



Summary of Stream Flow Conditions at Five Riverine Parks in the Southeast Coast Network, 2012

Natural Resource Data Series NPS/SECN/NRDS—2013/505



ON THE COVER

Confluence of Walnut Creek and the Ocmulgee River near Ocmulgee National Monument in Macon, Georgia. Photograph by Allan Cressler.

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Natural Resource Data Series NPS/SECN/NRDS—2013/505

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Summary and Key Findings

- The National Park Service (NPS) Southeast Coast Network (SECN) evaluated stream flow variability and the magnitude and timing of specific flow events at five parks within the Network during 2012. The streams and rivers of these parks ranged in size from small creeks to small- and medium-sized rivers that make up significant park acreage along the Chattahoochee, Congaree, Ocmulgee, Wateree and Tallapoosa Rivers.
- Flow patterns were characterized and put in historical context using U.S. Geological Survey stream flow data, The Nature Conservancy's Indicators of Hydrologic Alteration software, and Flow software (Dowd 2011), which generates graphical representations of annual stream flow data.
- Across all parks, high flow pulses were more frequent at two gages, while extreme low-flow pulses were more frequent at nine gages. The average length of each event type ranged 1–10 days for extreme low-flow pulse length and 1–5.5 days for high flow pulses length. Extreme low-flow pulses tended to occur June–October at all parks except Chattahoochee River National Recreation Area (CHAT) where extreme low-flow pulses occurred primarily during February and March. High flow pulses primarily occurred primarily from January to May except at CHAT where high flow pulses occurred October–November. No small floods (defined as a flood event with an initial high flow with a peak flow greater than a two-year return interval event) occurred at any SECN park in 2012.
- At CHAT, the most commonly observed flow conditions on all sections during 2012 (32–42% of the time) were 1000–1500 cfs. These flows are considered optimal for wade and tube fishing, novice rafting, and canoeing.
- River flows along the sections of the Chattahoochee were below 750 cfs 6–31% of the time. Extreme low flows were more common on Sections 2–4 and a comparison of the number of times daily flow was below 750 cfs at Section 2 and Section 3 (23 and 44, respectively) may indicate that Section 3 was impacted by water withdrawals.
- High flows (greater than 2,000 cfs), which impaired fishing activities and allowed only mid-level paddling activities at CHAT, occurred approximately 11% of the time on section 1, 11% of the time on section 2, 13% of the time on section 3, and 14% of the time on section 4 of the Chattahoochee River within the Park.

Introduction

Evaluation of stream flow characteristics offers some of the most appropriate and useful indicators for assessing aquatic ecosystem integrity, and for monitoring environmental changes over time. It also provides key support data for other vital signs indicators including water quality, threatened and endangered aquatic species, wetlands, and riparian habitats. The hydrologic output of a watershed is a function of land characteristics, human use, weather and climate conditions, urbanization, and soil characteristics. Hydrologic variation plays a key part in structuring the biotic diversity within river ecosystems by controlling critical habitat conditions within the river channel, the floodplain, and hyporheic zones. A stream's flow regime is a primary governing factor that is largely responsible for determining the type and magnitude of various physical and ecological processes that occur in a stream system (Puckridge et al. 1998). Although other environmental factors and characteristics of a stream influence the overall condition of a stream and its biological communities, a stream's flow is thought of as the master variable (Power et al. 1995). Stream flow has been shown to provide important conceptual and empirical linkages between watershed conditions, in-stream habitats, and the biotic integrity of stream biological communities. The large amount of uncertainty associated with many projections for changes in water availability due to climate change (Brekke et al. 2009, Miller and Yates 2006) means that more data are likely needed before the direction and magnitude of the influence can be inferred. This large amount of uncertainty has led to a federal recommendation to increase the tracking of water resources so that changes can be monitored more closely and water availability can be anticipated (Brekke et al. 2009).

Purpose and Scope

In an effort to evaluate the significance of changes in flow regimes due to both naturally-occurring and regulated conditions, the National Park Service Southeast Coast Network (SECN) began harvesting relevant stream flow data sets collected at selected sites and disseminating this data to Network parks in the context of historical flow characteristics and/or park-specific flow thresholds. This report provides a summary of the previous calendar year's flow conditions in the context of recent historical flows (Table 1) and provides information on overall flow variability as well as the seasonality and timing of ecologically relevant flow events in rivers near or adjacent to SECN parks. Data from the Chattahoochee River are put in the context of river flow thresholds that have management or use implications. The NPS makes use of publically available data sets from stations monitored by the U.S. Geological Survey Water Science Centers in Alabama, Georgia, and South Carolina as part of various ongoing national, state, and locally funded projects. Links to stream flow data sets, as well as additional ancillary water-quality data sets collected during the previous water year (October to September) for stations included in this analysis, are provided in appendices. This effort is part of the SECN Surface Water Quantity monitoring effort described by DeVivo et al. (2008). Additional climate data that may further aide in the interpretation of data presented in this report may be found in the Summary of Weather and Climate Monitoring in Southeast Coast Network parks, 2012 (Wright et al. 2013).

Parks Included in this Summary

SECN parks include a diversity of stream types, and many (if not all) have been altered by human activities, including impoundments, channelization, lowering of water tables, increased runoff, pollution, sedimentation, recreation, and introduced species (including mussels, fishes,

and aquatic plants). Stream flows have a large influence on stream biota (Hackney and Adams 1992) and nearly all major stream systems have been channelized or dammed (Adams and Hackney 1992). In the Southeastern U.S., 144 major reservoirs have been constructed and all large rivers flowing in or adjacent to SECN parks are influenced. Five parks within the Network were selected for evaluations—those characterized by significant non-tidal, flowing water resources within or adjacent to park boundaries (Figure 1). In some cases, stations outside and upstream of these parks were included in the evaluation if it was thought that these data would help characterize flow conditions within the park. The USGS gage on Cedar Creek located in the Congaree National Park was not included in this analysis because only stage data have been recorded at this site. The lotic resources of these parks range in size from small streams to small- and medium-sized rivers including significant park acreage along the Chattahoochee, Congaree, and Tallapoosa Rivers.

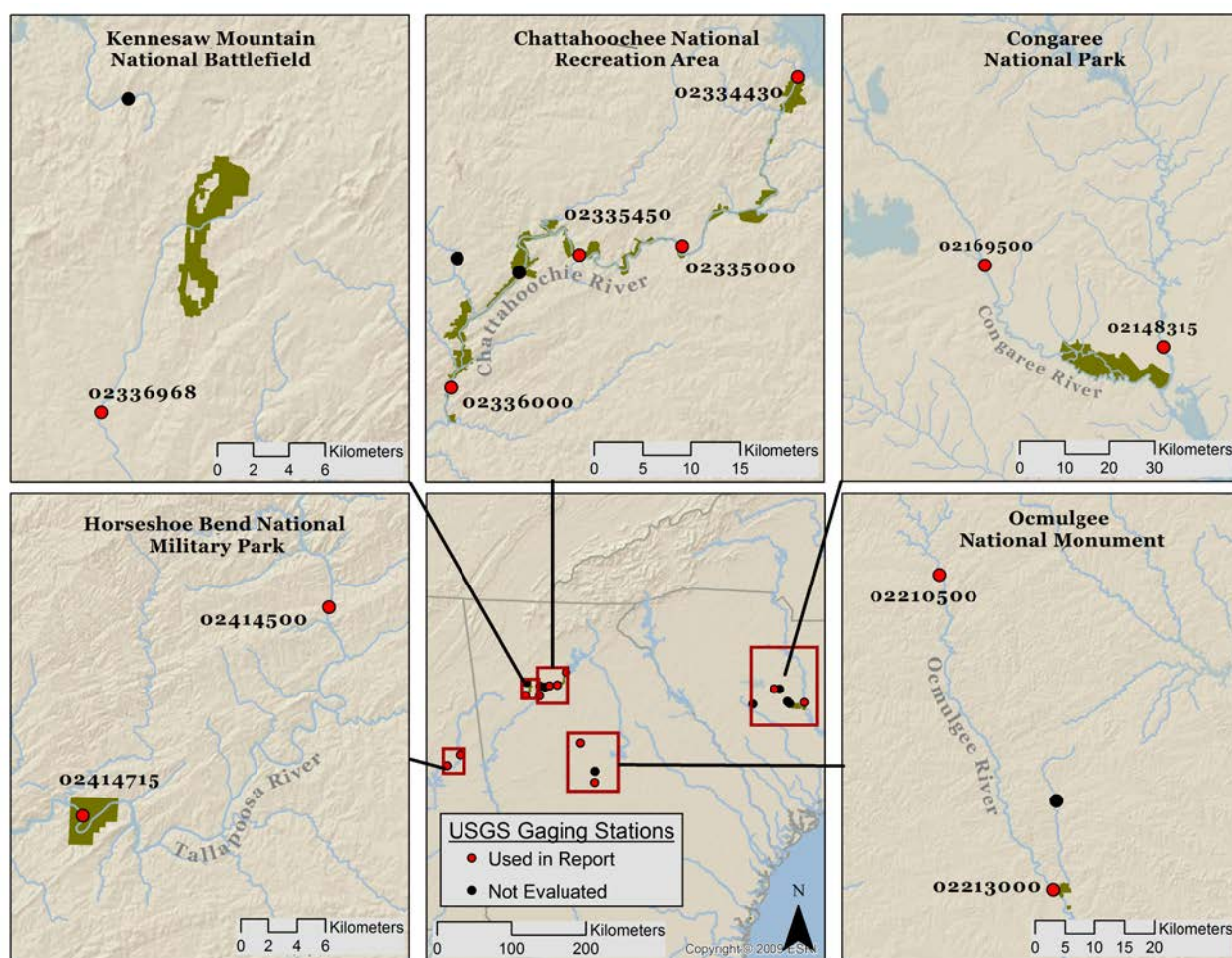


Figure 1. Map showing locations of inland river parks in the Southeast Coast Network. Individual park maps show locations of USGS gages near and within park boundaries.

