WALLACE DAM

Lake Oconee

Study Report

Water Resources

Wallace Dam Hydroelectric Project
FERC Project Number 2413

Prepared with:

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ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ft	feet
GDNR	Georgia Department of Natural Resource
Georgia Power	Georgia Power Company
GEPD	Georgia Environmental Protection Division
Hwy	Highway
I-20	Interstate 20
m	meters
mg/L	milligrams per liter
MPN	most probable number
MW	megawatts
NTU	nephelometric turbidity units
PAD	Pre-application Document
PD	plant datum
PLP	Preliminary Licensing Proposal
SM	Standard Methods
sq mi	square miles
TMDL	total maximum daily load
TSI	trophic state index
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
WRD	GDNR Wildlife Resource Division

EXECUTIVE SUMMARY

A water resources study was conducted for Georgia Power Company's Wallace Dam Hydroelectric Project (Federal Energy Regulatory Commission [FERC] No. 2413) to characterize existing water resources and to develop water resources information for evaluating the effects of continued project operations on water quality in the Oconee River. The study area included Lake Oconee and the Wallace Dam tailrace area within the project boundary; the Oconee River upstream to Athens-Clarke County; and tributary watersheds to Lake Oconee. Information was developed for this study based on review of existing information and water quality monitoring within Lake Oconee and the Wallace Dam tailrace area.

The Wallace Dam Project is a 321.3-megawatt pumped storage facility located on the Oconee River at river mile 172.7 in Hancock, Putnam, Greene, and Morgan Counties, Georgia. The Project consists of Wallace Dam, a powerhouse, and Lake Oconee, a 19,050-acre reservoir. The Oconee River watershed upstream of Wallace Dam covers an area of 1,830 square miles in the Piedmont physiographic province. Georgia Power operates the Wallace Dam Project using Lake Oconee as the upper reservoir. Lake Sinclair, a separately licensed project located immediately downstream, serves as the lower reservoir.

Georgia Power operates the Wallace Dam Project to provide generation during peak power demand hours. Lake Oconee typically starts near elevation 435 feet (ft) plant datum before the Wallace Dam generation cycle, and ends near elevation 433.5 ft. At night, reversible turbine units pump water back up and into Lake Oconee for reuse in the next day's generation cycle. The average daily fluctuation of Lake Oconee is approximately 1.5 ft.

The classified use of the Oconee River within the Wallace Dam project boundary is Recreation and Drinking. Lake Oconee and the Wallace Dam tailrace area support their designated uses. However, several tributaries to Lake Oconee upstream of the project boundary are not supporting their designated uses due to fecal coliform or fish community impacts. Non-point sources and urban runoff are the likely causes of impairment for each of these tributary streams.

Quarterly water chemistry data indicated good overall water quality conditions in Lake Oconee. Total phosphorus concentrations, turbidity, and fecal coliform densities were usually higher at upstream or tributary stations, indicating likely influences from upstream non-point agricultural sources. Trophic state index scores indicated mesotrophic conditions.

Monthly water quality vertical profiles recorded for Lake Oconee from June 2015 through August 2016 revealed the extent of mixing in Lake Oconee that occurs as a result of pumped storage operations. Unlike typical southeastern reservoirs, which undergo summer thermal stratification, water temperature profiles in the forebay of Wallace Dam showed that the water column is well mixed to weakly stratified during much of the summer. In early summer (June and July), the dissolved oxygen (DO) concentrations in the forebay were stratified, with values

declining with increasing depth. By early August, however, water temperature and DO concentrations in the forebay became more uniformly distributed in the water column.

Seasonal water quality vertical profiles of Lake Oconee collected in 2003-2016 indicate that vertical stratification becomes most developed in the spring and early summer, as surface temperatures rise and cooler water is still available. By August, the water column exhibits warmer temperatures and only narrow temperature variation from the surface to the bottom. The effects of mixing on reduced temperature variation were most evident at the mainstem reservoir monitoring stations and the tributary embayments closest to Wallace Dam.

Two separate hourly monitoring events over 24-hour periods conducted in Lake Oconee in July and August 2016 indicated that temporary stratification develops in the forebay and other mainstem locations during generation periods and quiescent phases of Wallace Dam operations. However, once pumpback operations begin, the water column becomes completely mixed in the forebay, as water is pumped in from Lake Sinclair. Similar but less complete effects of mixing occurred at other mainstem reservoir sampling stations. The vertical profiles indicate that tributary locations, especially the one in Richland Creek remain stratified throughout the generation and pumpback cycle with respect to DO concentrations and that dam operations have little short-term effects on the water quality in Richland Creek.

Continuous water quality monitoring data (DO and temperature) recorded in the Wallace Dam tailrace from July 2015 to September 2016 were aligned with operational data from the same period to examine the effects of project operations on tailrace water quality. During June, July, and early August periods, generation at Wallace Dam resulted in daily DO depressions in the tailrace to values below 4.0 milligrams per liter (mg/L). Pumpback on the same days corresponded with increases in tailrace DO values to above 4.0 mg/L. The DO values during generation corresponded with DO levels in the forebay of Wallace Dam at depths of 2 to 7 m and greater. For the first complete year of monitoring, 9.2 percent of the tailrace DO readings were less than the instantaneous DO criterion of 4.0 mg/L, and 18 percent of the days averaged DO values less than 5.0 mg/L. Outside of the June to early August period, tailrace minimum DO values were higher than 4.0 mg/L and the daily average was higher than 5.0 mg/L.

Two hourly tailrace monitoring events conducted in August 2016 characterized variation in tailrace water quality over the course of normal summer pumpback and generation operations. The range of values recorded indicated water quality to be relatively uniform across the tailrace during each event. DO values decreased after generation began and remained low throughout the interim and pumpback periods. DO recovery began during the daylight interim period, presumably as a result of photosynthesis.

Despite early summer DO depressions in the Wallace Dam tailrace area, overall water quality conditions are good and continue to support an aquatic community typical of southeastern reservoirs and the designated uses of the tailrace reach. In addition, the tailrace supports important fishing and other recreational opportunities.

1.0 INTRODUCTION

This report presents findings of the Water Resources Study conducted for Federal Energy Regulatory Commission (FERC) relicensing of Georgia Power Company's (Georgia Power's) Wallace Dam Hydroelectric Project (Wallace Dam Project, the Project) (FERC No. 2413). This study was conducted according to the approved Study Plan for the Wallace Dam Project. The approved Study Plan consists of Georgia Power's Revised Study Plan filed on November 24, 2015 (Georgia Power, 2015a), as approved by the Study Plan Determination issued by FERC on December 17, 2015 (FERC, 2015a). Georgia Power will use the information generated by the study to evaluate the environmental effects of its proposed action in the Preliminary Licensing Proposal (PLP), to be filed with FERC by November 21, 2017.

The Wallace Dam Project is an existing 321.3-megawatt (MW) pumped storage project consisting of Wallace Dam, a powerhouse, and Lake Oconee. The Project is located on the Oconee River in Hancock, Putnam, Greene, and Morgan Counties, Georgia (Figure 1). Georgia Power operates the Wallace Dam Project using Lake Oconee as the upper reservoir. Lake Sinclair, located immediately downstream, serves as the lower reservoir. Georgia Power operates Lake Sinclair as the separately licensed Sinclair Hydroelectric Project (Sinclair Project) (FERC No. 1951). Georgia Power is not proposing to add capacity or make any major modifications to the Wallace Dam Project under the new license. The Project occupies about 370 acres of U.S. Forest Service lands within the Oconee National Forest, which abuts Lake Oconee's northernmost reaches. The current license expires May 31, 2020.

Georgia Power proposes to continue operating the Wallace Dam Project as it is currently operated. The Pre-application Document (PAD) describes the project facilities and current operations and summarizes information characterizing the affected environment (Georgia Power, 2015b). The PAD also includes the Wallace Dam Operations Primer as Appendix D. Scoping Document 1 (FERC, 2015b) summarizes the environmental issues identified during FERC's public scoping process pursuant to the National Environmental Policy Act.

1.1 <u>Objectives</u>

The specific objectives of the study are to:

- Characterize water use, availability, and water quality in the Wallace Dam Project study area.
- Characterize the effects of continued project operation on water quality in Lake Oconee and the tailrace area within the project boundary.
- Document the extent of mixing that occurs in Lake Oconee as a result of the pump-back/generation cycles. This information will also be used to assess how project operations affect habitat conditions for fish, including sport fish species, and other

aquatic organisms in Lake Oconee and the Wallace Dam tailrace (see Aquatic Resources Report).

- Review the substantial amount of water resources information and data available for the Oconee River, along with the findings of Georgia Power's water quality monitoring in the project waters, to evaluate the effects of continued project operation on water quality, including water temperature and dissolved oxygen (DO) concentrations, in Lake Oconee and the tailrace area.

1.2 Project Overview

The Wallace Dam Project is located on the Oconee River at river mile 172.7 in the upper Oconee River basin of the greater Altamaha River basin (Figure 2). The Oconee River basin drains a total watershed area of 5,330 square miles (sq mi) in east-central Georgia (Georgia Environmental Protection Division [GEPD], 1998). The watershed upstream of Wallace Dam covers an area of 1,830 sq mi, comprising about 34 percent of the Oconee River basin (Figure 2). The Oconee River flows south about 20 miles from Athens-Clarke County before entering Lake Oconee (GEPD, 1998). Athens-Clarke County includes the City of Athens and the main campus of the University of Georgia. From Wallace Dam, the river flows immediately into Lake Sinclair, a 15,330-acre impoundment formed by Sinclair Dam. Wallace Dam and Sinclair Dam impound about 69 river miles of the mainstem Oconee River in the Piedmont physiographic province. Downstream of Sinclair Dam, the Oconee River flows 143 miles to its confluence with the Ocmulgee River in the Coastal Plain physiographic province to form the Altamaha River. The Altamaha River flows 137 miles southeast to the Atlantic Ocean.

1.2.1 Project Facilities

The Wallace Dam Project was built and commercial operation began in December 1979. The Project consists of Lake Oconee, an earth and concrete gravity dam, a semi-outdoor type powerhouse integral with the dam, a five-gate spillway, a 20,000-foot-long excavated tailrace (into Lake Sinclair), a 230-kilovolt substation, and a 15.67-mile-long transmission line. The discharge capacity of each spillway gate is 35,000 cubic feet per second (cfs) at the normal full pool elevation of 435 feet (ft) plant datum (PD)[1].

The powerhouse is located immediately downstream of the dam on the east side of the river. It contains six turbine-generator units, including two conventional units and four reversible, pumped storage units. The nameplate generating capacity of the Project is 321.3 MW. The total turbine hydraulic capacity is 50,545 cfs at full gate operations.

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[1] Plant datum = mean sea level (NAVD88) – 0.20 feet (+/- 0.01 feet).

Lake Oconee covers 19,050 acres at the normal full pool elevation of 435 ft PD. At normal full pool the total reservoir storage is approximately 370,000 acre-feet. The average reservoir depth is 21 ft; the maximum depth is approximately 120 ft. The maximum pool for spillway design flood is elevation 441 ft. The normal maximum tailwater elevation is 340 ft.

1.2.2 Project Operations

The Wallace Dam Project is Georgia Power's largest hydroelectric development. In the period 1996-2015, the Project contributed an average of 24.8 percent of Georgia Power's total hydropower generation. The following description of how Georgia Power operates the Wallace Dam Project is summarized from the Wallace Dam Operations Primer. The Wallace Dam Operations Primer provides additional information, including numerous figures illustrating operation, and can be found in Appendix D of the PAD (Georgia Power, 2015b).

Water for generation at Wallace Dam comes from inflow plus storage in Lake Oconee. Wallace Dam generates during peak power demand hours to meet the electrical system demand. Some of this water subsequently passes downstream for hydropower generation at Sinclair Dam to meet both electrical system demand and river flow requirements in the Oconee River downstream of Sinclair Dam.[2] The remaining volume of water from Wallace Dam remains in Lake Sinclair for a few hours before being pumped back up and into Lake Oconee by the reversible units for reuse in the next day's generation cycle. Pumpback operations occur at night, when electrical system demand is low (i.e., off-peak electrical hours) and therefore the cost of power is lower.

For normal daily operations, Lake Oconee fluctuates between elevations 435 and 433.5 ft PD. Lake Oconee typically starts near elevation 435 ft before the Wallace Dam generation cycle, and ends near elevation 433.5 ft. During pumpback, Lake Oconee typically refills up to elevation 435 ft. Depending on power demand, the reservoir may not fluctuate the full amount on a daily basis. The average daily fluctuation of Lake Oconee is approximately 1.5 ft.

