnant-flow conditions, concentrations for ammonia ranged from less than (<) 0.02 to 0.224 milligram per liter (mg/L) as nitrogen (N), nitrite plus nitrate ranged from < 0.016 to 0.50 mg/L as N, total nitrogen ranged from 0.74 to 1.96 mg/L as N, total phosphorus ranged from 0.02 to 0.28 mg/L, and suspended sediment ranged from 5 to 80 mg/L for environmental samples collected from Ledge Creek. The highlighted analytical results in table 4 indicate the samples with constituent concentrations that did not meet the applicable water-quality standards presented in table 3.

Holman Creek Water-Quality Data

The analytical results for the water-quality samples collected in 2005 and 2008 are summarized for sites H-2, H-4, H-6, H-7, and H-8 on Holman Creek (table 5; back of report). Concentration data are presented for both regular environmental samples and quality-assurance samples, including sample replicates and field blanks. Excluding the September 8, 2005, sampling, when samples were collected under mostly stagnant-flow conditions, concentrations for ammonia ranged from 0.014 to 0.475 mg/L as N, nitrite plus nitrate ranged from < 0.04 to 0.52 mg/L as N, total nitrogen ranged from 0.50 to 2.78 mg/L as N, total phosphorus ranged from 0.01 to 0.17 mg/L, and suspended sediment ranged from 4 to 762 mg/L for environmental samples collected from Holman Creek. The highlighted analytical results in table 5 indicate the samples with constituent concentrations that did not meet the applicable water-quality standards presented in table 3.

Acknowledgments

Funding for this work was provided by the U.S. Army Corps of Engineers. Appreciation is extended to the private landowners who allowed access to their properties. The authors are especially grateful to Douglas Smith for the use of information from his administrative report detailing results of the initial study phase conducted in 2005. The authors also thank Cassandra Pfeifle, Ryan Rasmussen, and Scott Caldwell, U.S. Geological Survey, for their help in collecting hydrologic and water-quality data for this project.

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- U.S. Geological Survey, 2007, North Carolina Water Science Center operating procedures and guidelines, Chapter B—Quality-assurance plan for water-quality activities of the North Carolina Water Science Center, 38 p.

Table 4. Analytical results of water-quality samples collected from Ledge Creek in Granville County, North Carolina, 2005 and 2008.

[ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; µg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Instantaneous discharge, ft ³ /s (00061)	Barometric pressure, mm Hg (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	pH, water, standard units (00400)	Specific conductance, unfiltered, µS/cm at 25 °C (00095)	Temperature, water, °C (00010)	Hardness, water, mg/L as CaCO ₃ (00900)	Calcium, filtered, mg/L (00915)
Ledge Creek at Secondary Road 1004 at Stem (site L-2; latitude 36°11'40" longitude 78°43'41")											
0208701450	09/07/05 0930	Environmental	0	759	0.7	8	7.2	370	17.8	120	33.7
0208701450	09/07/05 0935	<i>Replicate</i>	0	759	0.7	7	7.2	370	17.8	130	39.7
0208701450	12/05/05 1230	Environmental	17	753	10	87	6.7	100	8.4	21	4.91
0208701450	02/14/08 1045	<i>Blank</i>	--	--	--	--	--	--	--	--	--
0208701450	02/14/08 1115	Environmental	0.72	757	11.7	93	6.8	123	5.2	--	--
0208701450	03/05/08 0940	Environmental	8.8	746	10	93	6.1	81	11.3	--	--
0208701450	04/28/08 1345	Environmental	8.6	--	8.5	92	6.7	69	18.3	--	--
0208701450	04/28/08 1350	<i>Replicate</i>	8.6	--	8.5	92	6.7	69	18.3	--	--
Ledge Creek at Secondary Road 1215 near Stem (site L-3; latitude 36°10'33" longitude 78°42'51")											
208701500	09/07/05 1050	Environmental	0	762	0.3	3	6.9	155	19.5	52	14.3
208701500	12/05/05 1130	Environmental	27	754	9.9	85	6.9	108	8.4	27	6.43
208701500	02/14/08 1245	Environmental	1.8	761	11.4	92	6.4	128	6.0	--	--
208701500	03/05/08 1045	Environmental	19	750	9.7	90	6.2	79	11.5	--	--
208701500	03/05/08 1050	<i>Replicate</i>	19	750	9.7	90	6.2	79	11.5	--	--
208701500	04/28/08 1435	<i>Blank</i>	--	--	--	--	--	--	--	--	--
208701500	04/28/08 1515	Environmental	16	--	8	85	6.6	73	18.1	--	--
Ledge Creek near Butner (site L-5; latitude 36°09'07" longitude 78°42'27")											
208701550	09/07/05 1240	Environmental	0	762	2.2	26	7.0	202	23.8	64	15.5
208701550	09/07/05 1430	<i>Blank</i>	--	--	--	--	--	--	--	--	--
208701550	12/05/05 1045	Environmental	2.3	755	5.2	46	6.7	142	9.3	39	7.4
208701550	02/14/08 1515	Environmental	--	760	9.6	84	6.4	190	9.3	--	--
208701550	03/05/08 1430	Environmental	--	751	8.4	84	6.2	84	14.5	--	--
208701550	04/28/08 1800	Environmental	--	--	5.4	63	6.7	98	21.5	--	--