Chattahoochee River National Recreation Area

The Chattahoochee River National Recreation Area (CHAT) is made up of 6,800 acres of mixed pine/hardwood forests and wetlands that buffer 48 miles of the Chattahoochee River (Figures 1). Surface water bodies within the park include the following: Chattahoochee River and associated

tributaries, Bull Sluice Lake, Sibley Pond (in the Cochran Shoals unit), and Island Ford Pond. Upstream of the park is Buford Dam that impounds Lake Lanier. Water released from Lake Lanier through Buford Dam into the Chattahoochee River flows from the lower strata of the lake (hypolimnion during the stratification period). The dam also regulates the flow within CHAT. Current regulations require that the flow be 750 cfs at the confluence of the Chattahoochee River and Peachtree Creek; however, beginning in 2008 Georgia Environmental Protection Division (EPD) allowed this standard to be lowered by 100 cfs during droughts to preserve storage in Lake Lanier (GAEPD 2008).

Congaree National Park

Congaree National Park (CONG) lies in the floodplain of the Congaree River in the Coastal Plain physiographic province of South Carolina (Figure 1). The park is made up of 24,180 acres of currently owned land, and 26,776 acres of authorized area. The Park consists of old-growth bottomland forests along the Congaree and Wateree Rivers, and comprises an extensive floodplain ecosystem. The upstream watershed includes over 5 million acres (Knowles 1996) and major flood events along the Congaree River occur, on average, 10 times per year. Ninety-percent of Congaree National Park is annually flooded by major high flow events (Knowles 1996) driven primarily by flows from the Broad River. Natural flows in the Congaree River have been altered since the late 1920s by the construction of Dreher Shoals Dam which impounds Lake Murray. River flows from the Broad River, a major tributary to the Wateree which intersects with the Wateree River approximately 23 river miles upstream of the Congaree National Park's boundary, are also impacted by upstream dams and can further alter river flow patterns in the park.

Horseshoe Bend National Military Park

Horseshoe Bend National Military Park (HOBE) is made up of 2,040 acres of mixed hardwood forest located in eastern Alabama (Figure 1). Most of the Park is upland, with approximately 10% of the area representing wetlands. A portion of the forest is recovering farmland. There are many open fields that commemorate historic battlefronts and the Park averages 100,000 visitors per year. Surface water bodies at the park include the Tallapoosa River and Whale Creek. Surface water resources in the HOBE study area include the Tallapoosa River; Emuckfaw, Timbergut, Hillabee, Dobbs, and numerous other creeks (National Park Service 1997). Flows through HOBE have been significantly affected since 1983 by the construction of the Harris Dam and Lake hydropower project.

Kennesaw Mountain National Battlefield Park

Kennesaw Mountain National Battlefield Park (KEMO) is located in the Atlanta metropolitan area in the Allatoona Mountain Range (Figure 1) and consists of approximately 3,000 acres of mixed hardwood pine forest and open fields. Less than 10% of the Park is considered wetlands. Kennesaw Mountain is located in the northern portion of the Park. The Park receives approximately 1.5 million visitors per year (includes passing traffic). Multiple creeks are located within the Park including John Ward Creek, Noses Creek and Allatoona Creek, which originate outside the Park boundaries.

Ocmulgee National Monument

Ocmulgee National Monument (OCMU) is located on the Fall Line, near Macon, Georgia (Figure 1). The 702-acre park is surrounded by urban and suburban development. Roughly 300

acres of the park are classified as emergent wetlands. Surface water resources in the area include the Ocmulgee River, Walnut Creek, Swift Creek, Town Creek, and other small creeks; Edwards, Club, Nelsons, and other impounded lakes and ponds; and swamps and wetlands (National Park Service 2001). Flows in the Ocmulgee River near the Ocmulgee National Monument have been impacted for over 100 years by the construction of Lloyd Shoals Dam (Lake Jackson) in 1911.

Table 1. USGS station names, drainage areas and periods of record used to calculate flow metrics for SECN River Parks during 2012. [sq. mi., square miles]

Park Name	Station Name	USGS Station ID	Drainage Area (sq. mi.)	Period of Record
Chattahoochee River NRA	Chattahoochee River at Buford Dam	02334430	1040	1960-2012
	Chattahoochee River near Norcross, GA	02335000	1170	1960-2012
	Chattahoochee River near Roswell, GA	02335450	1230	1976-2012
	Chattahoochee River at Atlanta, GA	02336000	1450	1960-2012
Kennesaw Mountain NBP	Noses Creek near Powder Springs, GA	02336968	44.5	1999-2012
Congaree National Park	Wateree River below Eastover, SC	02148315	5590	1969-2012
	Congaree River at Columbia, SC	02169500	7850	1939-2012
Horseshoe Bend MP	Tallapoosa River at Wadley, AL	02414500	1675	1984-2012
	Tallapoosa River at New Site, AL	02414715	2058	1984-2012
Ocmulgee National Monument	Ocmulgee River near Jackson, GA	02210500	1420	1988-2012
	Ocmulgee River at Macon, GA	02213000	2240	1960-2012

Methods

Data Acquisition and Analysis

Daily value flow data spanning the recent periods of record were downloaded from relevant USGS stations and evaluated for inclusion in this analysis. Gages were considered relevant if the station was located on a major river or large stream located upstream of or within a park's boundary. Although 20 years of data or more is considered an ideal period of record for hydrologic analyses on natural systems (Richter et al. 1997), we considered a minimum of 12 years of data in these managed systems for this analysis. Some stations that had only stage data available were not considered. Additionally, flow periods prior to long periods of missing data and prior to the construction and filling of new reservoirs were ignored. This resulted in the historic evaluation and context being more relevant since it incorporated only more-recently collected data and evaluated flow under a river's managed or more developed conditions (Table 1). All USGS gages located near or within SECN parks (including periods of records and data types) can be found in the SECN Surface Water Monitoring Protocol (Jones et al. 2010).

Indicators of Hydrologic Alteration (IHA) software (TNC 2009) was used to characterize general flow conditions and significant ecological events by processing the edited period of record at each station. This program used single-period daily values in cubic feet per second (cfs) to calculate nonparametric and parametric statistical metrics including median monthly flow values and extreme event characterization and timing (Table 2). IHA also was used to calculate Environmental Flow Components (EFCs) which are typically used to characterize natural flow and departures from natural conditions (Table 2). EFCs are flow events defined by river ecologists and delineated based on reoccurring flow patterns observed at a site over many years. In this context, EFCs are meant to characterize flow events that have become typical since diversions or development occurred. The EFC procedure set initial high flows as 75% of daily flows for the period of record used. We defined small floods as those events with a two-year return interval. Although none occurred, we defined large floods as those events with a 10-year return interval. Extreme low flows were defined as being less than 10% of all flows for the period. The algorithm calculates these metrics by making three passes through the data. During the first pass, each day is assigned to one of two initial event types: low flows and high flows. During the second pass, all days that were initially assigned as high flows are re-assigned to 1, 2, or 3 high flow classes (i.e., small floods, high flow pulses, etc.). During the third pass, some of the initial low-flow days are re-assigned to the extreme low-flow class. More detailed information related to the algorithm can be found in the IHA user's manual (2009).

Annual river flow characteristics were also described and put into a historical flow context using a program that produces daily flow graphs that depict median monthly flow, interquartile range, and daily flow (Flow software; Dowd 2011). This graphical representation allows for quick comparison of basic flow characteristics versus historical patterns at each gaging station within or near SECN parks. Similar to the IHA analysis, flow periods prior to long periods of missing data and prior to the construction and filling of reservoirs were ignored.

Assessment Criteria

Where defined, data are also interpreted in the context of existing resource criteria as defined by individual parks within the SECN. A park's Resource Stewardship Strategy (RSS) is a plan that includes strategies for managing natural and cultural resources. It is based on science and scholarship and is designed to help park staff achieve and maintain desired conditions for resources as spelled out in a park unit's General Management Plan. The intent of an RSS is to provide measurable indicators for impartially assessing the condition of a park's resources over time and to establish target values that represent desired conditions. Wherever possible, Vital Signs (such as stream flow) are selected as RSS indicators of resource condition. This facilitates the use of Vital Signs monitoring data when tracking and reporting a park's progress toward attaining target values as defined in its RSS. To date, only Chattahoochee River National Recreation Area has completed its RSS within the SECN (NPS 2010).

Minimum flows of water in the Chattahoochee River were selected by CHAT as an indicator of conditions as a part of the CHAT RSS (NPS 2010). Within the RSS, five management targets are identified based on their relevance to state standards, and recommended flows for rafting, canoeing and trout fishing or fishery condition (Table 3; Nestler et al. 1986).

Table 2. Indicators of Hydrologic Alteration Metrics and Environmental Flow Components calculated and used in this report. Potential Ecosystem Influences modified from IHA User's manual (TNC 2009). Table number in parentheses refers to the table in this report where information is presented.

Parameter Type	Definition	Potential Ecosystem Influences
Indicators of Hydrologic Alteration Metrics		
Median Monthly Flow Conditions (Table 4)	Median daily value for each calendar month	•Habitat availability for aquatic organisms •Soil moisture availability for plants •Availability of water for terrestrial animals •Availability of food/cover for furbearing mammals •Reliability of water supplies for terrestrial animals •Access by predators to nesting sites •Water temperature, oxygen levels, photosynthesis in water column
Extreme Flow Conditions (Table 5)	1 to 90 day minimum and maximum flows	•Balance of competitive, ruderal, and stress- tolerant organisms •Creation of sites for plant colonization •Structuring of aquatic ecosystems by abiotic vs. biotic factors •Structuring of river channel morphology and physical habitat conditions •Soil moisture stress in plants •Dehydration in animals •Anaerobic stress in plants •Volume of nutrient exchanges between rivers and floodplains •Duration of stressful conditions such as low oxygen and concentrated chemicals in aquatic environments •Distribution of plant communities in lakes, ponds, floodplains •Duration of high flows for waste disposal, aeration of spawning beds in channel sediments

Table 2. Continued.