Total generating capacity with all units operating is 321.3 MW. The majority of the total annual generation at Wallace Dam comes from the reuse of water pumped back into Lake Oconee at night, indicating the critical importance of the pumpback operations to the power benefits of the Project (see Table 1 of Appendix D in the PAD). During the summer, Wallace Dam usually generates about 7 to 8 hours across the afternoon peak demand period. During fall and winter, peak generation typically lasts 5 to 6 hours. Because of its large generating capacity, Wallace Dam is also a black-start facility for Georgia Power, meaning that it is capable of assisting in restoring electricity to the nearby system if another major generation facility goes off-line.

[2] The river flow requirements are included as articles in the separate FERC license for the Sinclair Project.

1.3 Study Area

The study area included Lake Oconee and the Wallace Dam tailrace area (Lake Sinclair) downstream to the project boundary at Georgia Highway (Hwy) 16, the Oconee River upstream of the Project to Athens-Clarke County, and tributary watersheds to Lake Oconee (Figure 1). New water quality monitoring field studies were conducted in Lake Oconee and the Wallace Dam tailrace area within the project boundary.

The larger tributaries entering Lake Oconee include the following streams in approximate descending order of watershed area (Figure 1): Apalachee River (233 sq mi); Hard Labor Creek (86 sq mi); Richland Creek (53 sq mi); Sugar Creek (49 sq mi); Fishing Creek (39 sq mi); Greenbrier Creek (30 sq mi); Beaverdam Creek (30 sq mi); and Town Creek (30 sq mi).

2.0 STUDY METHODS

The study methods followed the approved Study Plan (Georgia Power, 2015a; FERC, 2015a) and consisted of the elements described below.

2.1 Existing Information Review

Existing water resources in the study area were described and updated from the PAD, as appropriate, based on review of existing information and data. Key sources of information included Georgia Power seasonal water quality data collected between 1979 and the present; scientific literature and technical papers assessing nutrient loading sources and land management practices upstream of Lake Oconee; monitoring data and research publications on algal species composition in Lake Oconee; the Oconee River basin management plans developed as part of the Georgia State-wide Water Management Plan; and Georgia 305(b)/303(d) list documents, which assess whether surface water bodies in the project area are supporting their designated uses.

The literature review included the occurrence of cyanobacteria blooms in Lake Oconee, factors that could lead to harmful algal blooms, and their relationship, if any, to project operations. Literature review of cyanobacteria included the following sources:

- Scientific literature on factors potentially influencing algal abundance in Lake Oconee.
- Georgia Power algal research information.
- Research program of phycologist Dr. Kalina Manoylov of Georgia College and State University.
- GEPD and University of Georgia cyanobacteria monitoring projects and tracking systems.

2.2 Water Quality Monitoring in Lake Oconee

2.2.1 Monthly Vertical Profiles

Georgia Power conducted monthly vertical profile monitoring for one year at nine historical monitoring locations to characterize water quality in Lake Oconee. Monthly sampling began in August 2015 and continued through August 2016 (Figure 3). These data along with quarterly sampling data collected previously at the same nine locations by Georgia Power in most years since 1995 provide a robust water quality dataset for assessing water quality. The data also show the extent of mixing that occurs in Lake Oconee as a result of pumpback and generation operations. The nine monitoring locations represent the longitudinal change in water quality occurring through the mainstem reservoir as well as in major tributary embayments.

A description of each sample station is provided below:

- Lower pool (forebay) of reservoir next to Wallace Dam (Station OC1);
- Richland Creek embayment (Station OC2);
- Mainstem reservoir between Richland Creek and Lick Creek (Station OC3);
- Lick Creek embayment (Station OC4);
- Mainstem reservoir at Georgia Hwy 44 between Lick Creek and Sugar Creek (Station OC5);
- Mainstem reservoir at Interstate-20 (I-20) downstream of the Oconee River and Apalachee River confluence (Station OC6);
- Apalachee River embayment in upstream end of reservoir (Station OC7);
- Oconee River embayment in upstream end of reservoir (Station OC8); and
- Sugar Creek embayment (Station OC9).

Vertical profile data collection consisted of measurements of water temperature (ºC), DO (milligrams per liter [mg/L]), pH (standard units), and specific conductance (micromhos per centimeter [µS/cm]) taken at 1-meter intervals throughout the water column, along with Secchi disc transparency (meters [m]).

2.2.2 Quarterly Water Chemistry

In addition, 11 water chemistry parameters, including nutrients, were analyzed in surface grab samples (1-m depth) collected at six of the locations on a quarterly basis (Table 1). The six locations were Stations OC1, OC2, OC4, OC7, OC8, and OC9 (Figure 3). Georgia Power has sampled these stations historically for water chemistry, as summarized in the PAD (Georgia Power, 2015a). All water chemistry analyses were performed by Georgia Power, which operates a laboratory accredited by the National Environmental Laboratory Accreditation Program and recognized by GEPD. The parameters chlorophyll *a*, total phosphorus, and Secchi depth were used to calculate a trophic state index following Carlson (1977).

The water chemistry data presented herein include the quarterly data collected in 2013-2016 by Georgia Power. The PAD summarized water chemistry data for the years 1979 through

2012. This report supplements that information by summarizing all water chemistry data collected since 2012.

2.2.3 Hourly Vertical Profiles of Summer Pumpback/Generation

Georgia Power, in collaboration with GDNR Wildlife Resources Division (WRD) biologists, conducted two diel (day-night) sampling events in Lake Oconee in July and August 2016. Hourly vertical profiles of DO and water temperature, as well as pH and conductivity, were measured at seven of the monitoring locations over the course of a 24-hour period to represent a normal summer cycle of pumpback and generation. The seven monitoring locations for hourly vertical profiles included four stations on the mainstem reservoir (OC1, OC3, OC5, and OC6) spanning a distance of 20 river miles from the Wallace Dam forebay to the I-20 bridge, and three stations on the major tributary coves to this reach (OC2, OC4, and OC9). Monitoring began at 10:00 am and continued every hour through a generation cycle, an interim period, a pumpback cycle, and another interim period until 10:00 am the next day. Measurements were taken throughout the entire water column at 1-m intervals. Continuous measurements of DO and water temperature in the tailrace area during the sampling event were recorded by the probe at Station OCTR (Section 2.3.1).

2.3 <u>Water Quality Monitoring in the Tailrace</u>

2.3.1 Continuous Monitoring of DO and Water Temperature

Georgia Power conducted continuous water temperature and DO[3] monitoring in the Wallace Dam tailrace beginning in July 2015. The Station OCTR (Figure 3) monitoring location was established in the tailrace within the direct influence of generation and pumpback flows where the channel cross section is relatively uniform in depth and the water is well mixed. Georgia Power is continuing to collect data at the tailrace location through September 2017 for over two full years of monitoring to represent inter-annual variation in water quality conditions.

An electronic multi-parameter water quality measurement sonde and data recorder (YSI 6600) were deployed to continuously record DO concentration, pH, specific conductance, water temperature, and turbidity in the Wallace Dam tailrace. Water quality data were recorded every 60 minutes. The sonde was installed on a buoy-mounted system (YSI EMM68) at a depth of approximately 1 m, which is the depth at which GEPD (2015) applies the DO criteria where depth is equal to or greater than 2 m. Routine maintenance and necessary equipment calibration was performed monthly throughout the monitoring period.

The continuous DO and water temperature data collected from the tailrace monitoring location were aligned with real-time project operational data for the same periods, which indicated how the turbines were being operated (units, pumpback, generation, etc.). DO levels and water

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[3] Specific conductivity, pH, and turbidity were also recorded by the tailrace probe.

temperatures documented during these periods were correlated with reservoir vertical profile data collected from the same month.

2.3.2 Hourly Tailrace Monitoring of Summer Pumpback/Generation

In addition, Georgia Power conducted hourly measurements of DO and water temperature in the tailrace area over the course of a summer day during two events in August 2016 to characterize variation in tailrace water quality during a normal cycle of pumpback and generation operations. Georgia Power coordinated with WRD on the tailrace transect design and field data collection methods. Monitoring was conducted along a zigzag path that crossed the tailrace channel multiple times and extended from the safety-buoy line near the powerhouse downstream to the end of the project boundary at Georgia Hwy 16 bridge. The tailrace was divided into five distinct zones or reaches of approximately equal length for analysis and presentation of the data.

Each event was conducted during parts of the day to represent hourly changes in tailrace water quality conditions during operational periods when Wallace Dam was generating power, pumping water back upstream into Lake Oconee, and during interim periods between generation and pumpback. A water quality probe was lowered to a depth of 1 m and towed at that depth while the boat traversed the downstream zigzag path recording the water temperature and DO throughout the length of the tailrace. The monitoring path was repeated hourly during the targeted operational periods. In addition, vertical profiles of the reservoir forebay were measured on the same day as the tailrace transect monitoring event.

Georgia Power measured water temperature and DO along similar zigzag transects in the tailrace on several other occasions in 2015-2016. These were one-time transect measurements (i.e., not conducted hourly) taken in conjunction with monthly maintenance of the water quality sonde at Station OCTR. Their purpose was to evaluate and verify the location of the buoy as representing tailrace water quality conditions.

3.0 RESULTS AND DISCUSSION

3.1 Water Quantity

3.1.1 Stream Flow

This section updates stream flow at the project dam from the PAD. Because Wallace Dam discharges directly into Lake Sinclair, there is no United States Geological Survey (USGS) stream gage measuring this discharge. Therefore, daily inflow cannot be calculated from daily discharge and change in storage. The nearest USGS stream gages that measure stream flow are:

- Apalachee River near Bostwick, Georgia (No. 02209000) – about 13 miles upstream of the project boundary; 176-square mile drainage area; period of record July 1944 to present.

- Oconee River near Penfield, Georgia (No. 02218300) – at the bridge on Athens Hwy about 1.5 miles upstream from the project boundary; 940-square mile drainage area; period of record August 1977 to present.

- Oconee River at Milledgeville, Georgia (No. 02223000) – at Sinclair Dam; 2,950-square mile drainage area; period of record September 1903 to present.

Georgia Power calculated daily inflow duration statistics by month and year for the project by adding the flows from the Oconee River at Penfield to the Apalachee River at Bostwick and applying a ratio of the remainder of the ungaged drainage area to estimate the total Lake Oconee inflow. Monthly minimum, average, and maximum inflows at Wallace Dam for the period January 1997 through August 2016 are listed for each month of the year in Table 2. Appendix B provides daily inflow duration curves by month and annually for the period January 1997 through August 2016. Mean flows range from a low of 1,003 cfs in August to a high of 3,577 cfs in March. The minimum flows usually occur in late summer/early fall (August-October), and the high flows tend to occur in winter (November-February).

3.1.2 Water Withdrawals

Information compiled in the Upper Oconee Regional Water Plan (CH2M HILL, 2011) shows that surface water provides 94-percent of the water supply used by the municipal, industrial, energy, and agricultural water-use sectors in the Oconee River basin. Significant portions of the Oconee River watershed both upstream and downstream of the Wallace Dam Project are classified for drinking water supply, including Lake Oconee and Lake Sinclair.

Surface withdrawals for water supply comprise the vast majority of water uses in the project vicinity and include the cities of Greensboro, Sparta, and Madison. Annual average demand for surface water is 79 million gallons per day; these withdrawals support municipal (62 percent), industrial (20 percent), and agricultural (18 percent) needs. Non-consumptive uses, such as withdrawals for hydropower production, where the water is immediately returned are not included in these numbers[4]. Groundwater withdrawals account for only 6 percent of annual average demand for industrial (59 percent), municipal (24 percent), and agricultural (17 percent) uses from the underlying Cretaceous and fractured Crystalline rock aquifers (CH2M HILL, 2011).

Permitted surface water sources on Lake Oconee include (GEPD, 2016a):

- City of Greensboro, Greene County – permitted maximum daily withdrawal of 3.31 million gallons per day (MGD) and monthly average of 3.00 MGD; located in the Oconee River embayment toward the upstream end of Lake Oconee.

- Piedmont Water Resources, Greene County – permitted maximum daily and monthly average withdrawal of 2.00 MGD.

- City of Madison, Morgan County – permitted maximum daily and monthly average withdrawal of 2.00 MGD; located in the Apalachee River embayment toward the upstream end of Lake Oconee.

3.1.3 Treated Wastewater Discharges

The Oconee River also serves as a primary receiving water for assimilating treated sanitary effluent in the basin. The majority of wastewater (97 percent) is treated by facilities with point source discharges (CH2M HILL, 2011). In 2016, there were four water treatment plants, 10 land application permits, four private/industrial permits, and 18 National Pollutant Discharge Elimination System permitted discharges in the four nearest counties upstream of Lake Oconee, including Greene, Morgan, Oconee, and Clarke Counties (GEPD, 2016b). These discharges are potential sources of phosphorus to the reservoir. The addition of nutrients to the reservoir contributes to Lake Oconee's trophic status of mesotrophic to nearly eutrophic conditions (University of Georgia, 2006).

