SOUTH CAROLINA ELECTRIC & GAS COMPANY

COLUMBIA, SOUTH CAROLINA

SALUDA HYDROELECTRIC PROJECT

FERC NO. 516

DOWNSTREAM TEMPERATURE STUDY
DRAFT REPORT

MAY 2008

Prepared by:

Kleinschmidt
Energy & Water Resource Consultants

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1.0 INTRODUCTION

The Saluda Hydro Project (Project) is a Federal Energy Regulatory Commission (FERC) licensed project (FERC No. 516), owned and operated by South Carolina Electric & Gas Company (SCE&G), pursuant to the license issued by the FERC in 1984. The Project is located on the Saluda River within Richland, Lexington, Saluda, and Newberry Counties, South Carolina, and situated within proximity of the towns of Irmo, Chapin, and Lexington and within the metropolitan area of the City of Columbia, South Carolina, which is approximately 10 miles east of the Project (Figure 1).

SCE&G is in the process of relicensing the Project as the current operating license expires on August 31, 2010. This relicensing process involves cooperation and collaboration with a variety of stakeholders, including state and federal resource agencies, state and local government, non-governmental organizations (NGO), and interested individuals, in order to identify and address any operational, economic, and environmental issues associated with a new operating license for the Project. The Water Quality Technical Working Committee (WQTWC) is comprised of interested stakeholders who are collaborating with SCE&G to identify and make recommendations related to the effects of water releases from the Project on the temperature regime of the lower Saluda River (LSR) and Congaree River.

1.1 Background and Purpose

The Saluda River rises on the east slope of the Appalachian Mountains, and flows southwesterly across the Piedmont geomorphic province to its confluence at the fall line with the Broad River in Columbia, South Carolina, where the combined flows form the Congaree River. Between the Lake Murray dam and the confluence, LSR flows for

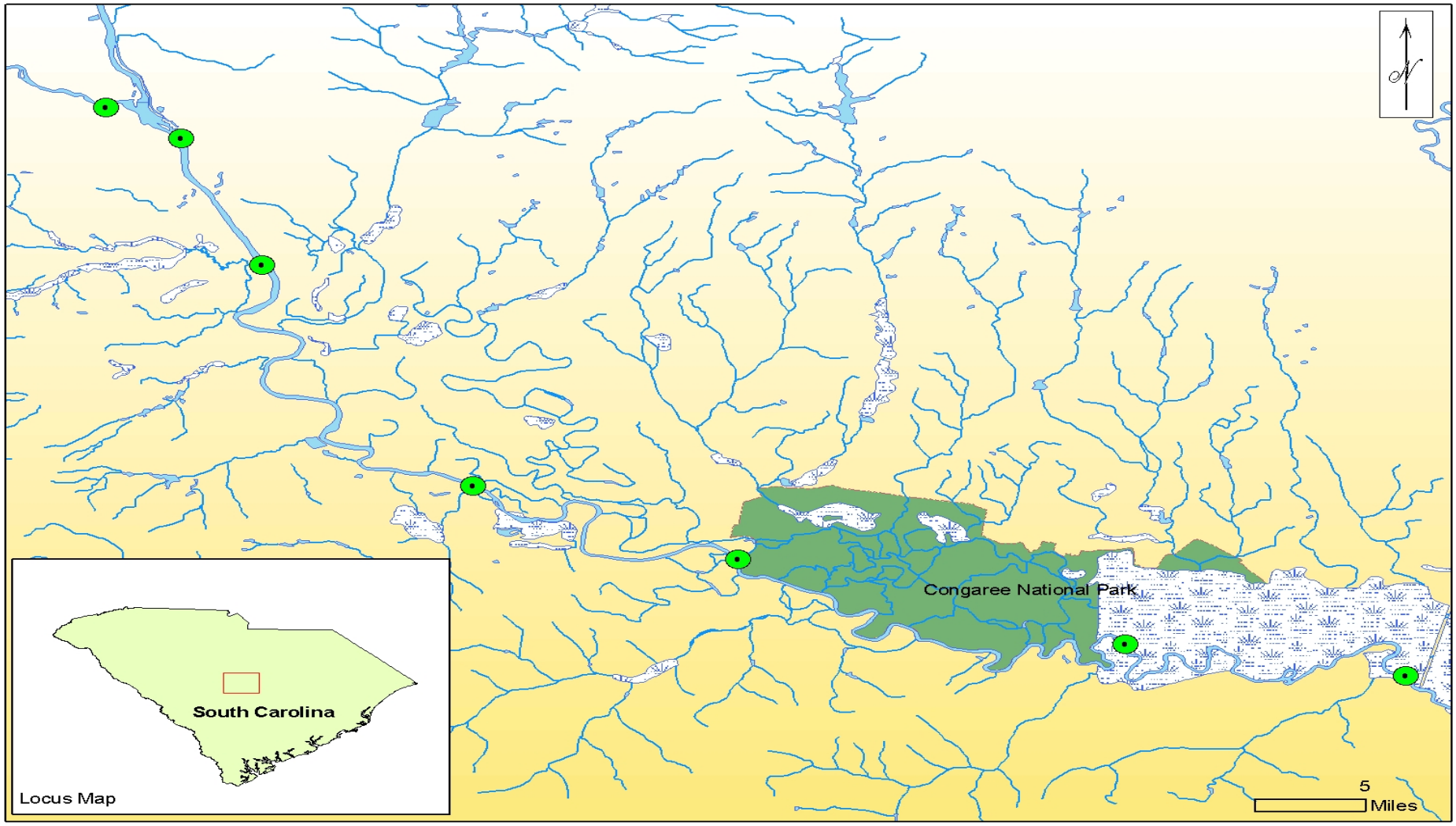
approximately ten miles through generally low gradient riverine geomorphology punctuated by occasional shoals and riffle habitat (Figure 2). Flow in this reach is primarily influenced by releases from the Saluda Project powerhouse, although there are some additional contributions from small tributaries such as Rawls, Twelvemile, Kinley , and Stoop creeks and Senn Branch, which collectively contribute approximately 100 square miles of additional drainage area. The average annual flow from the Saluda powerhouse to the LSR is 2,595 cfs with a minimum average daily flow of 285 cfs (Kleinschmidt, 2005).