Parameter Type	Definition	Potential Ecosystem Influences
Indicators of Hydrologic Alteration Metrics		
Magnitude of Extreme Flow Conditions (Table 5)	Magnitude of 1 to 90 day high and low	•Compatibility with life cycles of organisms •Predictability/avoidability of stress for organisms •Access to special habitats during reproduction or to avoid predation •Spawning cues for migratory fish •Evolution of life history strategies, behavioral mechanisms
Environmental Flow Components		
Monthly Low Flows (Table 4)	Median low-flow daily value for each calendar month	•Provide adequate habitat for aquatic organisms •Maintain suitable water temperatures, dissolved oxygen, and water chemistry •Maintain water table levels in floodplain, soil moisture for plants •Provide drinking water for terrestrial animals •Keep fish and amphibian eggs suspended •Enable fish to move to feeding and spawning areas •Support hyporheic organisms (living in saturated sediments)
Indicators of Hydrologic Alteration Metrics		
Extreme Low Flow and Low-Flow Pulses (Table 6)	Frequency, duration and timing of low flows and low-flow pulses	•Enable recruitment of certain floodplain plant species •Purge invasive, introduced species from aquatic and riparian communities •Concentrate prey into limited areas to benefit predators
High Flow Pulses (Table 6)	Frequency, duration and timing of high flow pulses	•Shape and physical character of river channel, including pools and riffles •Determine size of streambed substrates (sand, gravel, cobble) •Prevent riparian vegetation from encroaching into channel •Restore normal water-quality conditions after prolonged low flows, flushing away waste products and pollutants •Aerate eggs in spawning gravels, prevent siltation •Maintain suitable salinity conditions in estuaries •Influences bedload transport, channel sediment textures, and duration of substrate disturbance high pulses
Small Floods (Table 6)	Frequency, duration and timing of small floods	•Provide migration and spawning cues for fish •Trigger new phase in life cycle (i.e., insects) •Enable fish to spawn in floodplain, provide nursery area for juvenile fish •Provide new feeding opportunities for fish, waterfowl •Recharge floodplain water table •Maintain diversity in floodplain forest types through prolonged inundation (i.e., different plant species have different tolerances) •Control distribution and abundance of plants on floodplain •Deposit nutrients on floodplains

Table 3. Assessment criteria for evaluating status of flow conditions at Chattahoochee River National Recreation Area from NPS Resource Stewardship Strategy (NPS 2010) and Nestler et al. (1986).

Flow criteria threshold (in cfs)	Justification
Days less than 650	State standards for minimum flow at Peachtree Creek (River Mile 300.5).
750-1,000	Life history requirements for juvenile brown trout, adult brook trout. Possible wade and tube fishing, rafting.
1,000-1,500	Optimal conditions for wade and tube fishing, novice rafting and canoeing and hanging out; boat fishing possible.
1,500-2,000	Possible conditions for wade and tube fishing, novice rafting and canoeing and hanging out; optimal conditions for boat fishing.
Greater than 2,000	Powerboat fishing, mid-level rafting and canoeing.

Results

Summary of Flow Conditions in SECN River Parks

Riverine systems in and around SECN parks encompass drainage areas ranging from 44 to 7,850 sq mi. Regardless of drainage size, all large river flows through and adjacent to parks included in this report have been altered by placement of upstream impoundments.

Flows across SECN parks were highly variable, with median flows in SECN parks typically highest January–March (except at CHAT where highest median flows occurred during November) and lowest from July to October (except at CHAT where lowest median flows occurred January–March; Table 4). The duration of 1 to 90 day flow events is shown in Table 5. Typically, the magnitude of a high flow event decreases with increasing duration periods while the opposite is true for low-flow magnitudes. These flows are usually roughly proportional to the drainage area depicted except in the Chattahoochee River NRA where extreme low-flow magnitudes decrease between Stations 02335000 and 02335450, indicating potentially significant flow alterations due to the combination of municipal and private water withdrawals in the intervening section of river.

Across all parks, high flow pulses were more frequent at two gages, while extreme low-flow pulses were more frequent at nine gages. The average length of each event type ranged 1–10 days for extreme low-flow pulse length and 1–5.5 days for high flow pulses length (Table 6). Extreme low-flow pulses tended to occur June–October at all parks except CHAT where extreme low-flow pulses occurred primarily during February and March. High flow pulses primarily occurred primarily from January to May except at CHAT where high flow pulses occurred October–November. No small floods (defined as a flood event with an initial high flow with a peak flow greater than a two-year return interval event) occurred at any SECN park in 2012. Similarly, no large floods (defined as a flood event with an initial high flow with a peak flow greater than a 10-year return interval event) occurred during 2012 at any stations near these river parks and are not typical due to either the small size of the drainage (as is the case for KEMO flows) or upstream storage on the rivers flowing through the other parks. Figures 2–12 depict daily flows in comparison to the historical variability observed at each gage.

Management Thresholds at Chattahoochee River National Recreation Area

Water levels on the Chattahoochee River dropped to extremely low levels on two dates in July and October due to lack of scheduled water releases from Buford Dam mainly effecting activities on Bulls Sluice Lake (Fox 2012a). Additionally, high flows were frequent during November when the Army Corps of Engineers tripled the amount of water being released from Buford Dam to satisfy downstream needs and precluded recreational fishing activities (Fox 2012b). Daily flows were below the State threshold of 750 cfs at river mile 300.5 at Peachtree Creek 0 times during 2012. Flows at downstream Sections 2–4 (Figure 13) were also below the 750 cfs management target identified in the RSS for 0–71 days. The most commonly observed flow conditions on all sections during 2012 (32–42% of the time) were 1000-1500 cfs—flows considered optimal for wade and tube fishing, novice rafting and canoeing. River flows along the sections of the Chattahoochee (Figure 13) were below 750 cfs 6–31% of the time. Extreme low flows were more common on Sections 2–4 (Table 6) and a comparison of the number of times daily flow was below 750 cfs at Section 2 and Section 3 (23 and 44, respectively; Table 7) may

indicate that Section 3 was impacted by water withdrawals. Additional results of this analysis are summarized in Table 7.

Table 4. Monthly median flow magnitudes for SECN River Parks during 2012. Median flow calculated with IHA (TNC 2009) using daily data values collected by U.S. Geological Survey. Values in cubic feet per second (cfs). Darker blue color indicates higher flow magnitude.

Park Name	USGS ID	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Median Flow													
Chattahoochee River NRA	2334430	546	679	644	1095	1090	1065	1010	1010	993	1030	2250	1160
	2335000	873	861	827	1155	1060	1060	1120	1090	1055	1150	2680	1300
	2335450	776	756	741	929	1050	1007	1190	1050	1030	1150	2945	1430
	2336000	979	957	887	911.5	1100	961	1090	1050	968	1110	2590	1600
Kennesaw Mountain NBP	2336968	33	24	40	13.5	15	5.8	2.5	4.8	1.9	2.9	4.5	15
Congaree National Park	2148315	6210	3250	3230	3090	3290	2365	2190	2460	2505	1540	1535	1580
	2169500	4330	3520	4140	3350	3240	2135	1910	3160	1910	2280	1835	2630
Horseshoe Bend Military Park	2414500	2300	2270	4490	313.5	442	641.5	397	152	261	301	545.5	1440
	2414715	1950	2230	3280	729	572	622.5	335	201	227	269	630	1090
Ocmulgee NM	2210500	707	736	1220	475.5	345	269	276	253	246	285	263.5	895
	2213000	830	970	1520	660.5	458	341.5	376	427	298	330	284	789

Table 5. 1- to 90-day extreme flow magnitudes at SECN River Parks during 2012. Metrics calculated using Indicators of Hydrologic Alteration software (TNC 2009). Data from U.S. Geological Survey in cubic feet per second (cfs).

Park Name	USGS ID	1-day	3-day	7-day	30-day	90-day
Minimum						
Chattahoochee River NRA	2334430	459	475	480.7	591.3	635.7
	2335000	644	665.3	765	819	865.2
	2335450	491	531.7	622.1	712.2	782.3
	2336000	763	783.3	805.1	879.6	1044
Kennesaw Mountain NBP	2336968	0.99	1.03	1.14	2.41	4.72
Congaree National Park	2148315	1090	1090	1146	1394	1581
	2169500	1060	1213	1280	1894	2134
Horseshoe Bend MP	2414500	104	128	135.4	234	314.8
	2414715	123	133.3	141.9	216.5	275.4
Ocmulgee NM	2210500	216	233.3	241	246	338.5
	2213000	258	261.3	264.4	281.4	430.9
Maximum						
Chattahoochee River NRA	2334430	4300	3907	3420	2655	1692
	2335000	4230	3933	3491	2745	1854
	2335450	4650	4303	3779	2958	1964
	2336000	6000	4900	3754	2889	2050
Kennesaw Mountain NBP	2336968	447	187.3	123.3	68.2	50.02
Congaree National Park	2148315	8120	7800	6970	5853	4170
	2169500	21900	14870	10050	5001	4563
Horseshoe Bend MP	2414500	15400	13970	10740	5266	3914
	2414715	15000	13670	9847	4726	3644
Ocmulgee NM	2210500	5870	5163	3867	1902	1334
	2213000	7810	6380	4939	2600	1710

Table 6. Environmental Flow Components (TNC 2009) for flows in SECN River Parks during 2012. Timing refers to the average date (average of Julian dates) of a peak event if more than one occurred. [cfs, cubic feet per second; NC, metric not calculated]

		Extreme Low Flow				High flow pulses				Small Flood			
USGS ID		Frequency	Peak (cfs)	Duration (days)	Timing	Frequency	Peak (cfs)	Duration (days)	Timing	Frequency	Peak (cfs)	Duration (days)	Timing
Chattahoochee River NRA	2334430	18	534.5	2	2/6	7	3120	2	11/8	0	NC	NC	NC
	2335000	36	761	1	2/21	12	3440	1	10/18	0	NC	NC	NC
	2335450	35	636	1	3/21	18	3140	1	11/13	0	NC	NC	NC
	2336000	41	943	3	6/9	8	4550	1.5	11/13	0	NC	NC	NC
Kennesaw Mountain NBP	2336968	15	3.7	4	9/17	19	95	1	3/2	0	NC	NC	NC
Congaree National Park	2148315	10	1390	2	10/12	1	8120	1	5/20	0	NC	NC	NC
	2169500	29	1880	2	9/14	4	16250	2	NC ^a	0	NC	NC	NC
Horseshoe Bend Military Park	2414500	11	159	2	9/1	12	4480	1	NC ^a	0	NC	NC	NC
	2414715	18	243	3	10/19	5	11600	5	NC ^a	0	NC	NC	NC
Ocmulgee National Monument	2210500	9	258	10	7/16	5	4680	4	1/23	0	NC	NC	NC
	2213000	11	319	9	8/2	5	5570	5	1/24	0	NC	NC	NC

^aAverage timing not calculated due to distribution of Julian dates.