3.2 Water Quality in Lake Oconee

GEPD (2016c) classifies the water use of Lake Oconee within the Wallace Dam project boundary as Recreation / Drinking Water, and Fishable. In addition to general criteria applicable to all waters, specific criteria apply to these classified water uses, including criteria for bacteria (fecal coliform), DO, pH, and temperature, as set forth in the Rules and Regulations for Water Quality Control, Chapter 391-3-6 (GEPD, 2015). Based on historical data and

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[4] Georgia Power's Plant Harllee Branch, located on Lake Sinclair about 17 miles downstream of Wallace Dam, was retired in 2015 and no longer withdraws water for thermoelectric uses in the Oconee River basin.

GEPD's Water Quality in Georgia report (GEPD, 2016c), Lake Oconee's status on the draft 2016 is "Assessment Pending" due to an occasional pH excursion, but the list indicates this may be due to a lack of sampling due to personnel issues. In previous years (GEPD, 2012), Lake Oconee supported its designated uses and met water quality standards. Sampling in the current study did not reveal any violations of the pH standard (see Section 3.2.2 below).

Although Lake Oconee and the Wallace Dam tailrace area are generally meeting designated uses, several tributary streams to Lake Oconee are included on the draft 2016 303(d) list for being impaired as shown on Figure 4 (GEPD, 2016c). All the creeks listed do not meet their water use classification due to fecal coliform or fish community impacts. Non-point sources and urban runoff are the likely cause of impairment for each of these creeks. Consistent with the 303(d) listings, many tributaries to Lake Oconee often exceed regulatory standards for fecal coliform. Studies have indicated that the source of the contamination is bovine and not human; consistent with the heavy agricultural uses in the tributary areas (Bachoon et al, 2009). Increased use of adequate riparian buffers has been shown as one way to minimize the impacts of cattle farms (Fisher, 2001).

In 2002, in response to historical levels of mercury in fish tissue, the U.S. Environmental Protection Agency (EPA) developed a total maximum daily load (TMDL) for mercury for Lake Oconee. The TMDL was in response to Lake Oconee having largemouth bass exceeding Georgia's fish consumption guideline due to atmospheric deposition of mercury (EPA, 2002a). Mercury levels in Lake Oconee fish have decreased and there have been no restrictions since 2003 (GDNR, 2003).

GEPD is currently conducting a study that could result in a regulatory standard being placed on Lake Oconee chlorophyll-*a* concentrations. Chlorophyll-*a* is a green pigment found in algae and green plants that is vital for photosynthesis and serves as an indicator of nutrient levels in a waterbody. When the standard is developed, the regulation would also limit nutrient concentrations in Lake Oconee. Thus far, GEPD has developed chlorophyll-*a* standards for only a few lakes. The 2011 Georgia water quality standards indicate a numeric criterion for six other major lakes including Lanier, Allatoona, Jackson, West Point, Carters, and George.

3.2.1 Monthly Vertical Profiles

Vertical water quality profiles were measured in Lake Oconee on a monthly basis from June 2015 through August 2016. Table 3 summarizes the vertical profile measurements by station, which included water temperature, DO, specific conductance, pH, and Secchi depth transparency. The means and ranges of values recorded are presented by station across all depths, as well as the means and ranges limited to just those measurements collected at depths less than or equal to 1 m. GEPD (2015) applies the DO criteria specified in individual water use classifications at a depth of 1 m below the water surface where depth is equal to or greater than 2 m. All nine Lake Oconee monitoring stations exceeded 2 m depth (Table 3). Figures

5a through 5i show the 14 monthly vertical profiles of water temperature and DO measured at each station from June 2015 through August 2016.

DO concentrations and temperatures in Lake Oconee varied with location and depth throughout the water column on a seasonal basis. Typically, southeastern reservoirs exhibit summertime thermal stratification with warmer temperatures near the surface, a sharp decrease in temperature at mid-depths, and cooler waters at the bottom. The monthly temperature profiles at Station OC1 (Figure 5a), the location in the Wallace Dam forebay, show that the water column remained well mixed for most of the year with little variation from the surface to the bottom. Very limited thermal stratification was observed in the late spring and early summer (March-April 2016, June 2015, and June 2016). The monthly DO profiles at Station OC1 exhibited a similar pattern of relatively uniform values for most of the year, indicative of a well-mixed water column, but there was a more pronounced gradient (chemocline) of declining DO values with increasing depth observed in June 2015, June and July 2016, and to a lesser extent in March and April 2016. DO gradients near the surface in summer months were likely due to photosynthesis.

Georgia Power has collected vertical profile data in Lake Oconee on a seasonal basis every year since 1995 (Georgia Power, 2015a). Vertical profile data for the years 2003 through 2012 were presented and discussed in the PAD (Georgia Power, 2015b). Figures 6a through 6i show the vertical profile data for water temperature and DO collected at all nine reservoir stations in all seasons updated to include the years 2003 through 2016. Figure 6a shows the seasonal profiles for Station OC1. On this figure, the lack of summertime stratification in the forebay can be readily observed over the longer time period (note that quarterly summer profiles were typically measured in August). Station OC1 exhibits complete thermal mixing of the water column for most seasons in most years. The greatest variations from top to bottom in both water temperature and DO were observed in the spring (spring profiles were measured in May).

Figures 5b through 5i show the monthly vertical profiles collected during the 2015-16 monitoring period at locations upstream of the forebay. All locations showed some evidence of slightly warmer temperatures at the surface in June, but the temperatures were relatively uniform from the surface to the bottom during other months. (May and July frequently show increased temperatures at the surface for most locations.) It should be noted that all other stations were significantly shallower than Station OC1. Increased DO concentrations were evident in the surface waters at all locations in June and some other warm-weather months, likely due to photosynthesis. Station OC2 is located in the Richland Creek embayment and there was some indication of a summertime (June 2015 and June 2016) thermocline and chemocline with higher temperatures and DO concentrations at the surface and a rapid decline with increasing depth (Figure 5b). Although not as pronounced, some summer thermal stratification was evident at Station OC7 in the Sugar Creek embayment (Figure 5g).

Based on the summer vertical profiles for the years 2003 through 2016, the downstream end of Lake Oconee near the forebay of the dam (Station OC1) becomes vertically mixed as a result of Wallace Dam pumpback operations. Figure 6a shows the well-mixed nature of the water column at Station OC1 by August of most years, as reflected in both the isothermal temperature profiles (equal temperature throughout) and nearly uniform DO profiles in most years. The effects of mixing from pumpback operations gradually extend throughout the reservoir as the amount of cooler water diminishes at all stations by summer (August), when the water column exhibits little temperature variation from surface to bottom (Figures 6a-6i). The effects of mixing on temperature were most evident in the mainstem reservoir (Stations OC1, OC3, OC5, and OC6) and the tributary embayments closest to Wallace Dam (Stations OC2 and OC4) (Figure 3). These stations exhibited many summer (August) vertical profiles that were isothermal or nearly so (Figures 6a-6i). Stations OC7, OC8, and OC9 retained the greatest degree of thermal stratification. These stations are located relatively distant from the dam and have relatively shallow depth, thereby increasing their exposure to the influence of diurnal variation in ambient air temperatures.

Vertical stratification in water temperature and DO concentration within Lake Oconee tended to become most developed in the mainstem reservoir and tributary embayments closest to the dam in the spring (Figures 6a-6i). The cooler water available in the water column contrasted against the warming air temperatures in many years resulted in vertical stratification in both temperature and DO. By August, Station OC1 in the forebay exhibited DO vertical profiles that were nearly uniform or only weakly stratified in most years (Figures 5a and 6a). The other reservoir stations exhibited at least some vertical stratification in DO concentrations in August of most years, but not every year (Figures 6b-6i).

Figures 7a through 7l depict monthly vertical profile isopleths of DO concentration and water temperature measured at the six reservoir stations OC1, OC3, OC5, OC6, OC7, and OC8 for the period June 2015 through June 2016. The values at different locations in the reservoir and different depths were used to create isometric lines (i.e., isopleths) of equal temperature and DO along a cross-section of the reservoir. The isopleths were generated using Earth Volumetric Studio; a specialized software for three-dimensional data interpolation and visualization.

3.2.2 Quarterly Water Chemistry

Table 4 summarizes the results of the water chemistry analyses of grab samples collected quarterly from Lake Oconee from 2013 through 2016. Previous quarterly water chemistry data reported in the PAD included Georgia Power data from 1979-2012 as well as GEPD from 2004 (Georgia Power, 2015b). The chemical analyses indicate no unusual results for the water quality for Lake Oconee, which exhibited good water quality conditions throughout the monitoring period.

Figures 8a through 8c depict the range of values for water quality parameters sampled in 2013-2016. The graphs depict the ranges of values as box and whisker plots which show the 25th through 75th percentile as the red bar and the whiskers extend to show the range from the 5th to 95th percentile. These depictions are useful for comparing water quality monitoring stations from different locations in Lake Oconee. One notable difference is the higher concentrations of total phosphorus for the upstream stations: OC4, OC7, and especially OC8 and OC9 (Figure 8a). These elevated concentrations could represent on-point agricultural sources into the watershed. The same trend of higher values at OC4, OC7, OC8 and OC9 is also observed for turbidity measurements and chlorophyll-a (Figure 8b). For fecal coliform, it appears that OC4, OC7 and perhaps OC9, have somewhat increased densities that could be related to the proximity of those stations to dairy farming in the area.

Trophic state index (TSI) has been monitored in Lake Oconee and other Georgia reservoirs to monitor the degree of eutrophication. The Carlson TSI interrelates Secchi disc transparency, chlorophyll *a*, and total phosphorus to derive numerical classification of trophic conditions (Carlson, 1977). Carlson TSI scores are generated on similar scales for each of these three parameters. Higher TSI scores indicate enriched trophic conditions. TSIs are useful for evaluating the direction and rate of trophic change, although trophic states have been defined for a range of scores.

Lake Oconee currently does not have nutrient criteria, but criteria are planned for the near future (GEPD, 2013). Similar to many reservoirs with agricultural watersheds in Georgia, Lake Oconee is considered to be mesotrophic but approaching eutrophic conditions. Figure 9 shows the TSI values for Lake Oconee from 1979 to 2005 as measured and calculated by the University of Georgia (2006). TSI scores for Lake Oconee were calculated using the data from 2014-2016 collected by Georgia Power. As observed in the figure, TSI scores are in the same range with mesotrophic but approaching eutrophic conditions that were reported in 2006. Overall, the values remain in the 50-60 range of mesotrophic/eutrophic; however, it appears that Secchi depths are lower than in past years and phosphorus values are higher.

3.2.3 Hourly Vertical Profiles of Summer Pumpback/Generation

Georgia Power conducted two reservoir-wide sampling events to measure hourly vertical profiles of DO and water temperature over the course of a normal summer operation day with hydropower peaking followed by pumpback operations. The two 24-hour sampling events were conducted on July 27-28 and August 15-16. Vertical profile information was collected at Stations OC1, OC2, OC3, OC4, OC5, and OC9 (Figure 3).

Figure 10a shows each of the hourly vertical profiles of water temperature and DO concentration measured at Station OC1 during the July event. The monitoring event began at 10 am during the quiescent period (i.e., no generation or pumpback occurring) for Wallace Dam. These "interim" profiles are shown in orange. Generation began around 2 pm and these profiles are shown in red. There was another interim period beginning about 7 pm and these profiles are shown in blue. Pumpback operations began about 12:45 am; these profiles are shown in green. The remaining profiles for the event occurred during another interim period following pumpback and are shown again in orange. Vertical profiles for the other five reservoir stations are shown in Figures 10b-g.

A notable pattern from this first event, evident especially at Station OC1 but also at mainstem stations OC5 and OC6, was the pronounced decrease in DO with increasing depth (i.e., chemocline) during the first interim, generation, and second interim phases (Figures 10a, 10e, and 10f). Once pumpback began, the DO concentration became very well mixed throughout the water column as indicated by the vertical green lines (Figure 10a). During the fully mixed conditions (2 am to 6 am), the DO concentration at Station OC1 was about 3.6 mg/L. During the same time period, the DO values being recorded in the tailrace at Station OCTR, which represented the water being pumped back into Lake Oconee, averaged about 3.9 mg/L.