An important macrohabitat consideration on the LSR is that the ambient water temperature is influenced by cold water releases from below the thermocline of Lake Murray via the project powerhouse. USGS data suggest that average water temperatures in the LSR below the Project dam range from approximately 9.5 ^{o}C in February to 17.5 ^{o}C in early-October, and from approximately 10 to 18.5 ^{o}C in the vicinity of Riverbanks Zoo[1]. Cold water releases from the Saluda Hydro Project have supported a unique put, grow, and take rainbow and brown trout recreational fishery in the LSR since the early 1950's.

The objective of this study was to characterize the effects of water releases from the Project on the temperature regime of the LSR and Congaree River, including downstream extent of temperature alteration, timing and duration of temperature alteration, and mixing characteristics.

[1] Based on monthly averaged 2000 to 2006 data as measured at USGS Gage # 02168504 (below Murray Dam) and at USGS Gage # 2169000 (Columbia).

Figure 1-1: Map of Lower Saluda River Showing Location of Saluda Hydro Project and Temperature Sensor Deployment Sites



2.0 METHODOLOGY

Paired temperature probes (StowAway® TidbiT™) were deployed along the left and right riverbank (looking downstream) at 7 locations downstream of the Project dam in the LSR and Congaree River (Figure 1). A single temperature probe was also deployed adjacent to the USGS gage below Lake Murray Dam (# 02168504) to verify data collected by the gage. To allow for comparisons of the Broad River to areas downstream of the Project, an additional probe was placed at the City of Columbia Rowing Facility, located on the Broad River just upstream of the Columbia Diversion Dam and the confluence of the Broad with the LSR. All probes were anchored in the river's main flow by iron dumbbell weights tethered to a tree along the shoreline by a vinyl-coated cable. All probes were set to collect data at 15-minute intervals. Data were downloaded in the field to a PC-based laptop computer equipped with Boxcar software. For quality control purposes, all datafiles were cross-validated with the unit serial numbers and field notes. In addition, all datasets were plotted prior to analysis and examined for erroneous data (i.e. periods when the probe was obviously out of the water due to drought conditions, etc.).

T-tests were applied to the paired datasets to determine whether mean temperatures over the sampling period differed between left and right bank. An F-test was first applied to paired datasets, however, to determine the appropriate T-test (i.e., assuming equal variance vs. assuming unequal variance). This method was also used to compare data from the USGS gage downstream of the Saluda Hydro Dam with data from our probe at that site. Because T-tests revealed no significant differences between the two, and because the USGS gage provides a more extensive dataset, the USGS gage data was used for all comparisons contained herein.

3.0 RESULTS AND DISCUSSION

Water temperatures in the LSR at the USGS gage downstream of the Saluda Hydro Dam (#02168504) ranged from approximately 9.5° C to 19° C during the course of the study (Figure 2). For the paired probes deployed adjacent to Riverbanks Zoo (SR2), temperatures ranged from approximately 8.7° C to 24° C. This site experienced warming of approximately 5° to 7° C during summer months, with periodic excursions to near-dam temperatures during periods of Project operation. As expected, analyses revealed no significant differences between left and right banks for the site.