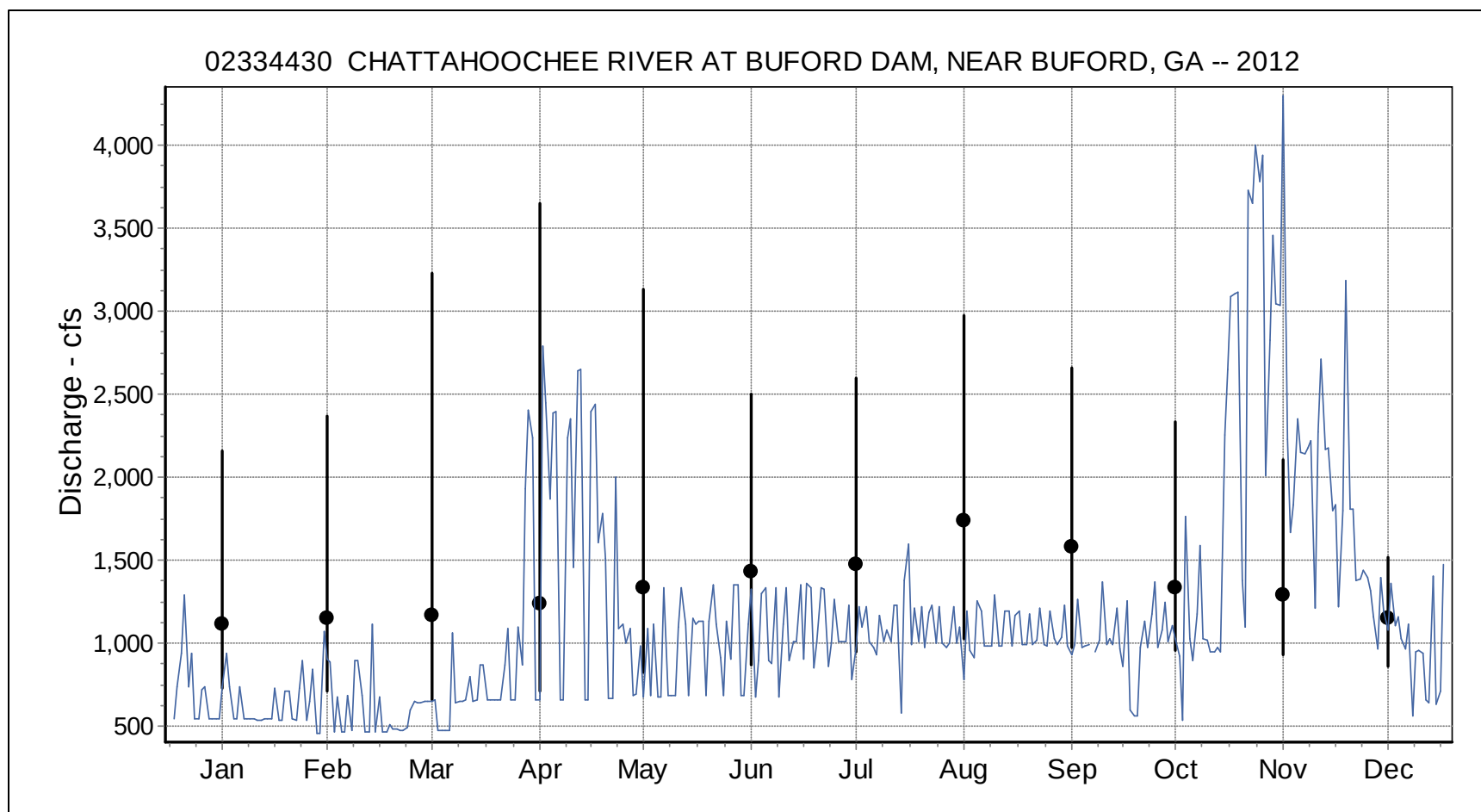


Figure 2. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River Near Buford, GA in 2012.

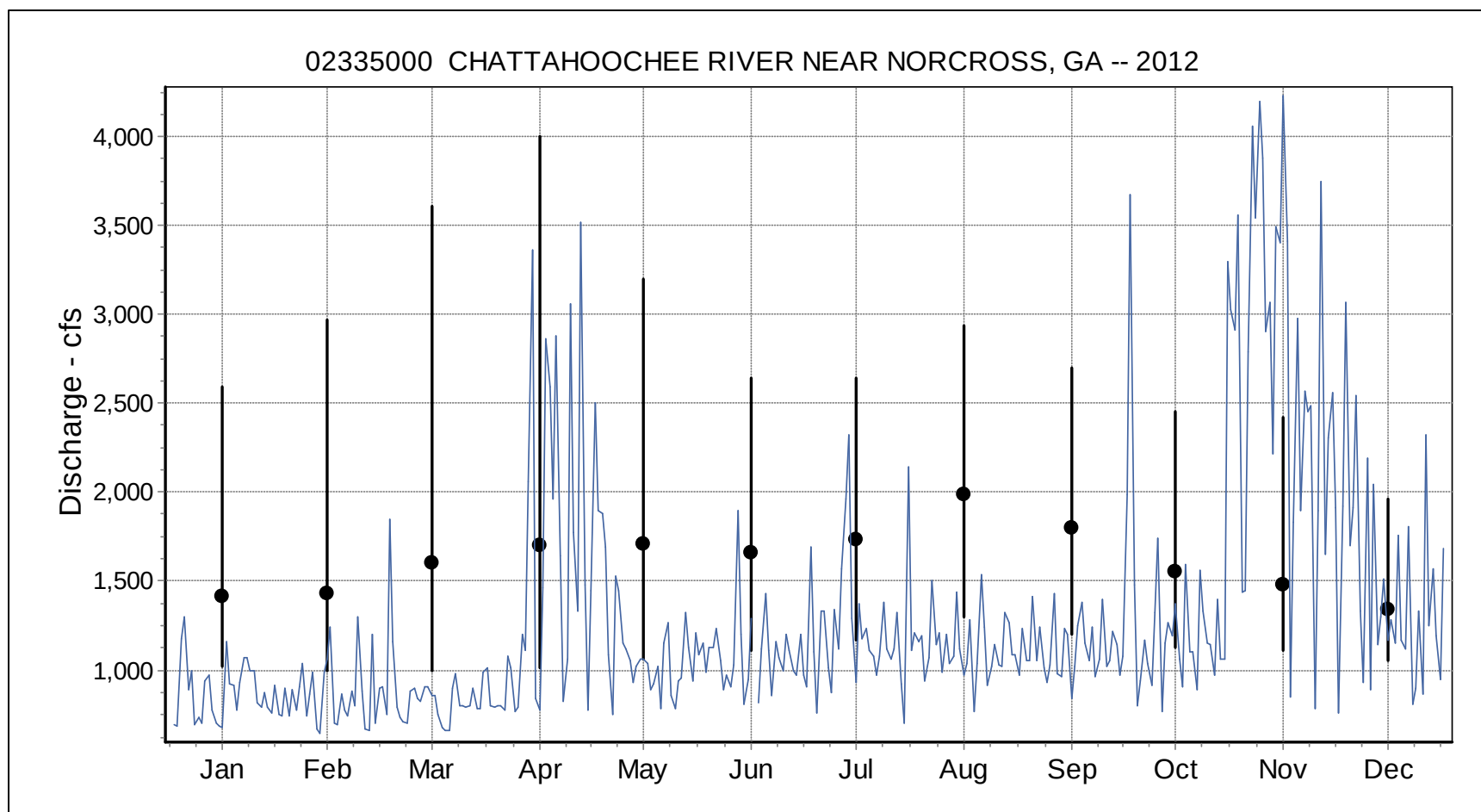


Figure 3. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River Near Norcross, GA in 2012.

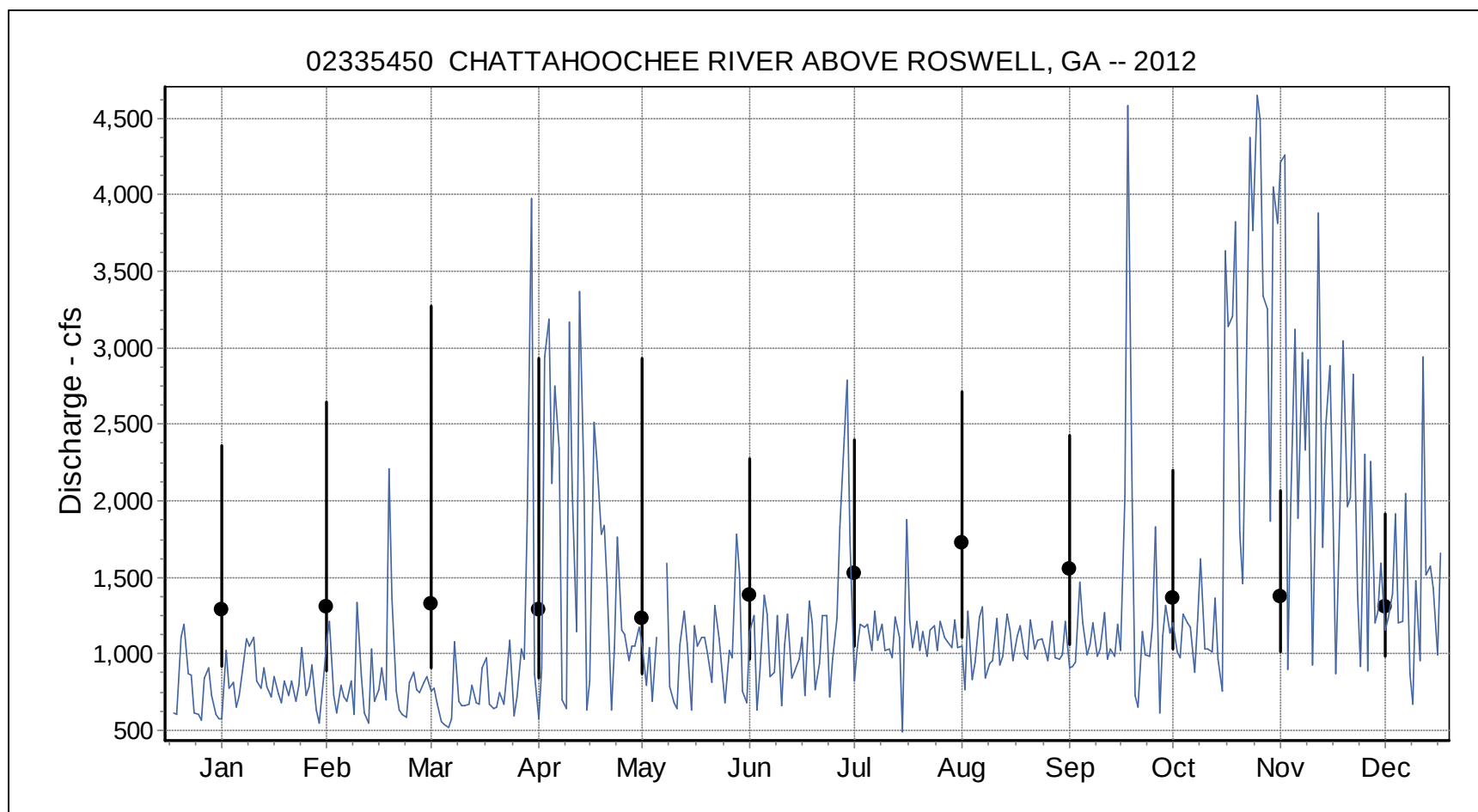


Figure 4. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River above Roswell, GA in 2012.