A similar pattern occurred for water temperature at Station OC1, with stratification developing during the first interim, generation, and second interim phases, followed by disruption of the temperature gradient upon the initiation of pumpback (Figure 10a). During the fully mixed conditions, temperature at Station OC1 in the forebay averaged 29.8°C compared to 30.0°C in the tailrace area at Station OCTR. The profiles at the tributary stations OC2, OC4, and OC9, especially the one in Richland Creek (OC2), indicated that the water column in these locations remained stratified throughout the generation and pumpback cycle (Figures 10b, 10d, and 10g). The consistent thermocline and chemocline are easily observed at Station OC2 in Richland Creek (Figure 10b). These patterns indicate that the generation and pumpback operations have little short-term effects on the water quality in the upper reach of Richland Creek.

Figures 11a through 11g show each of the hourly vertical profiles measured during the August event by station. Similar to the July event, the August event shows that at Station OC1 temperature and DO became very well mixed throughout the water column once pumpback began at 1 am (Figure 11a). During the fully mixed conditions, the water temperature at Station OC1 was about 30°C and DO values were about 5.3 mg/L, and matched closely the water temperature and DO values recorded at Station OCTR during the same time period. The immediate effects of pumpback were not as evident at Station OC3 during the July event (Figure 10c); however, during the August event, the effects of pumpback were evident for temperature and to a lesser extent for DO concentration (Figure 11c). Surface to bottom mixing during pumpback can also be noted for the mainstem stations OC5 and OC6 (Figures 11e and 11f). As in the July event, the pumpback operations appeared to have less effect on short-term mixing at tributary stations OC2, OC4, and OC9 (Figures 11b, 11d, and 11g).

As reported in the PAD, Georgia Power had limited previous data about DO in the tailrace. Georgia Power conducted a two-year in-house study in 1995-1996 to evaluate environmental factors related to DO variability in Lake Oconee and the lack of summer stratification. The field results and modeling scenarios were presented in a report by Georgia Power (1997). The intensive sampling program continuously recorded DO concentrations at multiple reservoir locations and assessed those concentrations relative to pumpback/generation operations, inflow/outflows, and nutrient loading. The study found that the mixing that occurs as a result of pumpback operations prevents the accumulation of oxygen-demanding materials in the lake bottom, which normally result in bottom waters devoid of oxygen. Instead, the oxygen demand is spread throughout the water column with relatively homogenous DO concentrations occurring from the surface to the bottom of the reservoir. The study observed that reducing tributary sources of oxygen-demanding materials and nutrient loading through the reduction of point and non-point sources in the watershed could increase DO concentrations in the reservoir. In addition, generation and pumpback were found to exert a positive effect on DO levels in the reservoir near Wallace Dam and in the tailrace area downstream.

3.2.4 Algal Blooms

Algal blooms can be natural occurrences that may occur with regularity but their frequency, duration, and intensity are increased by nutrient pollution, particularly nitrogen and phosphorous, from point and non-point sources (Pearl et al., 2001; Anderson et al., 2002; EPA, 2016). Nutrient pollution, together with a combination of increased temperatures, light availability (sunlight), and low flow create conditions favorable for algae growth (EPA, 2016). Lake Oconee is subject to nutrient loading from point and non-point source runoff from the upstream watershed (Fisher et al. 2000, 2001) and in 2014, there were 18 National Pollutant Discharge Elimination System permitted discharges in the four nearest counties upstream of the lake which are primary sources of phosphorous to Lake Oconee. The addition of nutrients to the reservoir contributes to Lake Oconee's trophic status of mesotrophic to nearly eutrophic conditions (University of Georgia, 2006). Increased nutrient levels when coupled with the physiochemical conditions often occurring during summer months, can lead to the overabundance of algae in areas of Lake Oconee.

Numerous genera of phytoplankton are capable of forming blooms; however, cyanobacteria, or blue-green algae, are the most notorious group forming blooms in freshwater systems because their blooms tend to be highly visible and can be toxic Paerl et al. 2001). A recent study of the algal community abundance in Lake Oconee indicated the algal community was dominated by diatoms and green filamentous algae while cyanobacteria comprised less than five percent relative abundance (Bachoon et al. 2009). Although the least abundant group in Lake Oconee, Georgia Power has documented the occurrence of several blue-green blooms (*Microcystis aeruginosa*) in Lake Oconee in recent years, likely due to nutrient loading in the lake from upstream watershed sources. A recent study of the algal community in Lake Sinclair indicated that potential bloom-forming cyanobacteria are naturally occurring members of the community, but are kept in low abundance under low nutrient conditions that promote high algal diversity (Manoylov and Dunn, 2014). Further, the algal community in open water, mainstem areas of Lake Sinclair was dominated by diatoms and green algae, which are tolerant of high flow and turbidity and rarely cause algal blooms, whereas shallow cove areas in Lake Sinclair were dominated by filamentous cyanobacteria (Manoylov and Dunn, 2014).

A review of available information from Georgia Power indicates that four blooms were documented on Lake Oconee from 2009 and 2014, between August and October. Each bloom was analyzed by Dr. Manoylov's research program at Georgia College and State University and determined to be largely dominated by cyanobacteria, either *Microcystis aeruginosa* or *Anabaena* sp. Toxicity tests detected the presence of microcystin at concentration levels below the World Health Organization (1999) guidelines for microcystin in recreational waters (10 micrograms per liter). Additionally, the extent of these blooms was limited to small, isolated cove areas. Large scale, lake-wide algal blooms have not been documented on Lake Oconee possibly because of the relatively short water retention time of the reservoir and the daily changes in flow direction associated with pumpback and generation. Deep-water hydraulic flushing, such as may be occurring during pumped storage operations at Wallace Dam, has been found to shift the dominance of the algal community from potential bloom forming species to non-bloom forming species (Lundgren et al., 2013) and could be a factor limiting the extent of harmful algal blooms on Lake Oconee.

The information review included contacting two University of Georgia cyanobacteria bloom monitoring projects but they had no bloom information available for Lake Oconee.

3.3 <u>Water Quality in the Wallace Dam Tailrace</u>

3.3.1 Continuous Monitoring of DO and Water Temperature

Georgia Power conducted continuous DO and water temperature monitoring in the Wallace Dam tailrace beginning in July 2015. Station OCTR is located in the tailrace within the direct influence of generation and pumpback flows where the channel cross section is relatively uniform in depth and the water is well mixed (Figure 3). The probe deployed at Station OCTR collected at least hourly recordings of water temperature, DO concentration, and other water quality parameters since June 30, 2015, covering 184 days in 2015, and it continues to record each day in 2016. Only 3 days in the monitoring period to date (in August 2016) encountered data loss, which occurred due to a malfunctioning cable. Georgia Power will continue collecting data at the tailrace location through September 2017 for an additional year (two full years) to represent inter-annual variation in water quality conditions.

The daily averages of water temperature and DO concentration recorded at Station OCTR in the Wallace Dam tailrace from July 1, 2015 through September 6, 2016 are plotted in Figure 12.

For the one-year period beginning June 30, 2015, almost 9,000 hourly readings were collected. The average water temperature in the tailrace was 20.1°C and the average DO concentration was 7.0 mg/L. Of those DO readings, 805 (9.2 percent) were less than the instantaneous DO criterion of 4.0 mg/L. When daily averages were calculated, 65 days of the year (18 percent) had a daily average DO value less than the daily average DO criterion of 5.0 mg/L. These DO depressions below the numeric criteria occurred almost exclusively in June and July. Lower DO in summer months is expected as warmer temperatures decrease oxygen solubility in water. Warmer temperatures also lead to increased biological and sediment oxygen demand causing the consumption of oxygen in the water column. Typically, this DO decrease is limited to deeper waters. However, the mixing of the forebay above Wallace Dam creates this decreased DO condition throughout the water column.

In order to examine the relationship between DO concentration in the Wallace Dam tailrace and project operations, the water temperature and DO values were plotted week by week for the period July 1, 2015 through September 6, 2016 on a graph indicating the operational status of Wallace Dam. Figures 13a-ae (62 weeks) show the hourly temperature and DO values with a dark colored bar chart to represent the number of units generating at Wallace Dam and a light-colored bar chart indicating when pumpback operations were occurring. Quiescent or interim periods between pumpback and generation were the blank areas between the bars.

The weekly plots of temperature and DO concentration aligned with project operational data for the same periods demonstrate an effect of project operation upon the water quality in the tailrace area, especially during the early portion of the summer critical period. During June, July, and early August, generation at Wallace Dam was frequently accompanied by a decrease in DO in the tailrace area to values below 4.0 mg/L (Figures 13a-13c, 13y-13ac). Pumpback on the same days resulted in an increase in DO to values above 4.0 mg/L. Some of the DO recovery was likely due to daytime photosynthetic activity in the water column of the tailrace (upper Oconee River arm of Lake Sinclair). The effect of generation can be seen during the week of July 15, 2015 (Figure 13b). DO concentration is rising on July 16 until generation begins, when it falls sharply to below 4.0 mg/L. DO values rises the next day (July 17) and fall again when generation begins. Note that on July 19 there was no generation at Wallace Dam and no drop in DO concentration occurred in the tailrace area.

Examination of June 2015, June 2016, and July 2016 monthly DO profiles for Station OC1 in Lake Oconee reveals that low-DO water (i.e., less than 4.0 mg/L) released during these early summer generation periods originated in the forebay of Wallace Dam at depths of 2 to 7 m and greater (Figure 5a). The powerhouse intake draws water from the middle and lower water column of Lake Oconee. The DO profiles of the next two mainstem reservoir stations upstream (OC3 and OC5) for the same months also were characterized by low-DO water at depths of 3 to 5 m and greater (Figures 5c and 5e). Thus, low-DO water was available throughout the lower mainstem reservoir during generation.

During other months of the year, generation had much less effect on water quality in the tailrace area because DO levels in the reservoir tended to be higher throughout the middle and lower water column in the forebay and in most other areas of the reservoir (Figures 5a-5i, 6a-6i).

Tailrace DO values outside of June, July, and early August were higher than 4.0 mg/L (Figure 13) and the daily average was higher than 5.0 mg/L (Figure 12).

3.3.2 Hourly Tailrace Monitoring of Summer Pumpback/Generation

Two hourly tailrace transect monitoring events were completed to characterize variation in tailrace water quality over the course of a normal cycle of pumpback and generation operations on a summer day. The first event was conducted on August 3-4, 2016. The second event was conducted on August 25, 2016.

During the first event August 4), the reservoir forebay was well mixed from top to bottom with less than 0.4 mg/L change in DO. During the second event (August 25), there was a 1.7 mg/L change in DO from the reservoir surface to the bottom indicating a slight degree of stratification occurring at the time the measurements were taken.

The tailrace area was divided into five reaches beginning at the dam and extending downstream to the end of the project boundary at the Georgia Hwy 16 bridge. The DO data are summarized in Table 5. DO values at Station OCTR are provided for the hourly reading recorded closest to the time of each transect measurement. In comparing the minimum, maximum, and mean DO values, it is evident that the tailrace area was relatively well mixed during each event. As discussed above, the DO values decreased quickly after generation began and remained low throughout the interim and pumpback periods. DO recovery began during the daylight interim period, presumably when photosynthesis was occurring and adding oxygen to the water.

Figure 14a-j shows the spatial distribution of DO concentrations during each hour's measurements for the August 3-4 monitoring event. The dots represent the actual readings recorded with the water quality sonde along the zigzag course. When monitoring began at 11 pm (Figure 14a), conditions were quiescent during the interim period before pumpback. The tailrace was well-mixed and exhibited overall lower DO concentrations (3.93-4.40 mg/L) (Table 5). Conditions remained similar through 3 am through the first several hours after pumpback began (Figures 14b-14e). When monitoring resumed at 2 pm, during the interim period before generation started, DO concentrations had increased from an average of 4.3 mg/L for the whole tailrace at 3 am to an average tailrace DO of 6.0 mg/L (Figure 14f). Figure 14g shows the tailrace at 3 pm just as generation began and a decrease in DO is already evident at the points closest to Wallace Dam. As generation proceeds, the DO values decrease farther downstream (Figure 14h). By 5pm (Figure 14i), the average tailrace DO concentration has returned to 4.3 mg/L.

Figure 15a-j shows the spatial distribution of DO concentrations for the August 25 monitoring event. Based on the results of the August 3-4 event, this event focused on evaluating the DO change during the daytime interim period after pumpback but before generation when photosynthesis was assumed to be occurring and influencing the tailrace DO. Overall, the DO was somewhat higher than observed on August 4. As shown in Figure 15a, the lowest DO values were observed during the 5 am monitoring period during the pumpback cycle (Figure 15a). Pumpback operations continued through 9 am and a small increase in DO values during these hours was observed (Figures 15b-15e). DO concentrations rose noticeably in the tailrace during the interim operations hours of 10 am, 11 am, and 12 pm (Figures 15f, g, h). When generation began at 1 pm, the resulting DO concentration decrease was apparent (Figure 15i).