Water temperatures at Congaree River sites generally followed patterns similar to the Broad River, even at upstream sites closer to the confluence (Figures 3 – 8). At the most upstream Congaree River site (CR1), located near the Gervais St. Bridge just downstream of the confluence of the Broad and Saluda rivers, water temperatures along the Saluda side of the river (right bank looking downstream) were significantly lower than those observed along the Broad River side (Figure 3). This site experienced the most extreme variability during the study, particularly along the Saluda side of the river. In addition to the site's proximity to the confluence and Saluda Hydro, the channel characteristics in this reach likely contributed significantly to periodic extreme variations in temperature observed during the study. Specifically, the Saluda side of the river is dominated by an extensive submerged bedrock outcropping which extends greater than half-way across the river, with the main river channel located along Broad River side. As a result, water depth during normal flow conditions on the Saluda side of the river were typically only 2 – 4 ft, with the majority of the LSR's volume shifted towards the center and left bank of the river. During extreme drought conditions (i.e., Summer 2007) this configuration likely allowed for significant, localized warming during periods of low flow, followed by significant temperature drops during Project operations. It should be noted that Project operations were also detectable on Broad River side of the river at this site, presumably due to the channel characteristics discussed above.

Temperature patterns at the second Congaree River site downstream (CR2), located just upstream of the Interstate 77 Bridge, did not differ between the left and right banks on a day-to-day basis and were similar to temperatures observed in the Broad River (Figure 4). Project operations were detectable at this site; however, temperature alterations appeared limited to timescales of hours to days, after which temperature returned to patterns similar to the Broad River. In addition to increased distance from Saluda Hydro, the reduced influence observed at this site is likely attributed to its location just downstream of the abandoned Granby Lock and Dam (located approximately 0.5 mi upstream of the

site). At the Granby Lock and Dam, the majority of the river's flow is forced through the open lock chamber, located along the extreme right bank (Saluda side of river), facilitating mixing in this reach.

Temperature patterns at the remaining downstream Congaree River sites (CR3 – CR6) were similar to those observed at CR2, with little day-to-day variation between left and right bank and overall temperature regimes resembling the Broad River data (Figures 5 – 8). Surprisingly, Project operations were periodically detectable at all downstream sites, particularly during Summer 2007 when drought conditions significantly reduced the influence of flows from the Broad. Project operations at downstream sites were typically detectable and followed a similar pattern on both sides of the river, presumably due to the mixing occurring at Granby Lock and Dam.

These data suggest that coldwater releases from the Project have a significant influence on the thermal regime of the LSR, and in some portions of the upper Congaree River during low flow conditions. Alterations of the temperature regime in the Congaree River are most pronounced upstream of the Granby Lock and Dam, where temperatures on the Saluda River side of the river are significantly cooler than those on the Broad River side. Areas of the Congaree River downstream of Granby Lock and Dam are periodically influenced by operation of the Saluda Hydro Project; however, these reductions in temperature are episodic in natures and typical occur on timescales of several hours to a day. One a day-to-day basis, temperature regimes at lower sites do not differ from one side of the river to the other and follow patterns similar to the Broad River. Temperature alterations in the Congaree River resulting from project operations appeared to be detectable farther downstream and to be of greater magnitude during 2007 than in 2006, particularly during the summer and fall months. This trend was likely attributed to extremely low flows experienced in the Congaree River due to prevailing drought conditions in the basin during this period, suggesting that the Summer/early-Fall 2007 data may not be reflective of temperature patterns during normal water years.

Figure 2. Water Temperatures at Lower Saluda River at Riverbanks Zoo (SR1) – 2006 and 2007