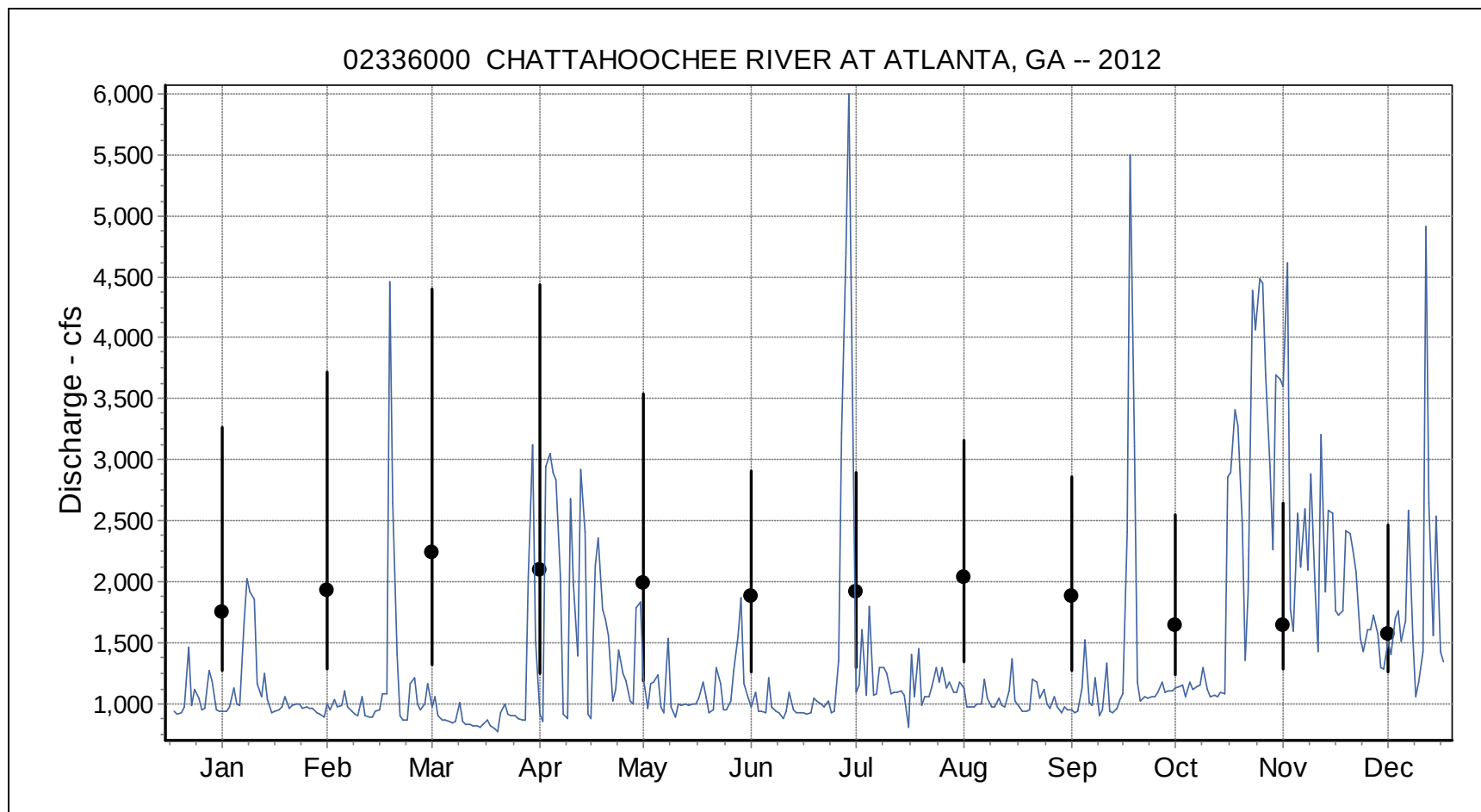


Figure 5. Daily flow (blue line), historical median monthly flow since the construction of Buford Dam (dots), and interquartile range (error bars) for the Chattahoochee River at Atlanta, GA in 2012.

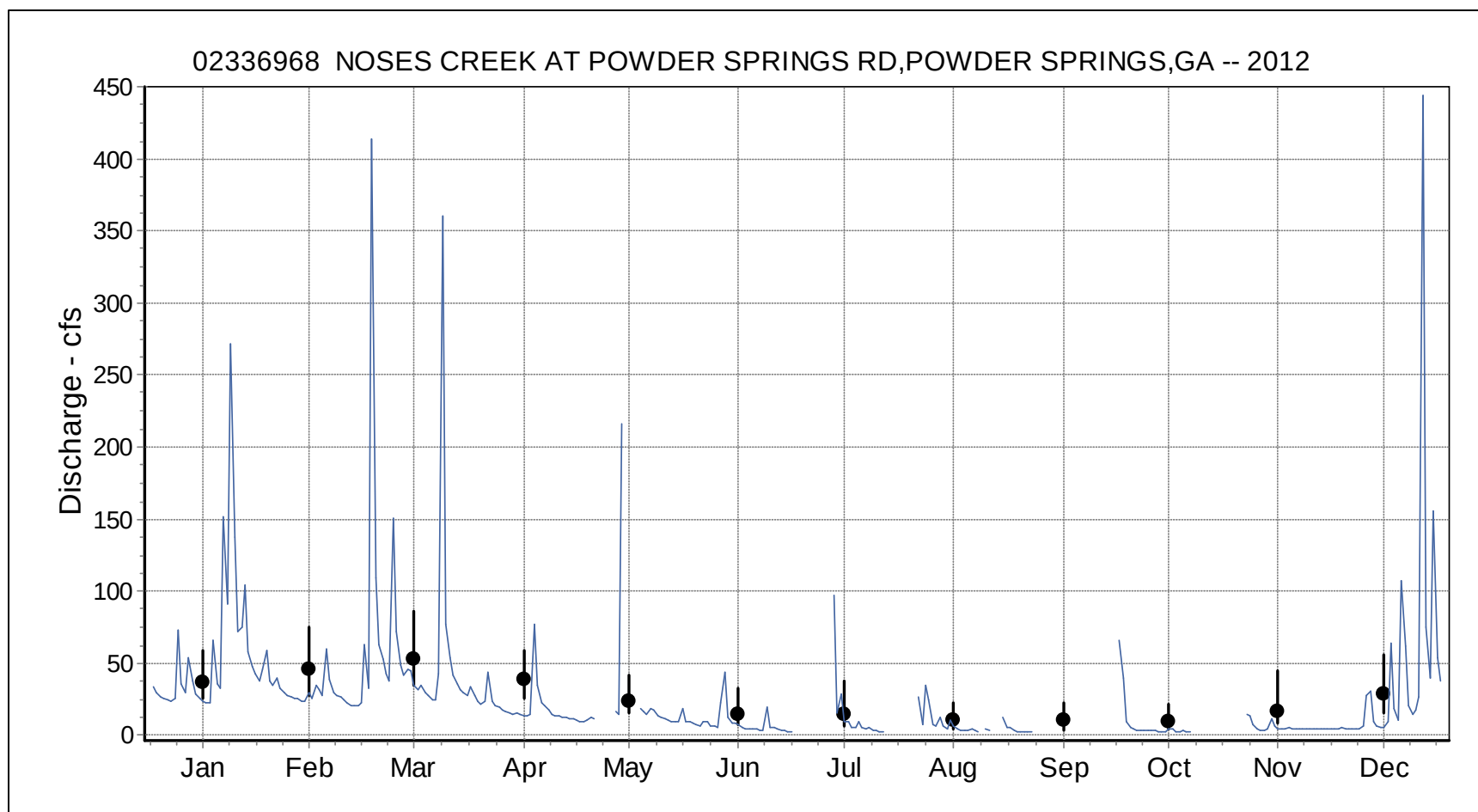


Figure 6. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for Noses Creek at Powder Springs Road, Powder Springs, GA in 2012.