Table 4. Analytical results of water-quality samples collected from Ledge Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; µg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Magnesium, filtered, mg/L (00925)	Potassium filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)	Alkalinity, filtered, mg/L as CaCO ₃ (39086)	Bicarbonate, water, filtered, mg/L (00453)	Chloride, filtered, mg/L (00940)	Fluoride, filtered, mg/L (00950)	Silica, filtered, mg/L (00955)	Sulfate, filtered, mg/L (00945)
Ledge Creek at Secondary Road 1004 at Stem (Site L-2; latitude 36°11'40" longitude 78° 43'41")											
0208701450	09/07/05 0930	Environmental	7.60	5.42	11.7	114	139	31.1	0.14	17.1	0.69
<i>0208701450</i>	<i>09/07/05 0935</i>	<i>Replicate</i>	8.37	6.01	12.7	122	146	31.3	0.13	<i>17.9</i>	<i>0.69</i>
0208701450	12/05/05 1230	Environmental	2.24	4.59	7.41	10	12	9.16	E 0.07	7.19	14
<i>0208701450</i>	<i>02/14/08 1045</i>	<i>Blank</i>	--	--	--	--	--	--	--	--	--
0208701450	02/14/08 1115	Environmental	--	--	--	--	--	--	--	--	--
0208701450	03/05/08 0940	Environmental	--	--	--	--	--	--	--	--	--
0208701450	04/28/08 1345	Environmental	--	--	--	--	--	--	--	--	--
0208701450	04/28/08 1350	<i>Replicate</i>	--	--	--	--	--	--	--	--	--
Ledge Creek at Secondary Road 1215 near Stem (Site L-3; latitude 36°10'33" longitude 78°42'51")											
208701500	09/07/05 1050	Environmental	3.88	5.57	6.09	57	69	5.49	0.14	13.6	1.67
208701500	12/05/05 1130	Environmental	2.71	3.92	7.49	11	14	7.66	E 0.1	9.03	18
208701500	02/14/08 1245	Environmental	--	--	--	--	--	--	--	--	--
208701500	03/05/08 1045	Environmental	--	--	--	--	--	--	--	--	--
<i>208701500</i>	<i>03/05/08 1050</i>	<i>Replicate</i>	--	--	--	--	--	--	--	--	--
<i>208701500</i>	<i>04/28/08 1435</i>	<i>Blank</i>	--	--	--	--	--	--	--	--	--
208701500	04/28/08 1515	Environmental	--	--	--	--	--	--	--	--	--
Ledge Creek near Butner (Site L-5; latitude 36°09'07" longitude 78°42'27")											
208701550	09/07/05 1240	Environmental	6.10	2.88	11.9	55	67	7.93	0.14	13.8	2.53
<i>208701550</i>	<i>09/07/05 1430</i>	<i>Blank</i>	--	--	--	--	--	--	--	--	--
208701550	12/05/05 1045	Environmental	4.91	1.68	11.1	41	50	6.94	0.15	0.06	3.24
208701550	02/14/08 1515	Environmental	--	--	--	--	--	--	--	--	--
208701550	03/05/08 1430	Environmental	--	--	--	--	--	--	--	--	--
208701550	04/28/08 1800	Environmental	--	--	--	--	--	--	--	--	--