Tailrace transects of water temperature and DO concentration were also measured in July 2015, November 2016, February 2016, and May 2016. These were one-time transect measurements (i.e., not hourly) with the exception of the May event. The May event included one transect during generation and one transect in the interim period between pumpback and generation. Figures displaying the DO data from these transect events are provided in Appendix A. Table 6 summarizes the average water temperature and DO concentrations across the tailrace area for each event compared to the reading measured at Station OCTR at the nearest hour. The figures and table indicate that there was not great variability in water temperature or DO concentration throughout the tailrace and, therefore, the present location of the buoy is well-representative of tailrace water quality conditions.

4.0 SUMMARY

The goal of the study was to characterize the effects of continued project operation on water quality in Lake Oconee and the tailrace area within the project boundary. This was accomplished by examining existing information as well as performing new studies. The new studies included continuous, diel, monthly, and season field studies of the water quality within Lake Oconee and the Wallace Dam tailrace.

The studies showed that water quality in Lake Oconee is good and supports its designated uses. Typical reservoir summer stratification with cooler waters at depth is not observed in the forebay of Lake Oconee; however, stratification does develop at many of the other locations in many years. Lake Oconee waters, especially in the forebay of Wallace Dam, remain vertically mixed because of the pumpback operations at Wallace Dam. The pumpback operations may prevent the growth of harmful algal blooms. The lake remains a mesotrophic/eutrophic lake with point and non-point sources of nutrients. Higher concentrations of phosphorus are seen in upstream locations reflecting the agricultural land uses in those areas.

Hourly studies of Lake Oconee indicated that at the forebay location (Station OC1) and other mainstem locations, there is some temporary summer stratification occurring during generation and quiescent phases of the Wallace Dam operations. However, once pumpback operations begin, the water column becomes well mixed from top to bottom. The profiles in the tributary locations, especially the one in Richland Creek, indicate that the reservoir remains stratified in these locations throughout the generation and pumpback cycle and that dam operations have little short-term effects on the water quality in Richland Creek.

The continuous monitoring of temperature and DO, for the one-year period beginning June 30, had an average temperature in the tailrace of 20.1°C and an average DO of 7.0 mg/L. Of those more than 9,000 DO readings, 805 (9.2%) were less than the instantaneous DO criterion of 4 mg/L. When daily averages were calculated, 65 days (18%) had a daily average less than the daily average DO criterion of 5 mg/L. These excursions below the criteria occurred almost exclusively in June and July. Examination of the continuous data in conjunction with the plant operational data, demonstrate a clear effect of dam operation upon the temperature and DO in the tailrace. During June, July and early August, generation at Wallace Dam is associated with a decrease on DO in the tailrace. Pumpback results in an increase in DO in the reservoir. Additionally, some of the DO recovery is likely due to daytime photosynthetic activity in the water column.

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TABLES

TABLE 1
List of Quarterly Water Chemistry Parameters and Analytical Methods

Parameter	Analytical Method[a]
Alkalinity (mg/L)	EPA 310.1
Turbidity (NTU)	EPA 180.1
Hardness (mg/L as $CaCO_3$)	SM2340
Total Phosphorus (mg/L)	EPA 365.1
Nitrate (mg/L)	EPA 300
Nitrite (mg/L)	EPA 300
Ammonia (mg/L)	EPA 350.3
Chlorophyll *a* (mg/L)	EPA 670/4-73-001
Fecal Coliform Bacteria (MPN colonies/100 ml)	EPA 600/8-78-017
Biochemical Oxygen Demand (mg/L)	EPA 405.1
Chemical Oxygen Demand (mg/L)	EPA 410.4

[a] EPA, Methods for Chemical Analysis of Water and Wastes; EPA SW-846, Test Methods for Evaluating Solid Waste – Physical/Chemical Properties; APHA-AWWA-WEF, Standard Methods (SM) for the Examination of Water and Wastewater. mg/L = milligrams per liter; ml = milliliter.

TABLE 2
Monthly Minimum, Mean, and Maximum Flow by Month at Wallace Dam, 1997-2016

Month	Minimum Flow (cfs)	Mean Flow (cfs)	Maximum Flow (cfs)
January	1,046	2,829	6,527
February	1,048	3,447	9,586
March	1,627	3,577	7,240
April	764	2,731	7,318
May	523	1,932	5,202
June	386	1,495	4,299
July	263	1,476	6,100
August	180	1,003	3,122
September	179	1,151	5,052
October	146	1,316	5,693
November	288	1,924	7,982
December	673	2,700	8,054

Table 3
Summary of Monthly Vertical Profile Measurements in Lake Oconee, June 2015 - August 2016

Station	Maximum Depth (m)	Summary of All Data				Up to 1.0 m (inclusive)			
		Number	Minimum	Mean	Maximum	Number	Minimum	Mean	Maximum
Temperature (°C)									
OC1	31.80	322	8.7	22.1	30.8	32	8.8	22.7	30.8
OC2	11.10	142	9.1	22.6	32.1	27	10.4	23.4	32.1
OC3	16.60	179	9.3	22.0	31.6	30	10.1	23.0	31.6
OC4	8.27	113	10.7	22.6	32.5	28	10.8	23.3	32.5
OC5	15.20	174	7.5	21.3	32.2	28	7.8	22.4	32.2
OC6	10.00	123	8.4	23.5	32.6	31	8.6	23.0	32.6
OC7	9.10	121	8.7	22.0	32.1	32	8.8	22.6	32.1
OC8	4.10	67	8.1	21.5	31.4	30	8.5	21.7	31.4
OC9	8.00	100	9.8	22.0	32.4	30	9.8	21.5	32.4
Dissolved Oxygen (mg/L)									
OC1	31.80	322	0.1	6.1	11.0	32	4.4	7.5	11.0
OC2	11.10	142	0.0	6.1	9.9	27	4.7	8.1	9.9
OC3	16.60	179	0.0	6.6	11.0	30	4.8	8.3	11.0
OC4	8.27	113	0.9	7.0	12.2	28	5.1	8.5	12.2
OC5	15.20	174	0.6	7.1	11.0	28	4.5	8.2	10.9
OC6	10.00	123	0.7	7.1	11.5	31	4.8	8.2	11.5
OC7	9.10	121	0.4	7.3	11.1	32	4.3	8.1	11.1
OC8	4.10	67	4.0	7.9	11.4	30	4.6	8.3	11.4
OC9	8.00	100	0.0	6.9	10.5	30	4.5	8.6	10.5
Specific Conductance (mS/cm)									
OC1	31.80	322	49	70	87	32	50	72	87
OC2	11.10	142	46	74	91	27	46	73	89
OC3	16.60	179	7	66	98	30	8	68	98
OC4	8.27	113	7	72	97	28	7	74	97
OC5	15.20	174	7	72	101	28	8	72	101
OC6	10.00	112	49	84	115	29	49	82	115
OC7	9.10	121	22	70	106	32	41	70	101
OC8	4.10	67	54	91	118	30	55	91	117
OC9	8.00	91	53	81	115	28	53	79	106
pH (Standard Units)									
OC1	31.80	256	6.0	6.9	8.5	14	6.3	7.5	8.5
OC2	11.10	109	6.2	7.2	8.9	13	7.0	7.7	8.9
OC3	16.60	141	6.4	7.2	8.6	16	6.4	7.5	8.1
OC4	8.27	83	6.7	7.4	9.1	15	6.8	7.8	8.8
OC5	15.20	134	6.2	7.1	8.3	14	6.2	7.5	8.3
OC6	10.00	96	6.2	7.2	8.4	17	6.2	7.4	7.9
OC7	9.10	88	6.4	7.1	8.1	16	6.4	7.3	7.9
OC8	4.10	52	6.5	7.3	8.2	16	6.6	7.4	7.8
OC9	8.00	65	6.3	7.5	9.2	15	6.4	7.7	9.0
Secchi Depth (ft)									
OC1	31.80	6	0.7	2.7	4.9				
OC2	11.10	5	1.3	3.0	5.9				
OC3	16.60	6	1.3	2.8	5.9				
OC4	8.27	6	1.0	2.0	3.0				
OC5	15.20	6	1.0	2.0	3.0				
OC6	10.00	6	1.0	1.6	2.0				
OC7	9.10	6	1.0	1.6	2.0				
OC8	4.02	6	1.3	1.6	2.0				
OC9	7.86	5	0.7	1.7	3.0				

Table 4
Summary of Water Quality Samples Collected in Lake Oconee, 2013-2016

			OC1				OC2				OC4			
Analyte	**Units**	**Criterion**	**Number**	**Minimum**	**Average**	**Maximum**	**Number**	**Minimum**	**Average**	**Maximum**	**Number**	**Minimum**	**Average**	**Maximum**
Alkalinity	mg/L	NA	14	15	22.9	28	14	14	23.6	27	14	15	26.4	34
Ammonia as N	mg/L	NA	13	0.010	0.0508	0.14	13	0	0.0369	0.09	13	0	0.041	0.08
BOD	mg/L	NA	3	1.38	1.89	2.36	3	1.5	1.89	2.37	3	1.86	2.64	3.47
Calcium	mg/L	NA	11	3.9	4.95	6.4	11	3.8	4.85	5.7	11	4.1	5.64	6.6
Chlorophyll-a	ug/L	NA	14	1.40	7.86	16	14	4.7	11.7	19	14	4.7	18.9	40
COD	mg/L	NA	4	0	7.00	15	4	4	9.50	17	4	5	11.25	18
Fecal Coliform	Col/100mL	200	3	2	3.00	4	6	1	4.17	13	5	2	15.50	41
Hardness	mg/L	NA	9	17	20.8	25	9	17	20.8	23	9	17	22.8	26
Magnesium	mg/L	NA	11	1.6	1.93	2.3	11	1.6	1.96	2.3	11	1.7	2.15	2.6
Nitrate	mg/L	10	12	0.0324	0	0.661	12	0	0	0.462	12	0	0	0.62
Nitrite	mg/L	NA	12	0.0	0.009	0.0347	12	0	0.002	0.0174	12	0.00	0.0	0.0283
Total Hardness	mg/L CaCO3	NA	2	17	19.00	21	2	17	18.50	20	2	21	23.50	26
Total Phosphorus	mg/L	NA	14	0.010	0.029	0.06	14	0.01	0.025	0.06	14	0.02	0.051	0.09
Turbidity	NTU	NA	14	3	9.06	37	14	2.2	6.51	25	14	2.7	13.85	39

			OC7				OC8				OC9			
Analyte	**Units**	**Criterion**	**Number**	**Minimum**	**Average**	**Maximum**	**Number**	**Minimum**	**Average**	**Maximum**	**Number**	**Minimum**	**Average**	**Maximum**
Alkalinity	mg/L	NA	14	10	22.3	33	14	14	27.4	42	14	16	26.6	36
Ammonia as N	mg/L	NA	13	0	0.02846	0.05	13	0	0.035	0.08	13	0	0.041	0.12
BOD	mg/L	NA	3	1.22	2.1300	2.65	3	1.16	2.3700	3.42	3	1.97	3.3467	4.26
Calcium	mg/L	NA	11	3	4.71	6.3	11	4.3	6.55	8.6	11	4.9	5.79	6.9
Chlorophyll-a	ug/L	NA	14	3.2	13.59	44	14	2.1	11.96	43	14	0	19.70	42
COD	mg/L	NA	4	2	7.25	19	4	5	10.75	17	4	0	6.00	20
Fecal Coliform	Col/100mL	200	6	2	19.60	58	6	2	4.00	7	5	1	15.50	46
Hardness	mg/L	NA	9	13	18.7	24	9	17	25.3	32	9	20	23.0	27
Magnesium	mg/L	NA	11	1.3	1.87	2.6	11	1.6	2.25	2.7	11	2	2.18	2.8
Nitrate	mg/L	10	12	0	0	0.718	12	0	0	0.997	12	0	0	0.631
Nitrite	mg/L	NA	12	0	0.0	0.0274	12	0	0.0	0.048	12	0	0.0	0.0209
Total Hardness	mg/L CaCO3	NA	2	19	23.00	27	2	23	26.00	29	2	22	25.50	29
Total Phosphorus	mg/L	NA	14	0.03	0.05	0.09	14	0.04	0.0679	0.12	14	0.03	0.064	0.12
Turbidity	NTU	NA	14	8.6	21.09	60	14	6.8	27.49	70	14	4.6	17.74	50

NA: No criterion available.
ND: Not detected.
Source: Georgia Power Environmental Laboratory