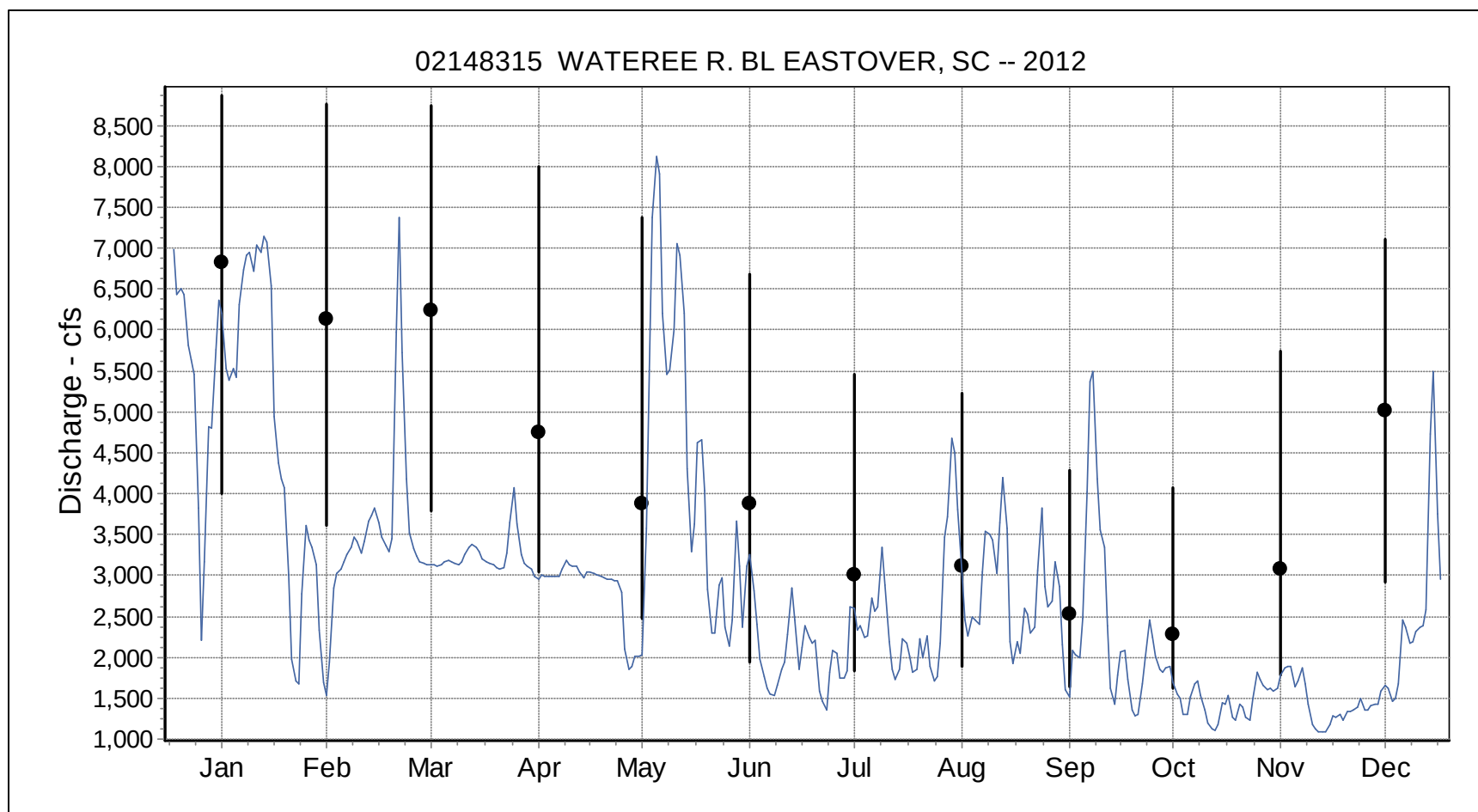


Figure 7. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Wateree River below Eastover, SC in 2012. Broken blue line indicates missing data.

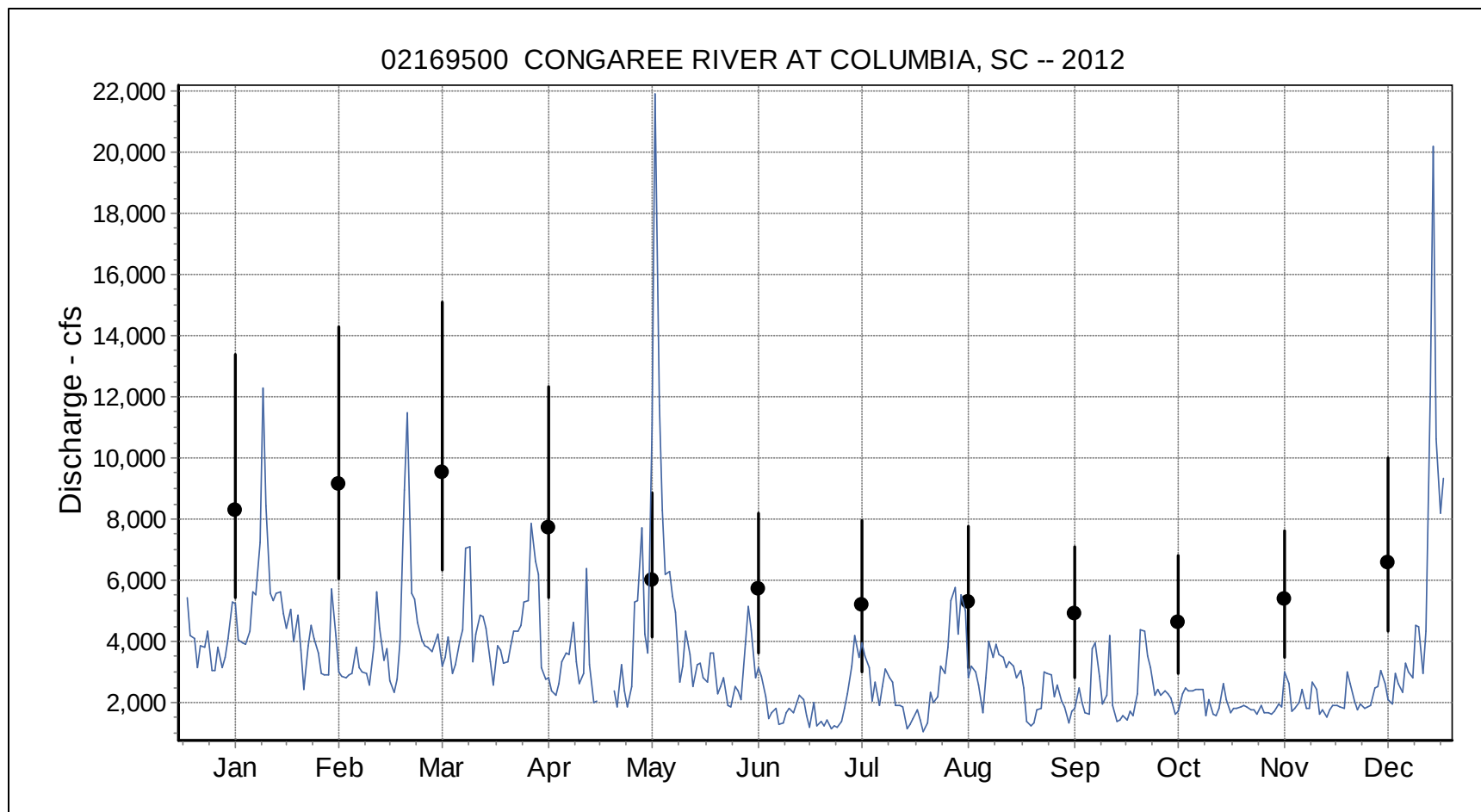


Figure 8. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Congaree River at Columbia, SC in 2012.

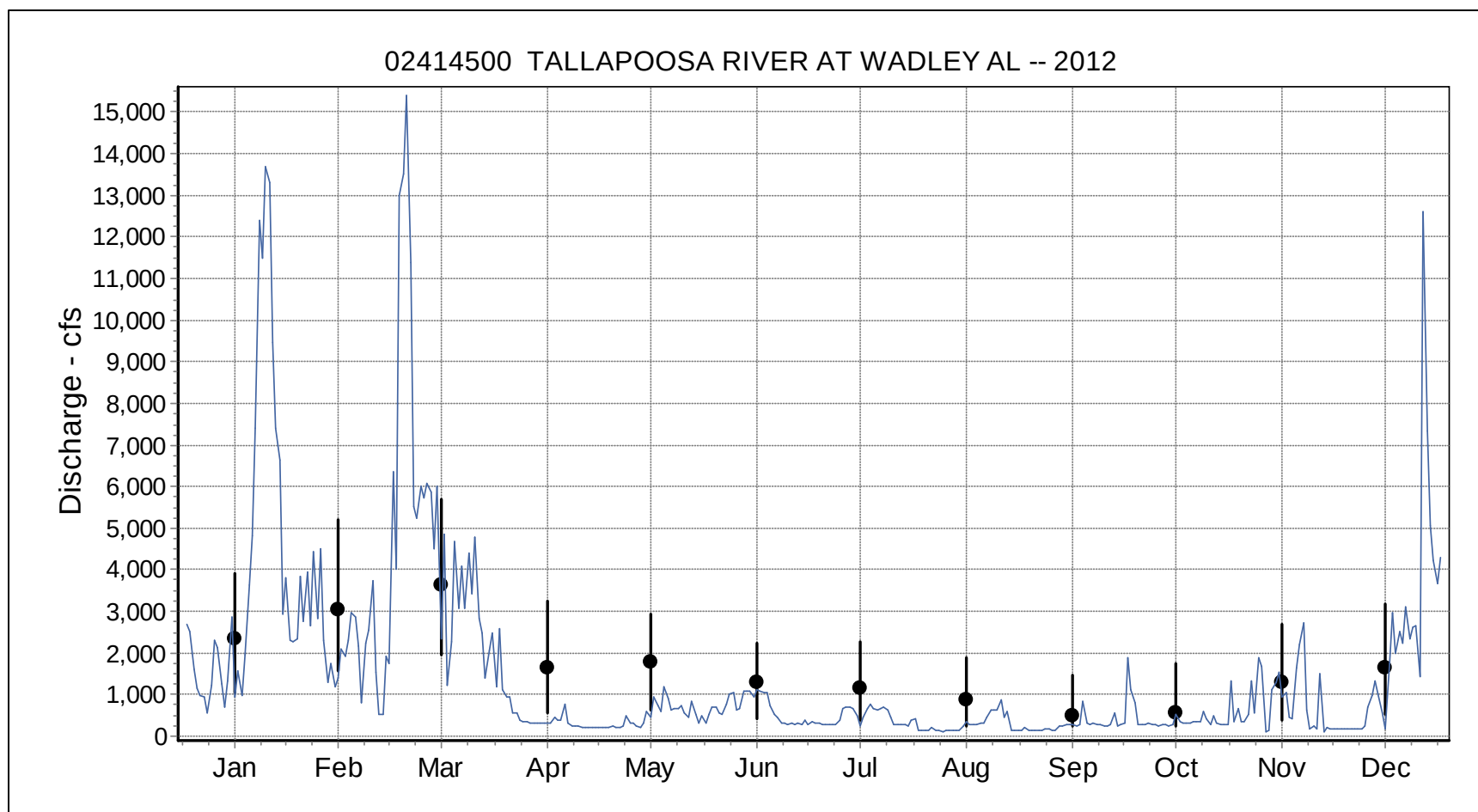


Figure 9. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Tallapoosa River at Wadley, AL in 2012.