Table 4. Analytical results of water-quality samples collected from Ledge Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; µg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Residue on evaporation at 180 °C, filtered, mg/L (70300)	Ammonia, filtered, mg/L as N (00608)	Nitrite plus nitrate, filtered, mg/L as N (00631)	Total nitrogen, unfiltered, mg/L (62855)	Ortho-phosphate filtered, mg/L as P (00671)	Total phosphorus, unfiltered, mg/L (00665)	<i>Enterococci</i> , MPN/100 mL (99601)	<i>E. coli</i> , MPN/100 mL (50468)	Total coliform, MPN/100 mL (50569)
Ledge Creek at Secondary Road 1004 at Stem (Site L-2; latitude 36°11'40" longitude 78°43'41")											
0208701450	09/07/05 0930	Environmental	235	0.116	< 0.016	1.51	< 0.006	0.12	> 2,400	1,000	> 2,400
0208701450	09/07/05 0935	<i>Replicate</i>	234	0.114	< 0.080	1.42	< 0.03	0.13	> 2,400	820	1000
0208701450	12/05/05 1230	Environmental	98	0.224	0.365	1.96	0.093	0.28	7,700	7,300	> 24,000
0208701450	02/14/08 1045	<i>Blank</i>	--	< 0.020	< 0.040	< 0.06	< 0.006	< 0.02	--	--	--
0208701450	02/14/08 1115	Environmental	--	0.066	0.42	1.12	0.006	0.04	--	--	--
0208701450	03/05/08 0940	Environmental	--	0.134	0.44	1.61	0.018	0.11	--	--	--
0208701450	04/28/08 1345	Environmental	--	0.022	0.12	1.0	0.009	0.07	--	--	--
0208701450	04/28/08 1350	<i>Replicate</i>	--	0.024	0.12	0.99	0.009	0.07	--	--	--
Ledge Creek at Secondary Road 1215 near Stem (Site L-3; latitude 36°10'33" longitude 78°42'51")											
208701500	09/07/05 1050	Environmental	116	1.13	< 0.08	4.06	< 0.03	0.43	140	36	> 2,400
208701500	12/05/05 1130	Environmental	86	E 0.007	0.276	1.11	E 0.028	0.16	11,000	10,000	> 24,000
208701500	02/14/08 1245	Environmental	--	< 0.020	0.32	0.74	E 0.005	0.02	--	--	--
208701500	03/05/08 1045	Environmental	--	0.027	0.50	1.47	0.013	0.1	--	--	--
208701500	03/05/08 1050	<i>Replicate</i>	--	0.028	0.53	1.49	0.014	0.11	--	--	--
208701500	04/28/08 1435	<i>Blank</i>	--	< 0.020	< 0.04	< 0.06	E 0.006	< 0.02	--	--	--
208701500	04/28/08 1515	Environmental	--	0.054	0.10	1.22	0.027	0.15	--	--	--
Ledge Creek near Butner (Site L-5; latitude 36°09'07" longitude 78°42'27")											
208701550	09/07/05 1240	Environmental	137	0.946	< 0.08	2.45	< 0.03	0.19	34	11	> 2,400
208701550	09/07/05 1430	<i>Blank</i>	--	--	--	--	--	--	< 1	< 1	< 1
208701550	12/05/05 1045	Environmental	72	0.021	< 0.016	0.89	< 0.03	0.06	13	26	3,100
208701550	02/14/08 1515	Environmental	--	0.069	E 0.02	0.91	< 0.006	0.04	--	--	--
208701550	03/05/08 1430	Environmental	--	< 0.020	0.33	1.47	0.008	0.11	--	--	--
208701550	04/28/08 1800	Environmental	--	0.047	< 0.04	1.38	0.033	0.12	--	--	--