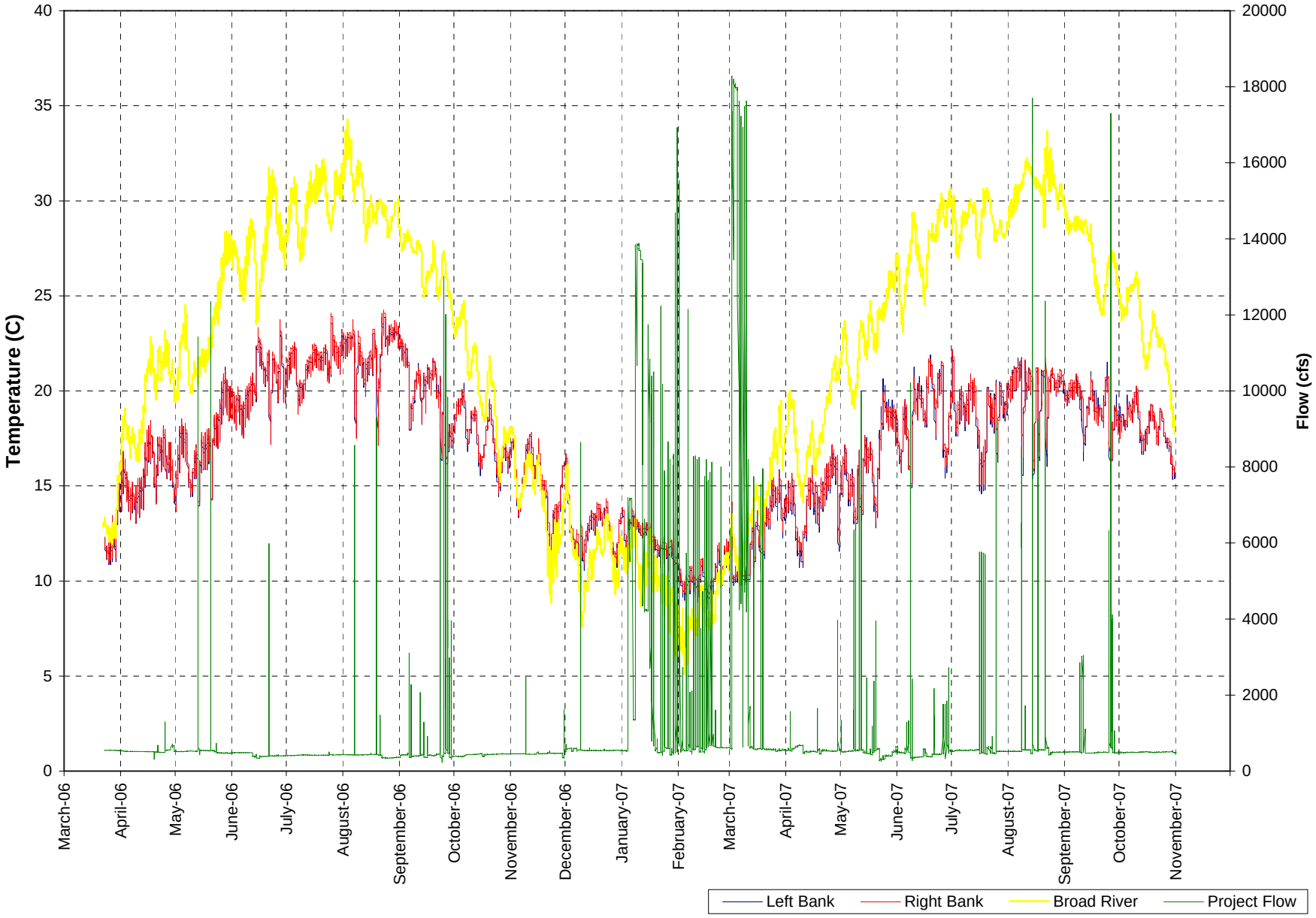


Figure 3. Water Temperatures at Congaree River Site 1 (CR1) – 2006 and 2007

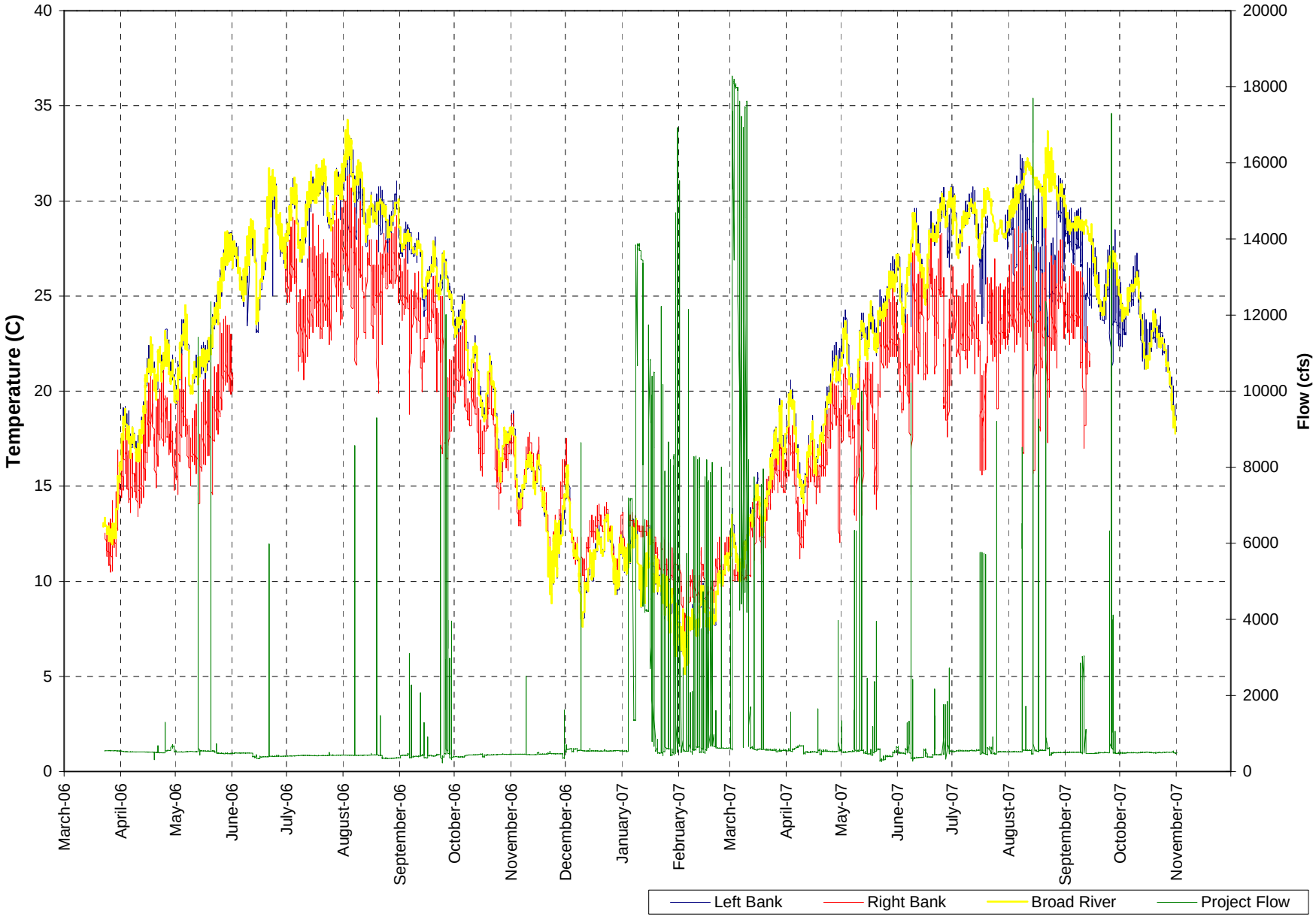