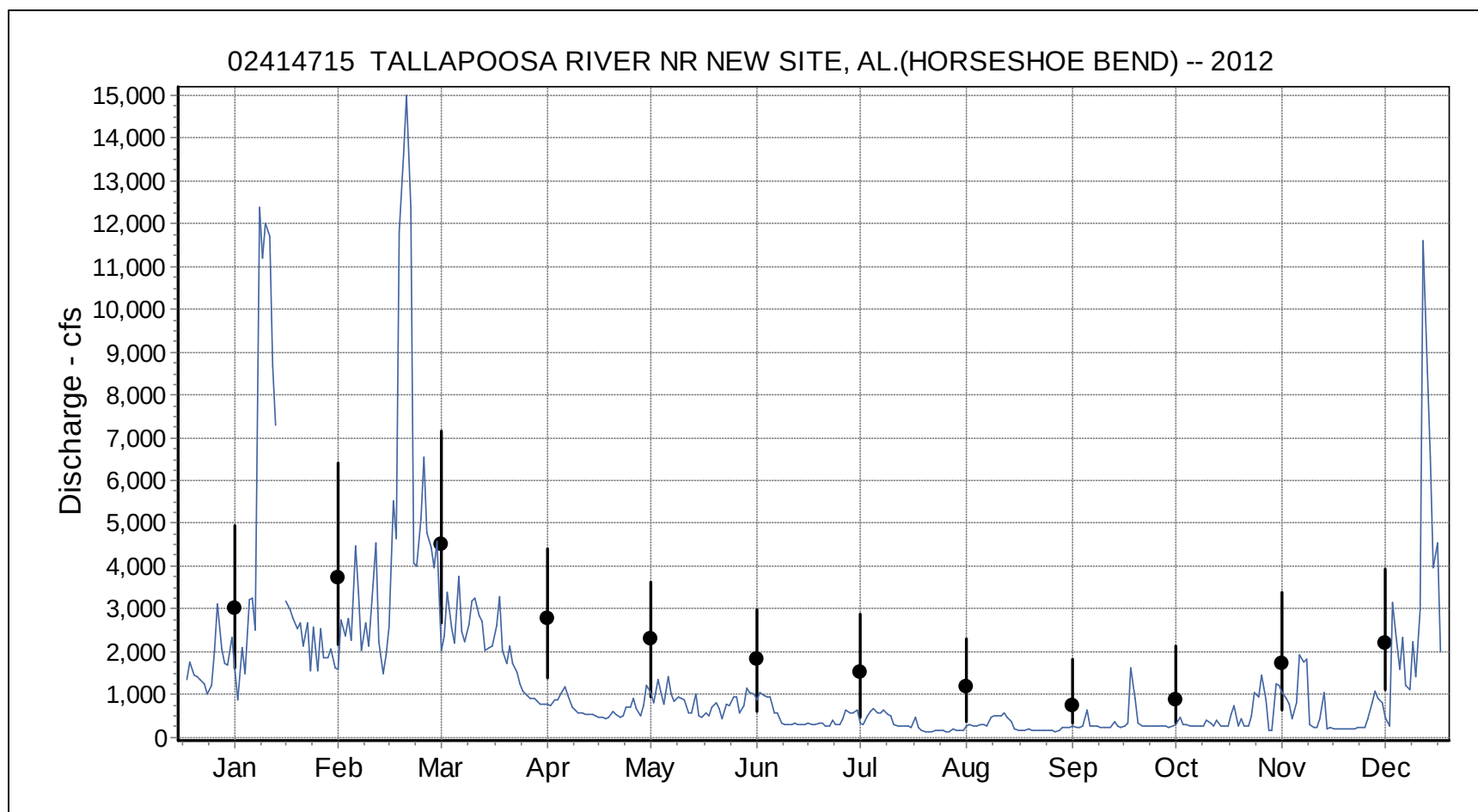


Figure 10. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Tallapoosa River near New Site, AL (Horseshoe Bend) in 2012.

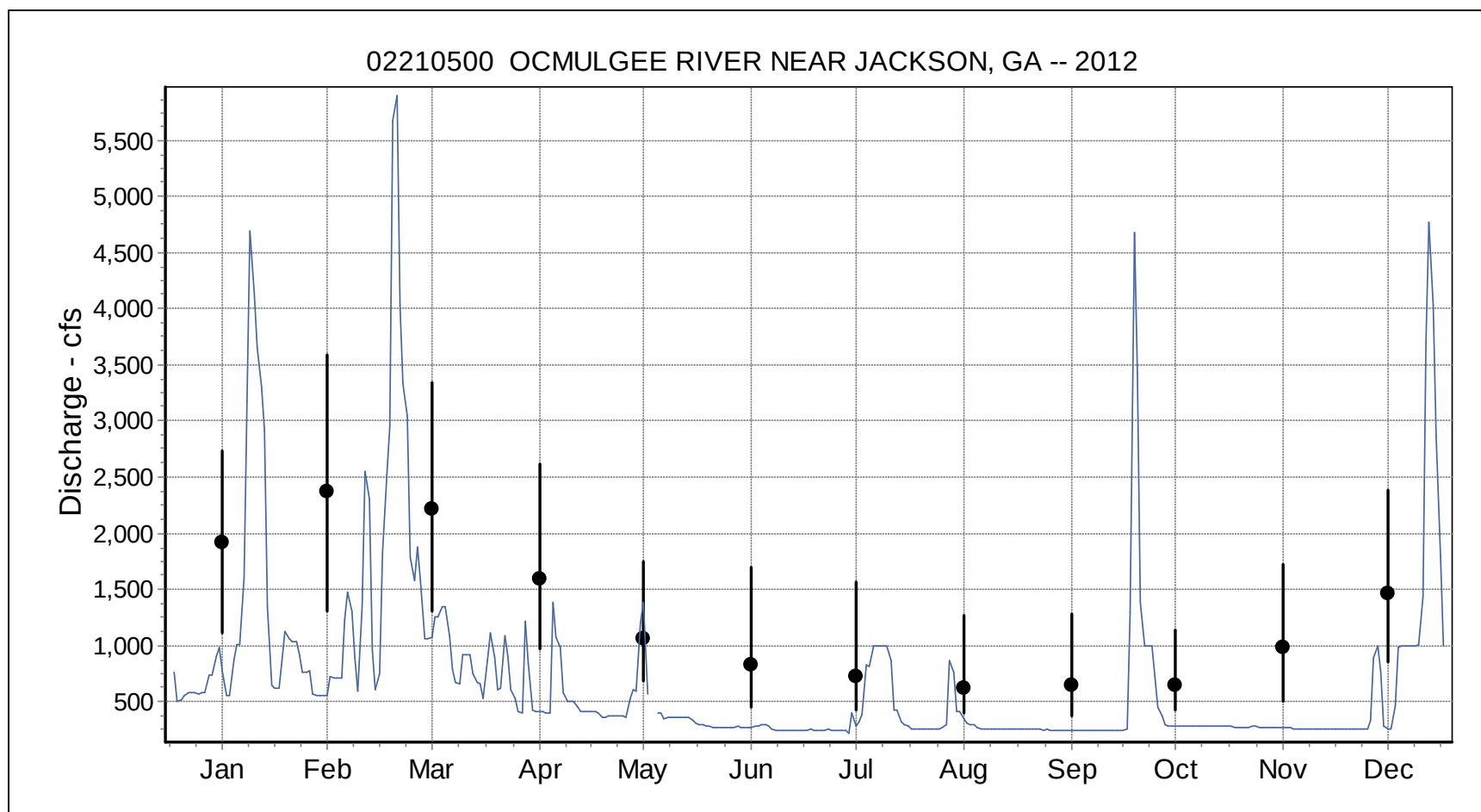


Figure 11. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Ocmulgee River near Jackson, GA in 2012. Broken blue line indicates missing data.

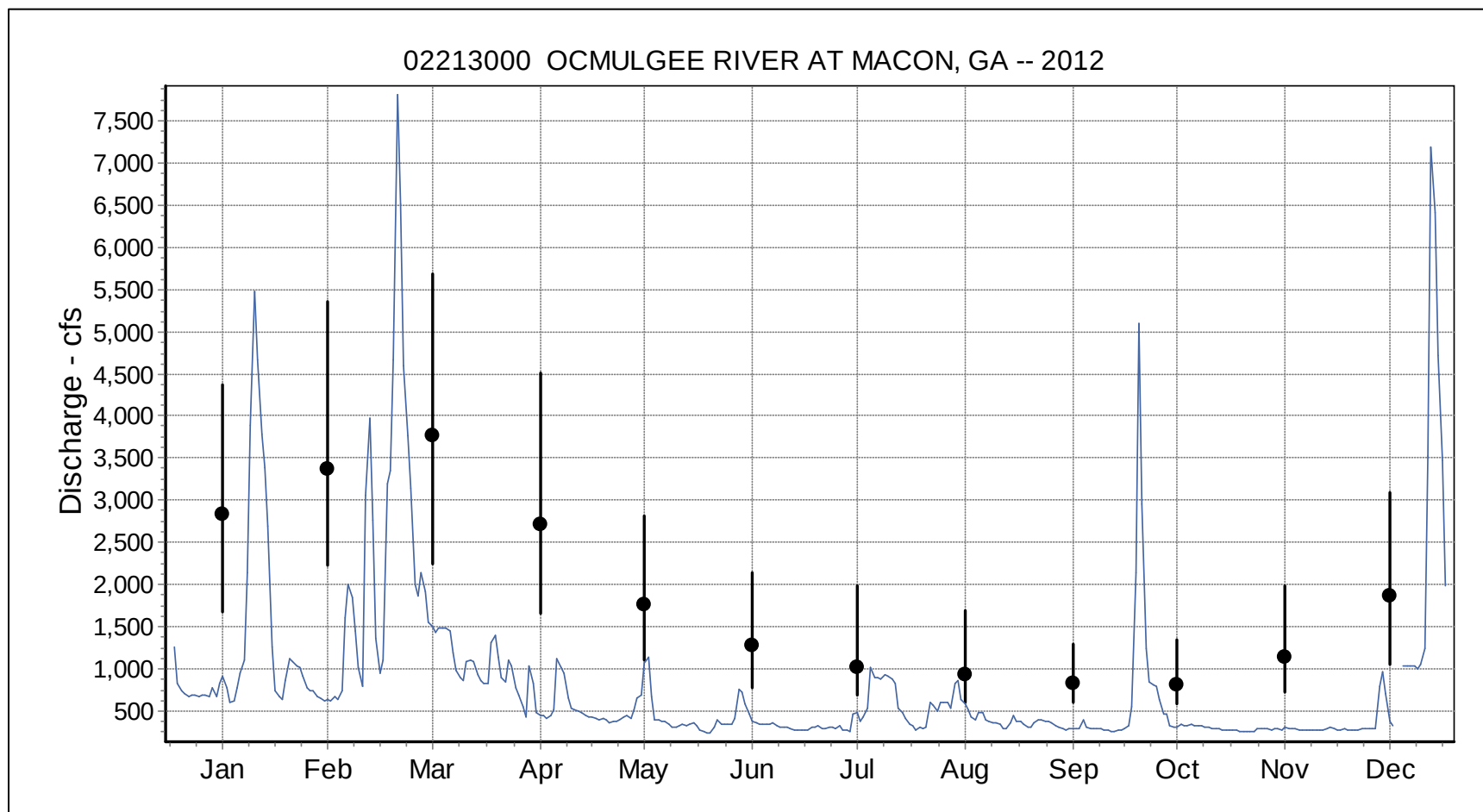


Figure 12. Daily flow (blue line), historical median monthly flow (dots), and interquartile range (error bars) for the Ocmulgee River at Macon, GA in 2012. Broken blue line indicates missing data.