Table 4. Analytical results of water-quality samples collected from Ledge Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; µg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Iron, filtered, µg/L	Manganese, filtered, µg/L (01056)	Suspended sediment concentration, mg/L (80154)	Suspended sediment discharge, ton/d (80155)	
Ledge Creek at Secondary Road 1004 at Stem (Site L-2; latitude 36°11'40" longitude 78°43'41")							
0208701450	09/07/05 0930	Environmental	329	8,870	58	0	
<i>0208701450</i>	<i>09/07/05 0935</i>	<i>Replicate</i>	<i>306</i>	<i>9,160</i>	<i>61</i>	<i>0</i>	
0208701450	12/05/05 1230	Environmental	463	77.5	80	3.6	
<i>0208701450</i>	<i>02/14/08 1045</i>	<i>Blank</i>	--	--	--	--	
0208701450	02/14/08 1115	Environmental	--	--	5	0.01	
0208701450	03/05/08 0940	Environmental	--	--	35	0.83	
0208701450	04/28/08 1345	Environmental	--	--	22	0.51	
<i>0208701450</i>	<i>04/28/08 1350</i>	<i>Replicate</i>	--	--	--	--	
Ledge Creek at Secondary Road 1215 near Stem (Site L-3; latitude 36°10'33" longitude 78°42'51")							
208701500	09/07/05 1050	Environmental	204	1,520	74	0	
208701500	12/05/05 1130	Environmental	227	85.9	67	4.9	
208701500	02/14/08 1245	Environmental	--	--	7	0.03	
208701500	03/05/08 1045	Environmental	--	--	44	2.2	
<i>208701500</i>	<i>03/05/08 1050</i>	<i>Replicate</i>	--	--	50	2.5	
<i>208701500</i>	<i>04/28/08 1435</i>	<i>Blank</i>	--	--	--	--	
208701500	04/28/08 1515	Environmental	--	--	69	3	
Ledge Creek near Butner (Site L-5; latitude 36°09'07" longitude 78°42'27")							
208701550	09/07/05 1240	Environmental	404	2,980	112	0	
<i>208701550</i>	<i>09/07/05 1430</i>	<i>Blank</i>	--	--	--	--	
208701550	12/05/05 1045	Environmental	61	87.1	16	0.1	
208701550	02/14/08 1515	Environmental	--	--	8	--	
208701550	03/05/08 1430	Environmental	--	--	37	--	
208701550	04/28/08 1800	Environmental	--	--	12	--	