TABLE 5
Wallace Dam Tailrace Transect Monitoring

August 4, 2016

				Reach 1				Reach 2				Reach 3				Reach 4				Reach 5			
Hour		Operations	OCTR	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max
23:00	8/3/2016	Interim	4.44	*112*	4.21	3.93	4.37	*86*	4.18	4.05	4.40	*72*	4.21	4.05	4.35	*84*	4.26	4.08	4.38	*90*	4.12	4.05	4.23
24:00:00	8/4/2016	Interim	4.4	*120*	4.15	3.79	4.33	*72*	4.17	4.03	4.32	*80*	4.15	3.98	4.26	*93*	4.22	3.98	4.35	*104*	4.09	3.97	4.17
1:00	8/4/2016	Pumpback	4.34	*137*	4.16	4.05	4.46	*91*	4.09	4.02	4.21	*97*	4.14	4.07	4.19	*112*	4.16	4.10	4.21	*110*	4.18	4.12	4.25
2:00	8/4/2016	Pumpback	4.29	*137*	4.15	4.09	4.20	*87*	4.20	4.11	4.26	*102*	4.27	4.16	4.32	*102*	4.21	4.09	4.31	*96*	4.21	4.09	4.49
3:00	8/4/2016	Pumpback	4.37	*156*	4.21	4.10	4.32	*70*	4.25	4.10	4.39	*70*	4.25	4.10	4.43	*70*	4.29	4.15	4.46	*69*	4.39	4.28	4.48
4:00	8/4/2016	Pumpback	4.63																				
5:00	8/4/2016	Pumpback	4.48	*Hourly readings not collected during this period.*																			
6:00	8/4/2016	Pumpback	4.68																				
7:00	8/4/2016	Pumpback	4.81																				
8:00	8/4/2016	Pumpback	5																				
9:00	8/4/2016	Pumpback	5.17																				
10:00	8/4/2016	Interim	4.97																				
11:00	8/4/2016	Interim	5.28																				
12:00	8/4/2016	Interim	5.77																				
13:00	8/4/2016	Interim	6.11																				
14:00	8/4/2016	Interim	6.46	*132*	5.76	5.45	6.31	*81*	6.03	5.75	6.31	*73*	6.09	5.80	6.31	*82*	6.00	5.78	6.29	*82*	6.06	5.82	6.32
15:00	8/4/2016	Generation	6.57	*124*	5.32	4.89	6.19	*82*	6.03	5.47	6.49	*87*	5.96	5.54	6.72	*109*	6.34	5.69	6.70	*87*	5.91	5.34	6.53
16:00	8/4/2016	Generation	4.86	*133*	5.05	4.63	5.51	*73*	4.95	4.72	5.23	*82*	4.93	4.73	5.29	*73*	5.00	4.80	5.29	*92*	5.15	4.93	5.66
17:00	8/4/2016	Generation	4.51	*140*	4.24	3.94	4.96	*64*	4.25	3.95	4.48	*76*	4.27	4.05	4.57	*89*	4.33	4.11	4.61	*83*	4.36	4.15	4.66
18:00	8/4/2016	Generation	4.5	*138*	4.27	3.80	5.13	*73*	4.24	3.80	4.56	*73*	4.17	3.81	4.54	*81*	4.23	3.82	4.52	*86*	4.21	3.82	4.50
19:00	8/4/2016	Generation	4.67	*127*	4.34	3.78	4.82	*58*	4.35	3.83	4.60	*85*	4.31	3.91	4.59	*84*	4.41	3.88	4.59	*85*	4.32	3.88	4.57
20:00		Generation	4.59																				
21:00		Generation	4.93	*Hourly readings not collected during this period.*																			
22:00		Generation	5.11																				

August 25, 2016

				Reach 1				Reach 2				Reach 3				Reach 4				Reach 5			
Hour		Operations	OCTR	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max	*N*	Mean	Min	Max
23:00	8/24/2016	Interim	4.74																				
0:00	8/25/2016	Interim	4.5	*Hourly readings not collected during this period.*																			
1:00	8/25/2016	Interim	4.57																				
2:00	8/25/2016	Pumpback	4.4																				
3:00	8/25/2016	Pumpback	4.52																				
4:00	8/25/2016	Pumpback	4.99																				
5:00	8/25/2016	Pumpback	5	*196*	4.98	4.71	5.54	*102*	5.05	4.77	5.17	*102*	5.14	5.08	5.26	*107*	5.25	5.15	5.39	*35*	5.35	5.22	5.44
6:00	8/25/2016	Pumpback	5.05	*152*	5.17	5.06	5.65	*90*	5.26	5.07	5.42	*103*	5.46	5.27	5.64	*97*	5.59	5.40	5.73	*66*	5.70	5.46	5.82
7:00	8/25/2016	Pumpback	4.79	*115*	5.34	5.20	5.50	*78*	5.40	5.09	5.58	*75*	5.49	5.16	5.69	*89*	5.60	5.29	5.73	*91*	5.69	5.49	5.83
8:00	8/25/2016	Pumpback	5.33	*115*	5.40	5.28	5.91	*72*	5.41	5.34	5.58	*73*	5.51	5.17	5.70	*83*	5.66	5.57	5.73	*93*	5.69	5.52	5.83
9:00	8/25/2016	Pumpback	5.32	*104*	5.48	5.35	5.93	*62*	5.44	5.35	5.53	*69*	5.60	5.38	5.73	*67*	5.74	5.64	5.82	*85*	5.76	5.61	5.91
10:00	8/25/2016	Interim	5.52	*99*	5.62	5.48	5.99	*57*	5.58	5.45	5.67	*65*	5.72	5.56	5.90	*65*	5.88	5.76	6.01	*75*	5.99	5.88	6.07
11:00	8/25/2016	Interim	5.74	*106*	5.76	5.61	5.93	*55*	5.78	5.71	5.87	*63*	5.97	5.74	6.16	*61*	6.08	6.01	6.15	*87*	6.20	6.08	6.33
12:00	8/25/2016	Interim	5.82	*93*	5.78	5.27	6.23	*63*	5.93	5.77	6.07	*62*	5.77	5.62	5.92	*57*	5.81	5.59	6.14	*81*	5.82	5.56	6.12
13:00	8/25/2016	Generation	4.85	*108*	5.02	4.95	5.46	*52*	5.02	4.95	5.21	*63*	5.01	4.96	5.13	*54*	5.09	4.99	5.56	*88*	5.19	5.02	5.51
14:00	8/25/2016	Generation	4.89	*111*	5.25	5.15	5.66	*54*	5.16	5.14	5.20	*67*	5.13	5.09	5.16	*62*	5.08	5.05	5.12	*92*	5.08	5.04	5.14
15:00	8/25/2016	Generation	5.31																				
16:00	8/25/2016	Generation	5.71	*Hourly readings not collected during this period.*																			
17:00	8/25/2016	Generation	5.66																				
18:00	8/25/2016	Generation	5.43																				
19:00	8/25/2016	Generation	5.46																				
20:00	8/25/2016	Generation	5.16																				
21:00	8/25/2016	Generation	5.06																				
22:00	8/25/2016	Interim	5.11																				

TABLE 6

Temperature and DO in the Tailrace Area Compared to Tailrace Station OCTR

Date	Wallace Dam Operations	*Temperature (°C)*		*Dissolved Oxygen (mg/L)*	
		OCTR	**Average for transects**	**OCTR**	**Average for transects**
7/22/2015	Generating	30.0	30.0	3.6	3.3
11/16/2015	Interim	18.3	18.7	6.9	7.2
2/18/2016	Interim	9.1	9.0	10.6	10.6
5/12/2016	Interim	21.51	21.5	6.2	6.1
5/12/2016	Generating	21.12	21.2	5.7	5.8

FIGURES

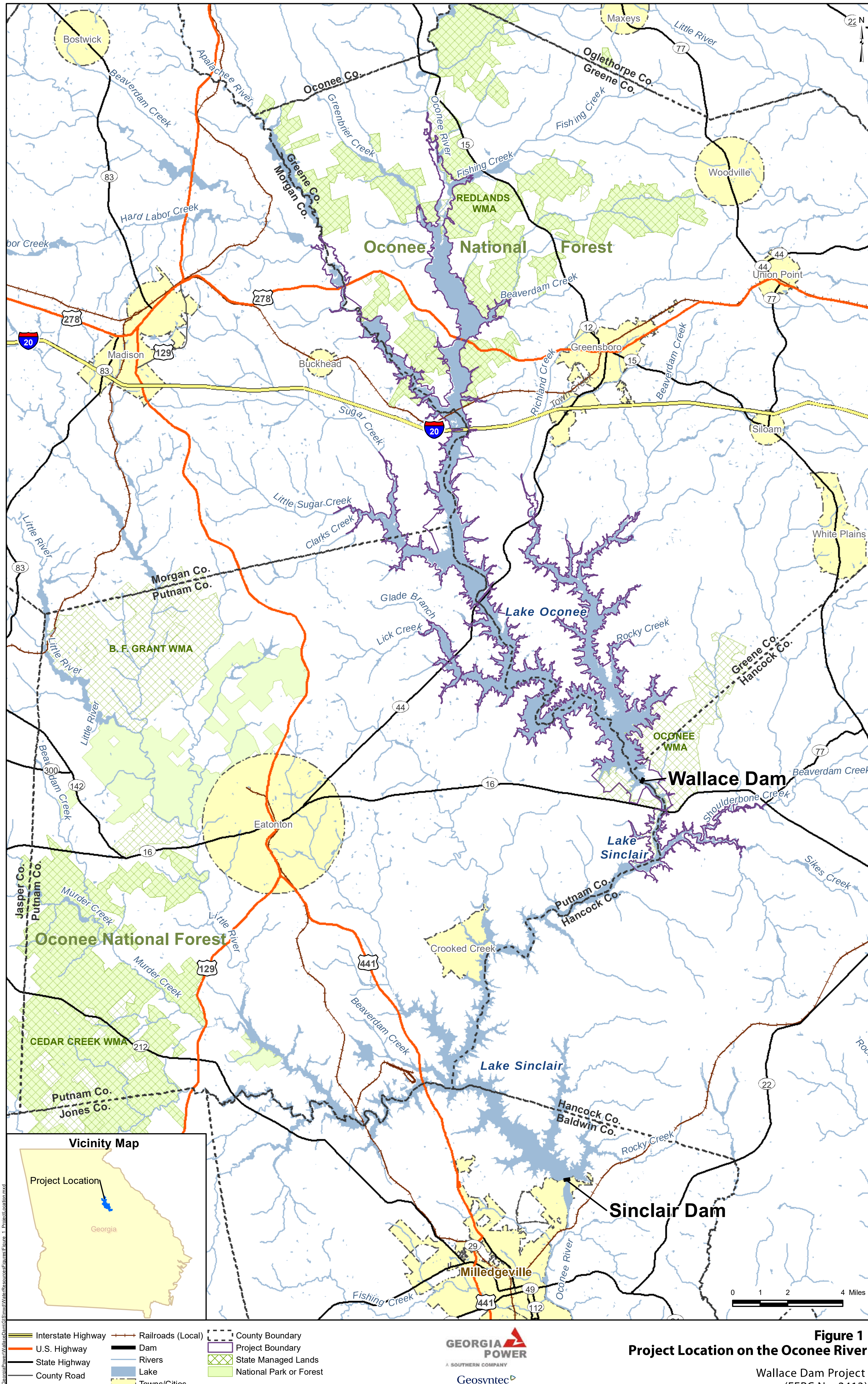

Figure 1
Project Location on the Oconee River

Wallace Dam Project
(FERC No. 2413)