Figure 4. Water Temperatures at Congaree River Site 2 (CR2) – 2006 and 2007

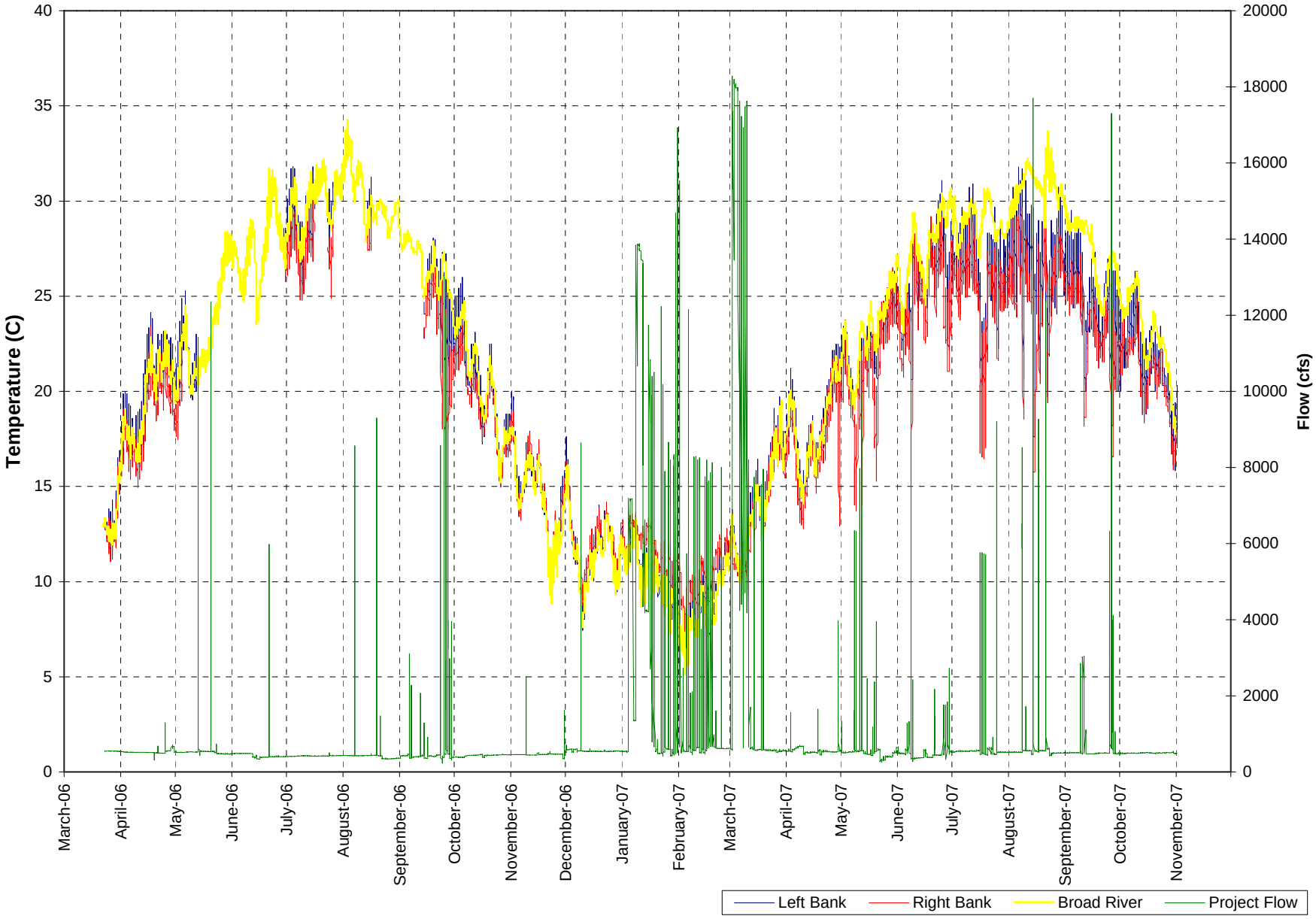