Table 5. Analytical results of water-quality samples collected from Holman Creek in Granville County, North Carolina, 2005 and 2008. [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; μS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; μg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Instantaneous discharge, ft ³ /s (00061)	Barometric pressure, mm Hg, (00025)	Dissolved oxygen, mg/L (00300)	Dissolved oxygen, percent of saturation (00301)	pH, water, standard units (00400)	Specific conductance, unfiltered, μS/cm at 25 °C (00095)	Temperature, water, °C (00010)		
Holman Creek tributary at Secondary Road 1132 at Stem (Site H-2; latitude 36°12'14" longitude 78°43'06")											
208701630	09/08/05 0940	Environmental	0	757	1.4	14	6.9	213	17.7		
208701630	12/05/05 1045	Environmental	5.6	753	11	94	7.3	59	8.2		
<i>208701630</i>	<i>12/05/05 1050</i>	<i>Replicate</i>	<i>5.6</i>	<i>753</i>	<i>10.9</i>	<i>93</i>	<i>7.1</i>	<i>59</i>	<i>8.2</i>		
208701630	02/14/08 1000	Environmental	0.24	757	11.3	88	5.7	98	4.6		
208701630	03/05/08 0850	Environmental	2.2	745	9.7	89	5.5	63	10.4		
208701630	04/28/08 1240	Environmental	1.4	--	8.4	88	6.2	57	16.9		
Holman Creek at I-85 near Stem (Site H-4; latitude 36°10'42" longitude 78°41'56")											
208701660	09/08/05 1040	Environmental	0	759	1.6	19	7.0	212	21.8		
208701660	12/05/05 1415	Environmental	1.4	755	8.5	73	6.9	190	8.4		
208701660	02/14/08 1345	Environmental	1.2	761	9.2	74	5.4	133	6.3		
<i>208701660</i>	<i>02/14/08 1350</i>	<i>Replicate</i>	<i>1.2</i>	<i>761</i>	<i>9.2</i>	<i>74</i>	<i>5.4</i>	<i>133</i>	<i>6.3</i>		
208701660	03/05/08 1245	Environmental	7.8	751	8.2	80	6.2	74	13.4		
208701660	04/28/08 1635	Environmental	15	--	5.3	58	6.2	92	18.5		
Holman Creek at Secondary Road 1129 near Stem (Site H-6; latitude 36°10'15" longitude 78°41'30")											
208701710	09/08/05 1205	Environmental	0	759	1.4	16	7.1	196	22.1		
208701710	12/05/05 1245	Environmental	26	753	8.3	71	6.4	135	8.1		
Holman Creek near Creedmoor (Site H-7; latitude 36°09'28" longitude 78°41'29")											
208701730	12/05/05 1430	Environmental	12	754	8.3	71	5.4	193	8.3		
<i>208701730</i>	<i>12/05/05 1525</i>	<i>Blank</i>	<i>--</i>	<i>--</i>	<i>--</i>	<i>--</i>	<i>--</i>	<i>--</i>	<i>--</i>		

Table 5. Analytical results of water-quality samples collected from Holman Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; μS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; μg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Hardness, water, mg/L as CaCO ₃ (00900)	Calcium, filtered, mg/L (00915)	Magnesium, filtered, mg/L (00925)	Potassium, filtered, mg/L (00935)	Sodium, filtered, mg/L (00930)	Alkalinity, filtered, mg/L as CaCO ₃ (39086)	Bicarbonate, water, filtered, mg/L (00453)	Chloride, filtered, mg/L (00940)	Fluoride, filtered, mg/L (00950)
Holman Creek tributary at Secondary Road 1132 at Stem (Site H-2; latitude 36°12'14" longitude 78°43'06")											
208701630	09/08/05 0940	Environmental	38	10.9	2.71	2.12	20.2	40	48	21.7	0.15
208701630	12/05/05 1045	Environmental	14	3.11	1.61	2.09	5.15	2	2	3.99	E 0.09
<i>208701630</i>	<i>12/05/05 1050</i>	<i>Replicate</i>	<i>14</i>	<i>3.03</i>	<i>1.64</i>	<i>2.07</i>	<i>5.19</i>	<i>2</i>	<i>3</i>	<i>4.04</i>	<i>E 0.06</i>
208701630	02/14/08 1000	Environmental	--	--	--	--	--	--	--	--	--
208701630	03/05/08 0850	Environmental	--	--	--	--	--	--	--	--	--
208701630	04/28/08 1240	Environmental	--	--	--	--	--	--	--	--	--
Holman Creek at I-85 near Stem (Site H-4; latitude 36°10'42" longitude 78°41'56")											
208701660	09/08/05 1040	Environmental	73	19.1	6.01	3.12	11.8	78	95	11.4	0.21
208701660	12/05/05 1415	Environmental	42	10.2	3.99	6.67	12.1	11	14	11.7	< 0.10
208701660	02/14/08 1345	Environmental	--	--	--	--	--	--	--	--	--
<i>208701660</i>	<i>02/14/08 1350</i>	<i>Replicate</i>	--	--	--	--	--	--	--	--	--
208701660	03/05/08 1245	Environmental	--	--	--	--	--	--	--	--	--
208701660	04/28/08 1635	Environmental	--	--	--	--	--	--	--	--	--
Holman Creek at Secondary Road 1129 near Stem (Site H-6; latitude 36°10'15" longitude 78°41'30")											
208701710	09/08/05 1205	Environmental	68	17.8	5.66	3.68	8.63	78	96	8.29	0.18
208701710	12/05/05 1245	Environmental	29	6.57	3.03	4.89	7.51	3	4	8.25	E 0.07
Holman Creek near Creedmoor (Site H-7; latitude 36°09'28" longitude 78°41'29")											
208701730	12/05/05 1430	Environmental	61	15.1	5.69	5.33	10.5	2	3	8.57	< 0.10
<i>208701730</i>	<i>12/05/05 1525</i>	<i>Blank</i>	--	--	--	--	--	--	--	--	--