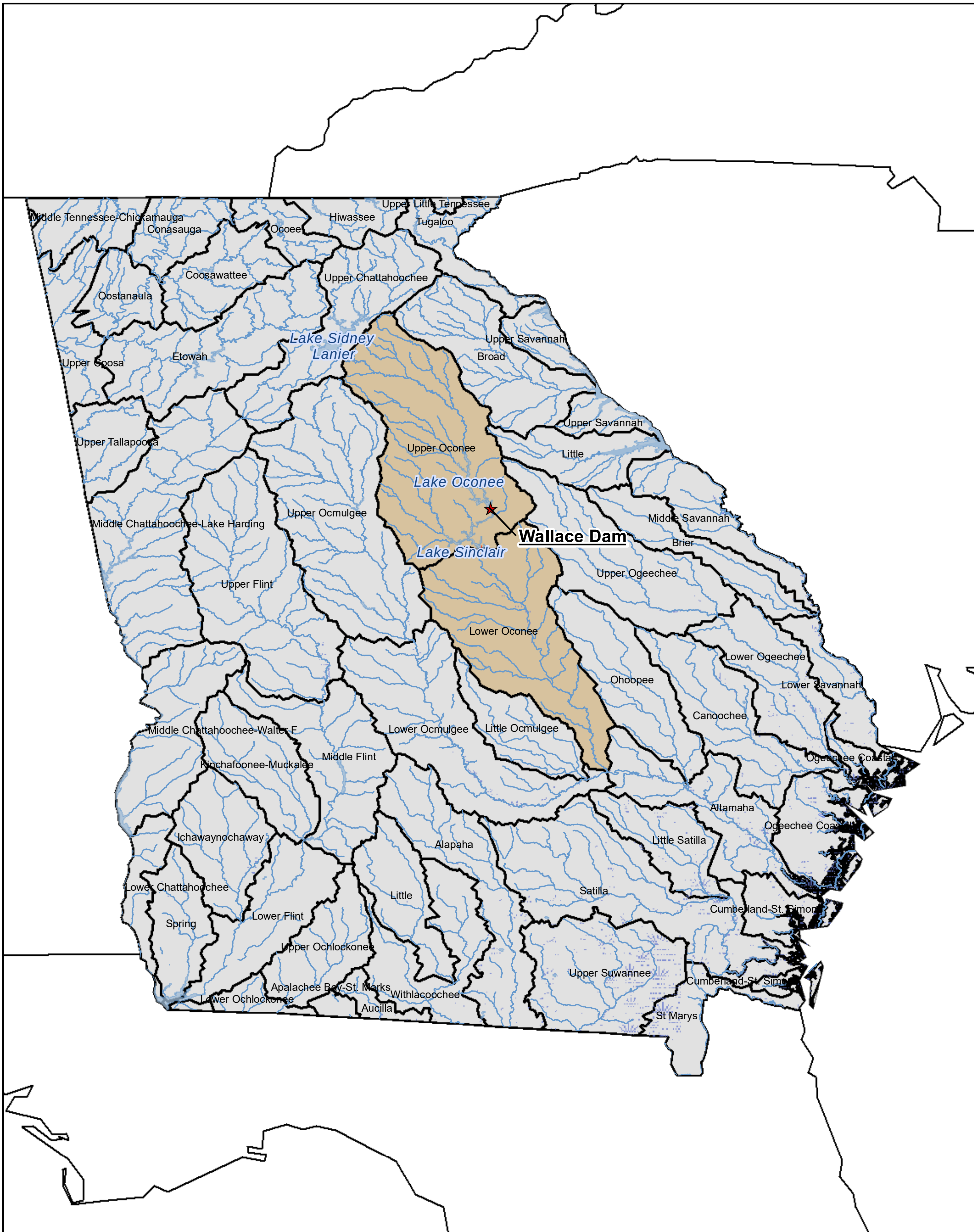

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Figure 2
Project Location in the Oconee River Basin

Wallace Dam Project
(FERC No. 2413)

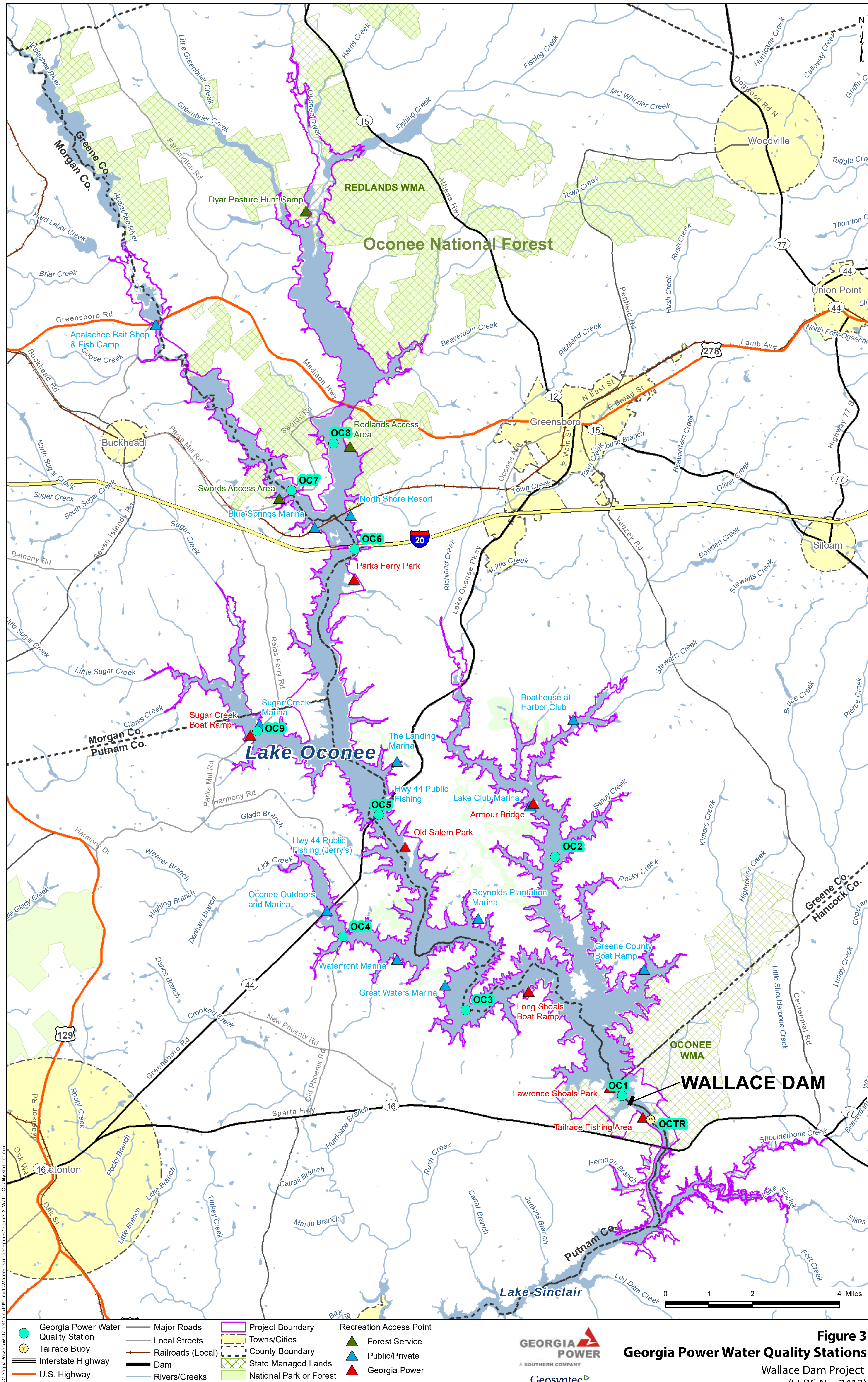
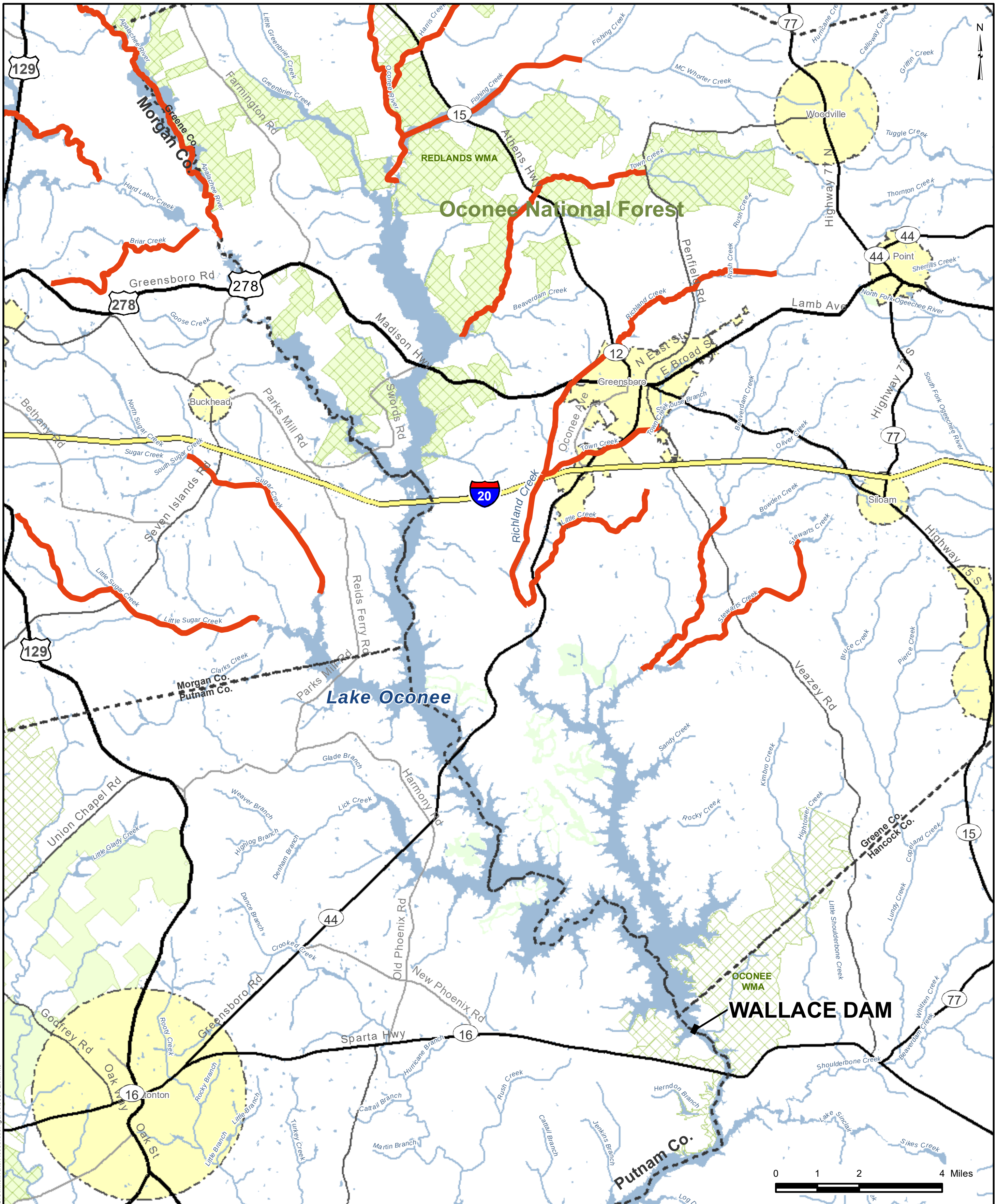


Figure 3
Georgia Power Water Quality Stations
Wallace Dam Project
(FERC No. 2413)



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\303d List.mxd

- 303(d) listed streams - 2012
- Dam
- Interstate Highway
- U.S. Highway
- State Highway
- Major Roads
- Local Streets
- Railroads (Local)
- Rivers/Creeks
- Lake
- Towns/Cities
- County Boundary
- State Managed Lands
- National Park or Forest
- Golf Course

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Figure 4

Clean Water Act Section 303(d)-listed Streams Segments

Wallace Dam Project

(FERC No. 2413)