Figure 5. Water Temperatures at Congaree River Site 3 (CR3) – 2006 and 2007

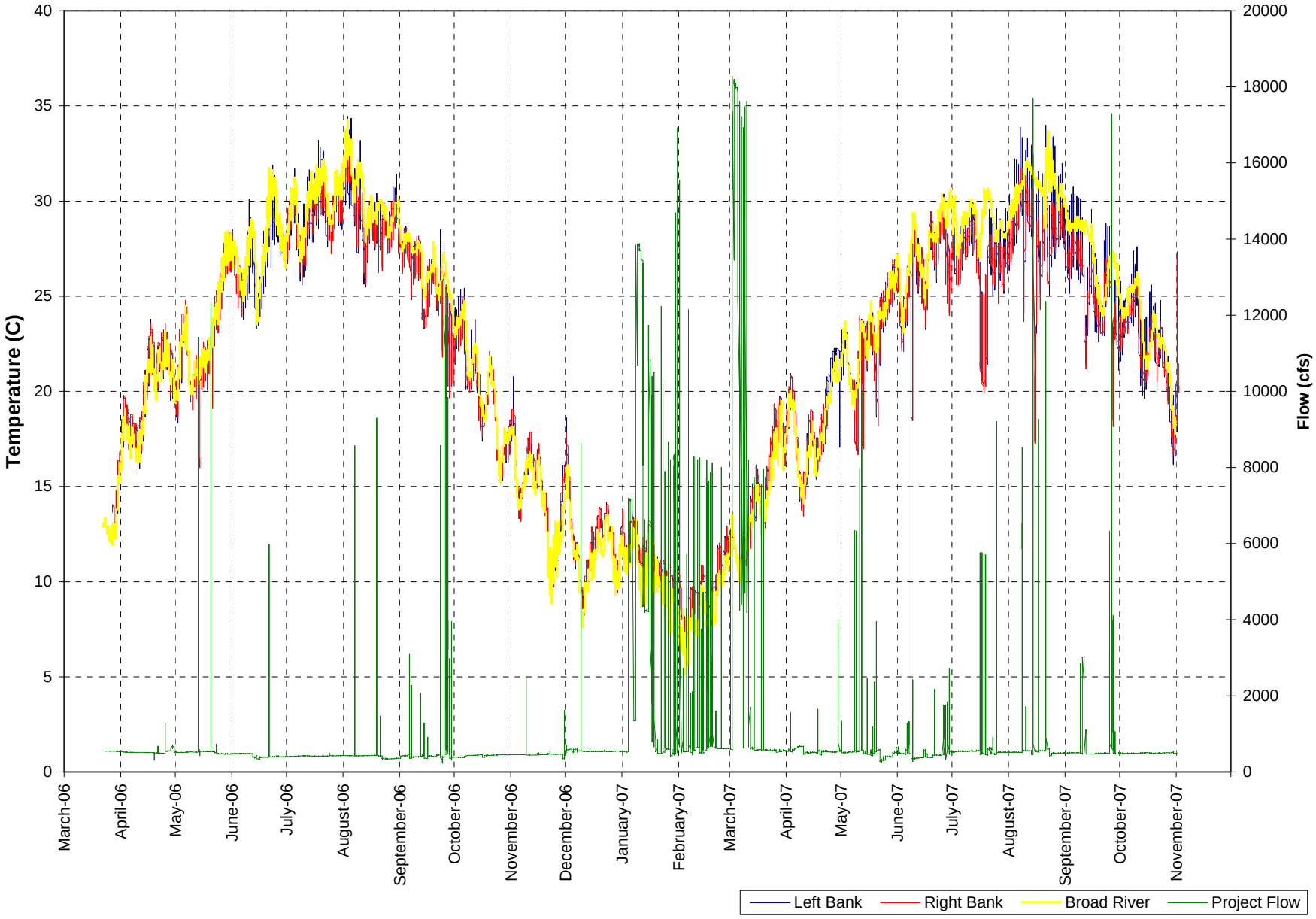


Figure 6. Water Temperatures