Table 5. Analytical results of water-quality samples collected from Holman Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; µg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	Silica, filtered, mg/L (00955)	Sulfate, filtered, mg/L (00945)	Residue on evaporation at 180 °C, filtered, mg/L (70300)	Ammonia, filtered, mg/L as N (00608)	Nitrite plus nitrate, filtered mg/L as N (00631)	Total nitrogen, unfiltered, mg/L (62855)	Ortho-phosphate filtered, mg/L as P (00671)	Total phosphorus, unfiltered, mg/L (00665)	Enterococci, MPN/100 mL (99601)
Holman Creek tributary at Secondary Road 1132 at Stem (Site H-2; latitude 36°12'14" longitude 78°43'06")											
208701630	09/08/05 0940	Environmental	10.5	19.3	136	0.344	0.019	1.31	< 0.03	0.21	190
208701630	12/05/05 1045	Environmental	6.92	12.6	75	0.032	0.109	1.08	< 0.03	0.17	3,900
208701630	12/05/05 1050	<i>Replicate</i>	6.83	12.6	74	0.019	0.115	1.14	< 0.03	0.17	3,400
208701630	02/14/08 1000	Environmental	--	--	--	< 0.020	0.070	0.52	0.006	0.04	--
208701630	03/05/08 0850	Environmental	--	--	--	< 0.020	0.190	1.13	0.014	0.09	--
208701630	04/28/08 1240	Environmental	--	--	--	E 0.013	< 0.04	0.86	0.011	0.06	--
Holman Creek at I-85 near Stem (Site H-4; latitude 36°10'42" longitude 78°41'56")											
208701660	09/08/05 1040	Environmental	11.1	1.02	138	0.206	0.079	1.72	< 0.03	0.123	34
208701660	12/05/05 1415	Environmental	8.49	39.9	127	0.044	0.427	1.86	< 0.03	0.143	360
208701660	02/14/08 1345	Environmental	--	--	--	< 0.020	0.160	0.50	E 0.005	E 0.02	--
208701660	02/14/08 1350	<i>Replicate</i>	--	--	--	< 0.020	0.150	0.52	E 0.005	E 0.02	--
208701660	03/05/08 1245	Environmental	--	--	--	< 0.020	0.140	0.85	E 0.005	0.06	--
208701660	04/28/08 1635	Environmental	--	--	--	0.025	E 0.03	0.82	0.006	0.05	--
Holman Creek at Secondary Road 1129 near Stem (Site H-6; latitude 36°10'15" longitude 78°41'30")											
208701710	09/08/05 1205	Environmental	12.4	E 0.13	135	0.294	< 0.08	1.70	< 0.03	0.174	6
208701710	12/05/05 1245	Environmental	9.6	26.3	107	0.014	0.452	1.33	E 0.028	0.111	6,900
Holman Creek near Creedmoor (Site H-7; latitude 36°09'28" longitude 78°41'29")											
208701730	12/05/05 1430	Environmental	15.5	52	135	0.124	0.52	2.78	E 0.021	0.089	4,600
208701730	12/05/05 1525	<i>Blank</i>	--	--	--	--	--	--	--	--	< 1