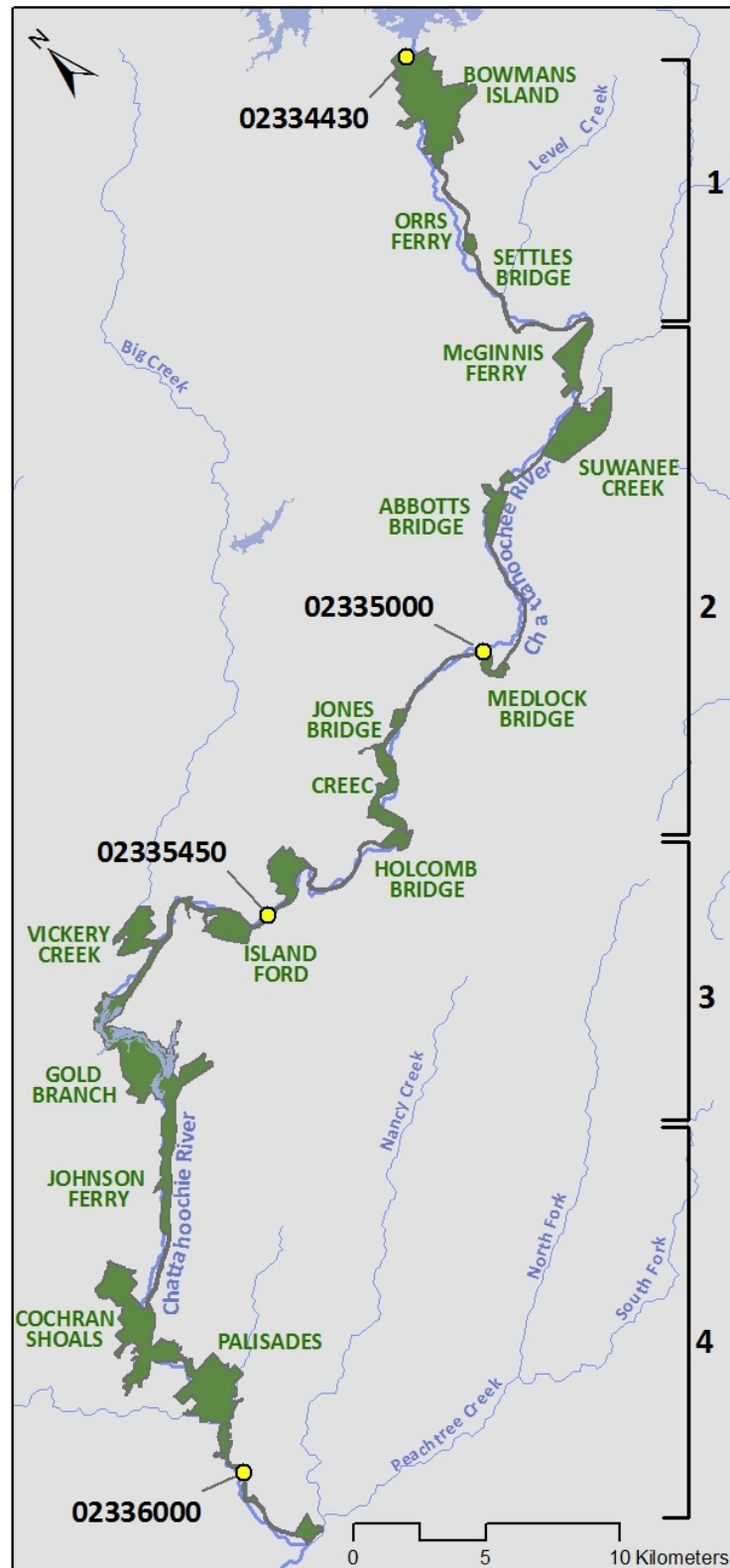


Figure 13. Park units and management sections along Chattahoochee River National Recreation Area in Atlanta, GA.

Table 7. Number of days, flow criteria and activity thresholds were met or exceeded in four sections of the Chattahoochee River National Recreation Area in Atlanta, Georgia during 2011. Flow criteria and activities (modified from Nestler et al. [1986]); low flow standard (<750 cfs) on River Segment 4 from GAEPD. River segments are based on proximity to nearest relevant gaging station and are shown in Figure 2. [NA, not applicable to segment; RM, river miles from mouth; cfs, cubic, feet per second]

Flow criteria threshold (in cfs)	Justification	River Segment			
		1	2	3	4
		RM 348 (Buford dam) to RM 340 ^a	RM 340 to RM 325.5 ^b	RM 325.5 to RM 317(Bulls Sluice Lake) ^c	RM 312.5 (Morgan Falls dam) to RM 300.5 ^d
Streamflow less than 750 at River Segment 4	State standards for minimum flow at Peachtree Creek (River Mile 300.5).	NA	NA	NA	0
750-1000	Life history requirements for juvenile brown trout, adult brook, possible wade and tube fishing, rafting.	77	121	95	146
1000-1500	Optimal conditions for wade and tube fishing novice rafting and canoeing and hanging out; boat fishing possible.	119	154	127	130
1500-2000	Possible conditions for wade and tube fishing, novice rafting and canoeing and hanging out; optimal conditions for boat fishing.	16	30	25	37
Greater than 2000	Powerboat fishing mid- level rafting and canoeing.	39	39	48	53

^aUSGS Gage ID 02334430

^bUSGS Gage ID 02335000

^cUSGS Gage ID 02335450

^dUSGS Gage ID 02336000

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Appendix A. Station Metadata Information

Chattahoochee River at Buford Dam (02334430)

Latitude: 34°09'25"/Longitude: 84°04'44"/Datum: NAD83

Gwinnett County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,040.00 square miles

Datum of gage: 912.04 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02334430&PARAMeter_cd=00065,00060,00062

Chattahoochee River near Norcross, GA (02335000)

Latitude: 33°59'50"/Longitude: 84°12'07"/Datum: NAD83

Gwinnett County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,170 square miles

Datum of gage: 878.14 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02335000&PARAMeter_cd=00065,00060,00062

Chattahoochee River above Roswell, GA (02335450)

Latitude: 33°59'09"/Longitude: 84°18'58"/Datum: NAD27

Fulton County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,220 square miles

Datum of gage: 858.01 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02335450&PARAMeter_cd=00065,00060,00062

Chattahoochee River at Atlanta, GA (02336000)

Latitude: 33°51'33"/Longitude: 84°27'16"/Datum: NAD83

Fulton County, Georgia

Hydrologic Unit 03130001

Drainage area: 1,450 square miles

Datum of gage: 750.10 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02336000&PARAMeter_cd=00065,00060,00062

Wateree River below Eastover, SC (02148315)

Latitude: 33°49'42"/Longitude: 80°37'14"/Datum: NAD27

Richland County, South Carolina

Hydrologic Unit 03050104

Drainage area: 5,590 square miles

Datum of gage: 77.43 feet above NGVD29.

URL to access data:

http://waterdata.usgs.gov/sc/nwis/uv/?site_no=02148315&PARAMeter_cd=00065,00060,00062

Congaree River at Columbia, SC (02169500)

Latitude: 33°59'35"/ Longitude: 81°03'00"/Datum: NAD27

Lexington County, South Carolina

Hydrologic Unit 03050110

Drainage area: 7,850 square miles

Datum of gage: 113.02 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/sc/nwis/uv/?site_no=02169500&PARAMeter_cd=00065,00060,00062

Tallapoosa River at Wadley, AL (02414500)

Latitude: 33°07'00"/ Longitude: 85°33'39"/Datum: NAD27

Randolph County, Alabama, Hydrologic Unit 03150109

Drainage area: 1,675.00 square miles

Datum of gage: 599.87 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/al/nwis/uv/?site_no=02414500&PARAMeter_cd=00065,00060

Tallapoosa River at New Site, AL (Horseshoe Bend) (02414715)

Latitude: 32°58'38"/ Longitude: 85°44'23"/Datum: NAD27

Tallapoosa County, Alabama

Hydrologic Unit 03150109

Drainage area: 2,058.00 square miles

Datum of gage: 528.62 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/al/nwis/uv/?site_no=02414715&PARAMeter_cd=00065,00060

Ocmulgee River near Jackson, GA (02210500)

Latitude: 33°18'28"/Longitude: 83°50'18"/Datum: NAD27

Butts County, Georgia

Hydrologic Unit 03070103

Drainage area: 1,420 square miles

Datum of gage: 419.29 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02210500&PARAMeter_cd=00065,00060,00062

Ocmulgee River at Macon, GA (02213000)

Latitude: 32°50'19"/ Longitude: 83°37'14"/Datum: NAD83

Bibb County, Georgia

Hydrologic Unit 03070103

Drainage area: 2,240 square miles

Datum of gage: 269.80 feet above NGVD29.

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02213000&PARAMeter_cd=00065,00060,00062

Noses Creek at Powder Springs Road at Powder Springs, GA (02336968)

Latitude: 33°51'33"/Longitude: 84°39'10"/Datum: NAD27

Cobb County, Georgia

Hydrologic Unit 03130002

Drainage area: 44.5 square miles

Datum of gage: 882.8 feet above NGVD29

URL to access data:

http://waterdata.usgs.gov/ga/nwis/uv/?site_no=02336968&PARAMeter_cd=00065,00060,00062

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 910/121339, June 2013

National Park Service
U.S. Department of the Interior



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