at Congaree River Site 4 (CR4) – 2006 and 2007

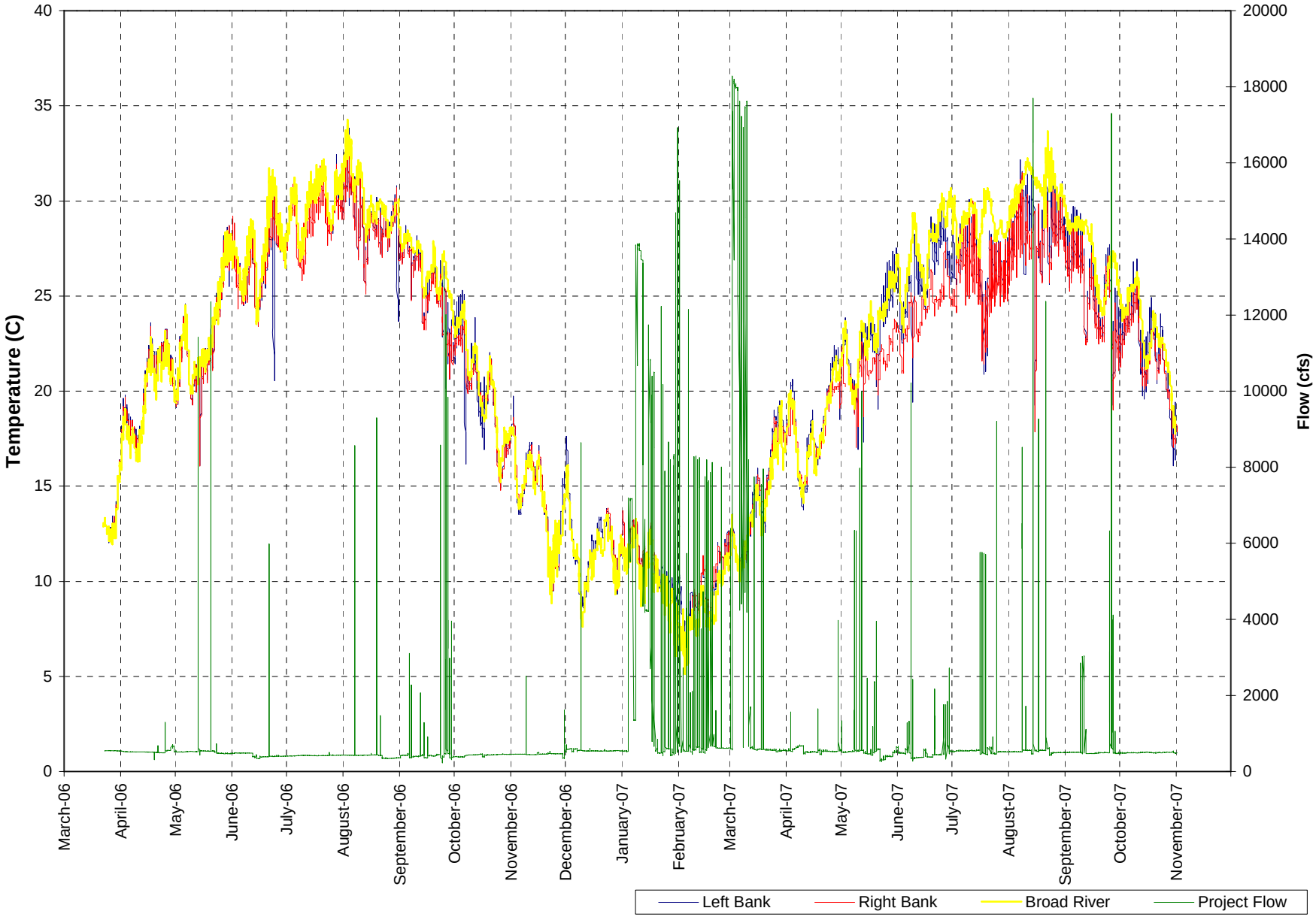


Figure 7. Water Temperatures at Congaree River Site 