Table 5. Analytical results of water-quality samples collected from Holman Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; μS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; μg/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	<i>E. coli</i> , MPN/100 mL (50468)	Total coliform, MPN/100 mL (50569)	Iron, filtered, μg/L	Manganese, filtered, μg/L (01056)	Suspended sediment concentration, mg/L (80154)	Suspended sediment discharge, ton/d (80155)			
Holman Creek tributary at Secondary Road 1132 at Stem (Site H-2; latitude 36°12'14" longitude 78°43'06")											
208701630	09/08/05 0940	Environmental	3,100	> 4,800	33	382	279	0			
208701630	12/05/05 1045	Environmental	4,900	> 24,000	253	69.5	762	12.0			
208701630	12/05/05 1050	<i>Replicate</i>	4,600	> 24,000	240	69.1	779	12.3			
208701630	02/14/08 1000	Environmental	--	--	--	--	13	0.01			
208701630	03/05/08 0850	Environmental	--	--	--	--	611	3.6			
208701630	04/28/08 1240	Environmental	--	--	--	--	27	0.10			
Holman Creek at I-85 near Stem (Site H-4; latitude 36°10'42" longitude 78°41'56")											
208701660	09/08/05 1040	Environmental	520	> 4,800	31	2,320	53	0			
208701660	12/05/05 1415	Environmental	1,500	24,000	256	413	26	0.10			
208701660	02/14/08 1345	Environmental	--	--	--	--	4	0.01			
208701660	02/14/08 1350	<i>Replicate</i>	--	--	--	--	6	0.02			
208701660	03/05/08 1245	Environmental	--	--	--	--	12	0.25			
208701660	04/28/08 1635	Environmental	--	--	--	--	15	0.61			
Holman Creek at Secondary Road 1129 near Stem (Site H-6; latitude 36°10'15" longitude 78°41'30")											
208701710	09/08/05 1205	Environmental	22	> 4,800	361	4,160	34	0			
208701710	12/05/05 1245	Environmental	3,500	> 24,000	225	196	24	1.7			
Holman Creek near Creedmoor (Site H-7; latitude 36°09'28" longitude 78°41'29")											
208701730	12/05/05 1430	Environmental	3,100	> 24,000	144	772	20	0.63			
208701730	12/05/05 1525	<i>Blank</i>	< 1	< 1	--	--	--	--			

Table 5. Analytical results of water-quality samples collected from Holman Creek in Granville County, North Carolina, 2005 and 2008.—Continued
 [ft³/s, cubic feet per second; mm Hg, millimeters of mercury; mg/L, milligrams per liter; μ S/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; mg/L as CaCO₃, milligrams per liter as calcium carbonate; site locations are shown in figure 1; highlighted constituent values do not meet applicable surface-water standards presented in table 3; italics identify quality-assurance and control samples; --, not available or not analyzed; E, estimated; N, nitrogen; P, phosphorus; MPN/100 mL, most probable number per 100 milliliters; <, less than; >, greater than; μ g/L, micrograms per liter; ton/d, tons per day]

Station number	Sampling date and time	Sample type	<i>E. coli</i> , MPN/100 mL (50468)	Total coliform, MPN/100 mL (50569)	Iron, filtered, μ g/L	Manganese, filtered, μ g/L (01056)	Suspended sediment concentration, mg/L (80154)	Suspended sediment discharge, ton/d (80155)			
Holman Creek at Secondary Road 1127 at Creedmoor (Site H-8; latitude 36°08'11" longitude 78°41'50")											
208701800	09/08/05 1305	Environmental	43	> 4,800	1,010	2,170	25	0.15			
<i>208701800</i>	<i>09/08/05 1305</i>	<i>Replicate</i>	<i>24</i>	<i>> 4,800</i>	--	--	--	--			
<i>208701800</i>	<i>09/08/05 1310</i>	<i>Blank</i>	--	--	< 6	< 0.6	--	--			
208701800	12/05/05 1245	Environmental	170	8,700	101	7,310	14	0			
208701800	02/15/08 1130	Environmental	--	--	--	--	4	--			
208701800	03/05/08 1530	Environmental	--	--	--	--	80	--			
<i>208701800</i>	<i>03/05/08 1540</i>	<i>Blank</i>	--	--	--	--	--	--			
208701800	04/28/08 1905	Environmental	--	--	--	--	15	1			

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