5 (CR5) – 2006 and 2007

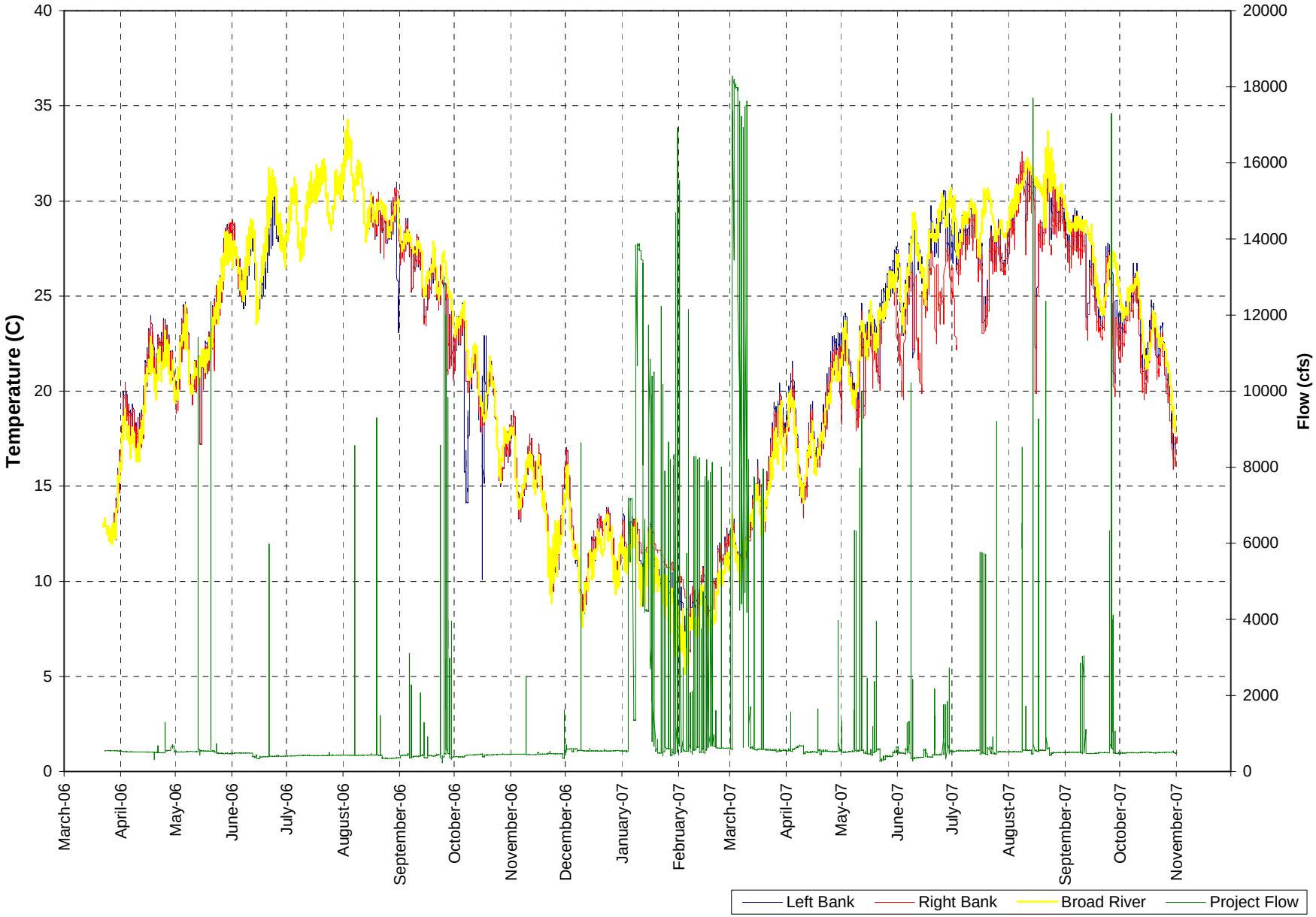


Figure 8. Water Temperatures at Congaree River Site 6 (CR6) – 2006 and 2007