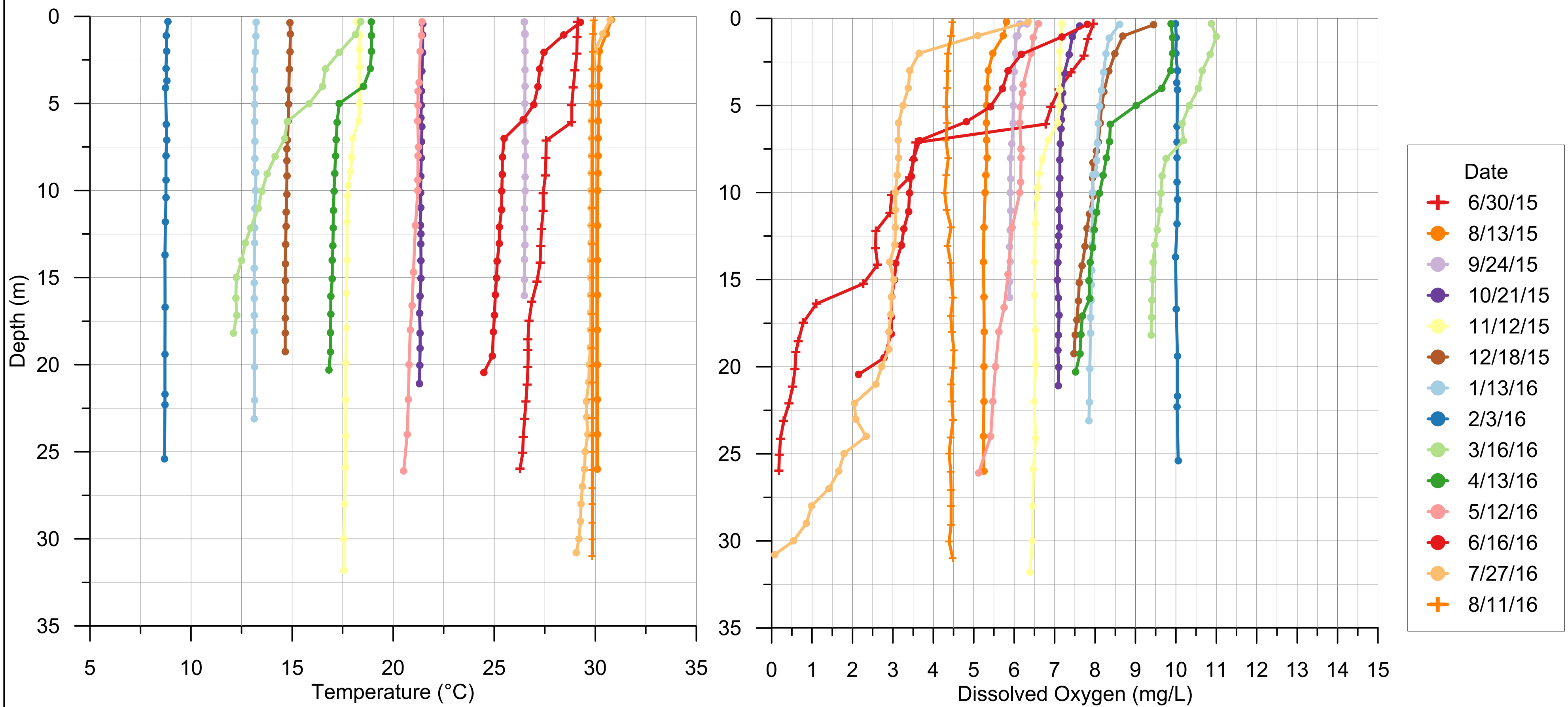

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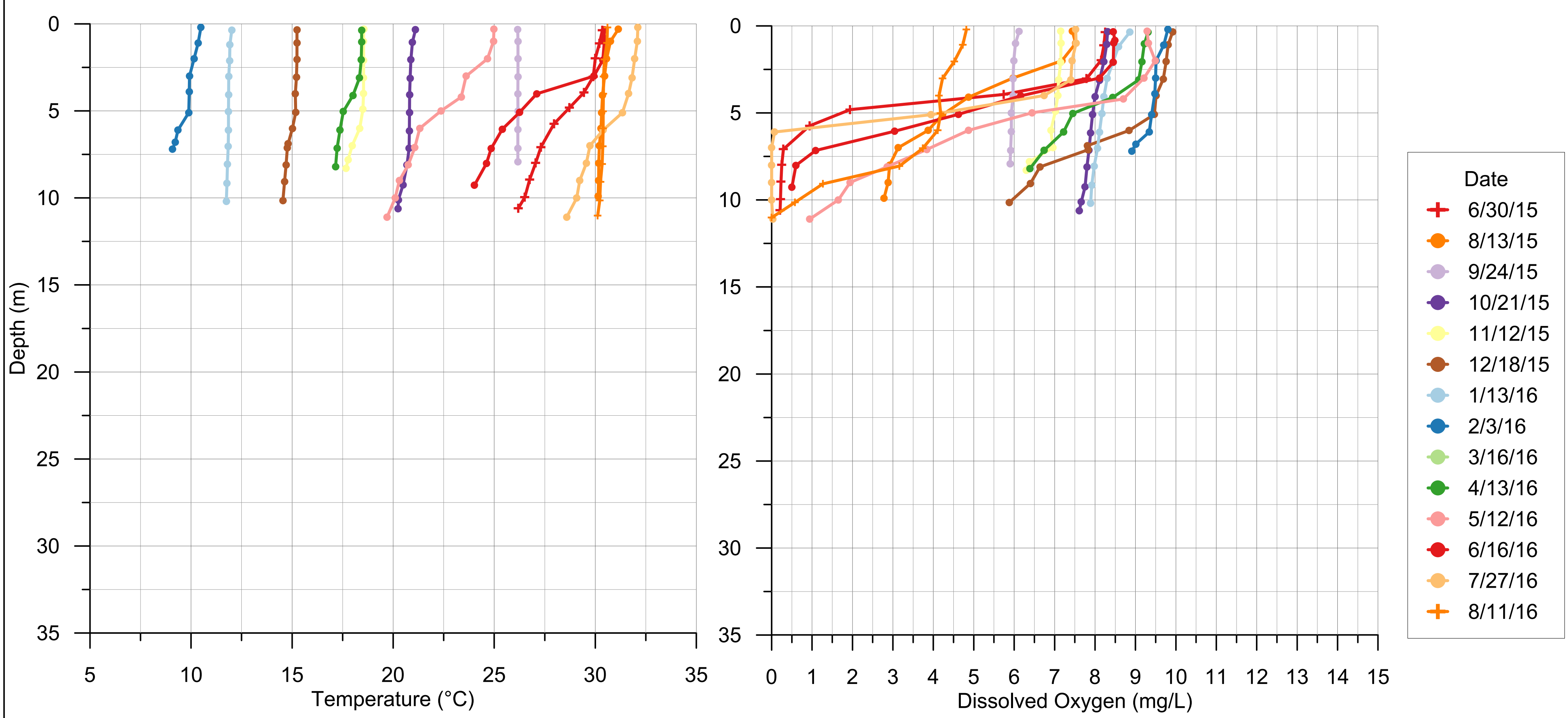
Figure 5a
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC1
Wallace Dam Project
(FERC No. 2413)



March 2016 missing for OC2.

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Figure 5b
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC2
Wallace Dam Project
(FERC No. 2413)

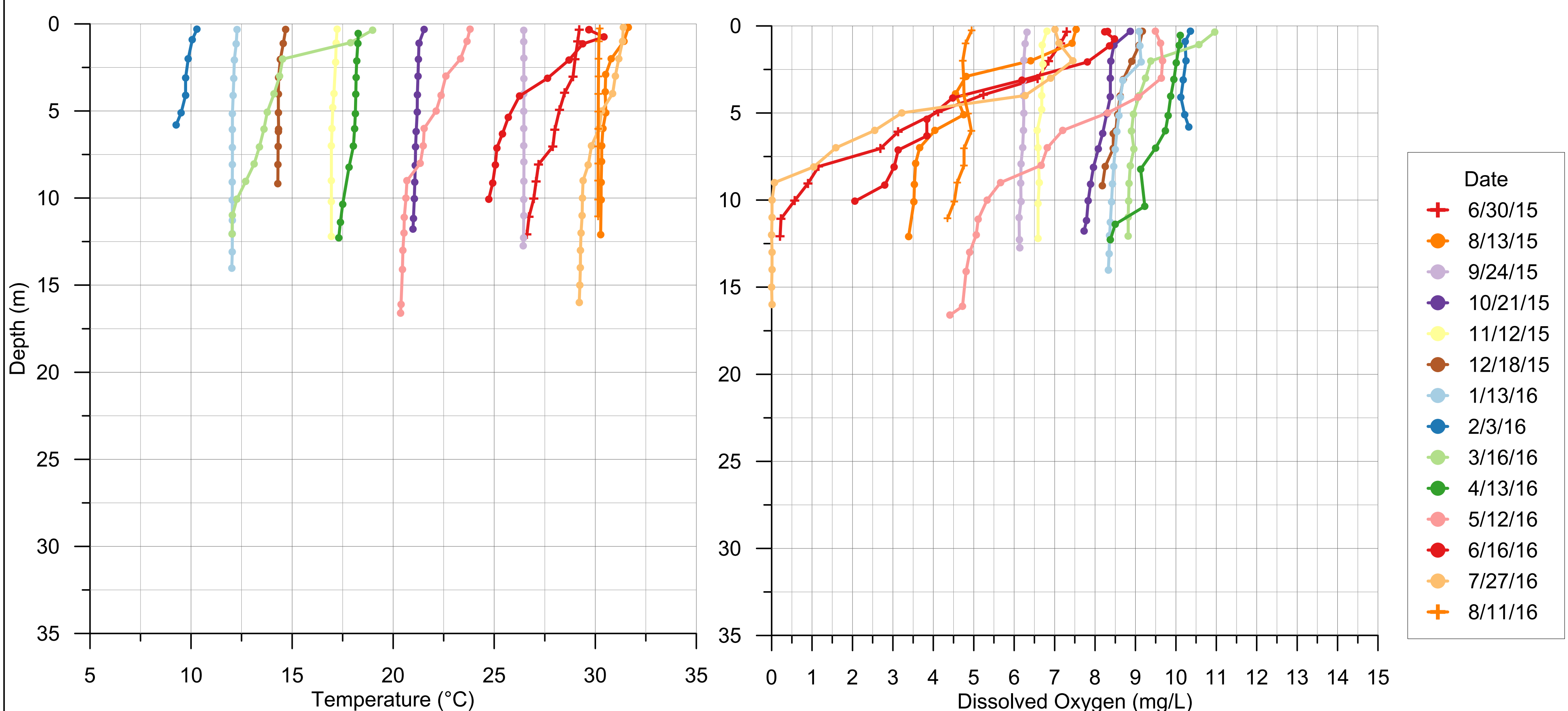

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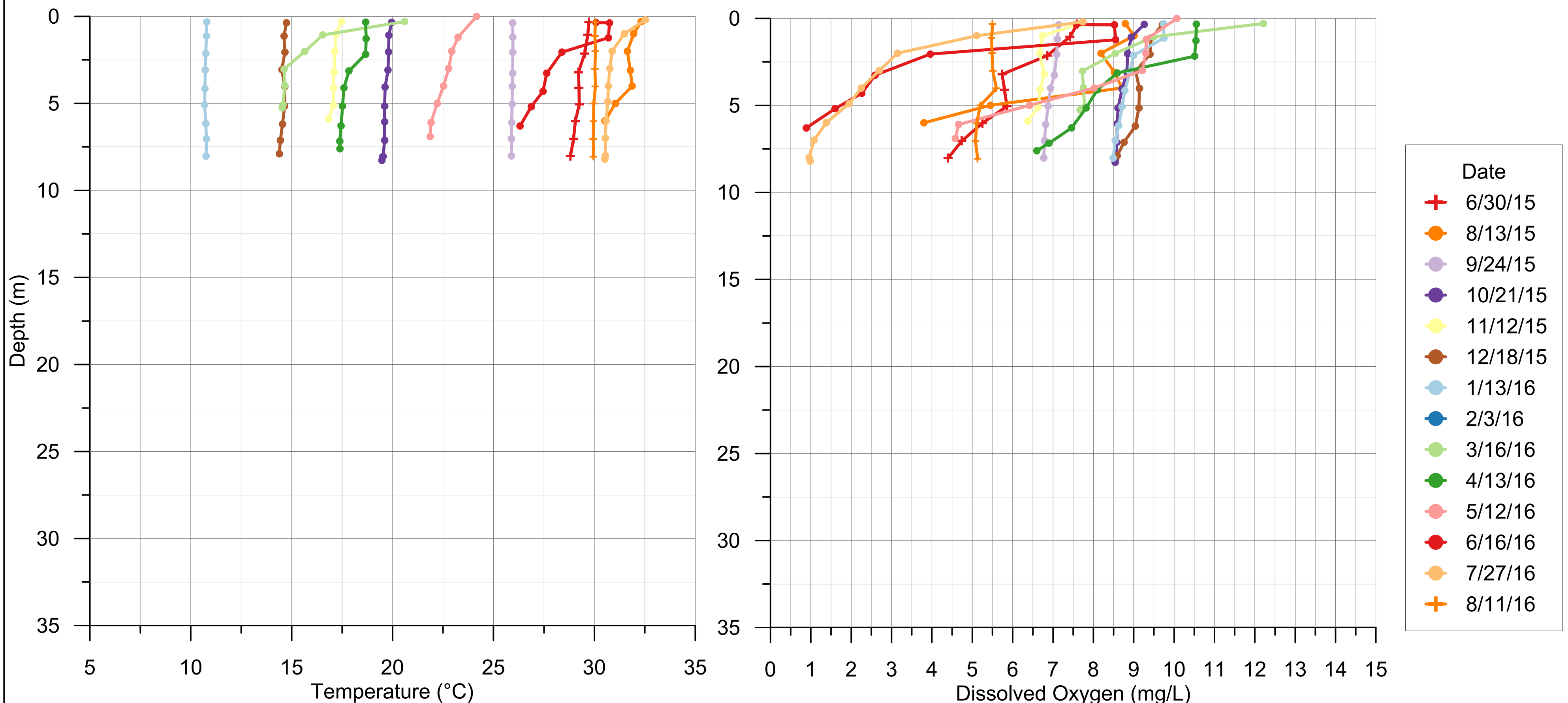
Figure 5c

Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC3

Wallace Dam Project

(FERC No. 2413)



February 2016 data is missing.

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Figure 5d
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC4
Wallace Dam Project
(FERC No. 2413)

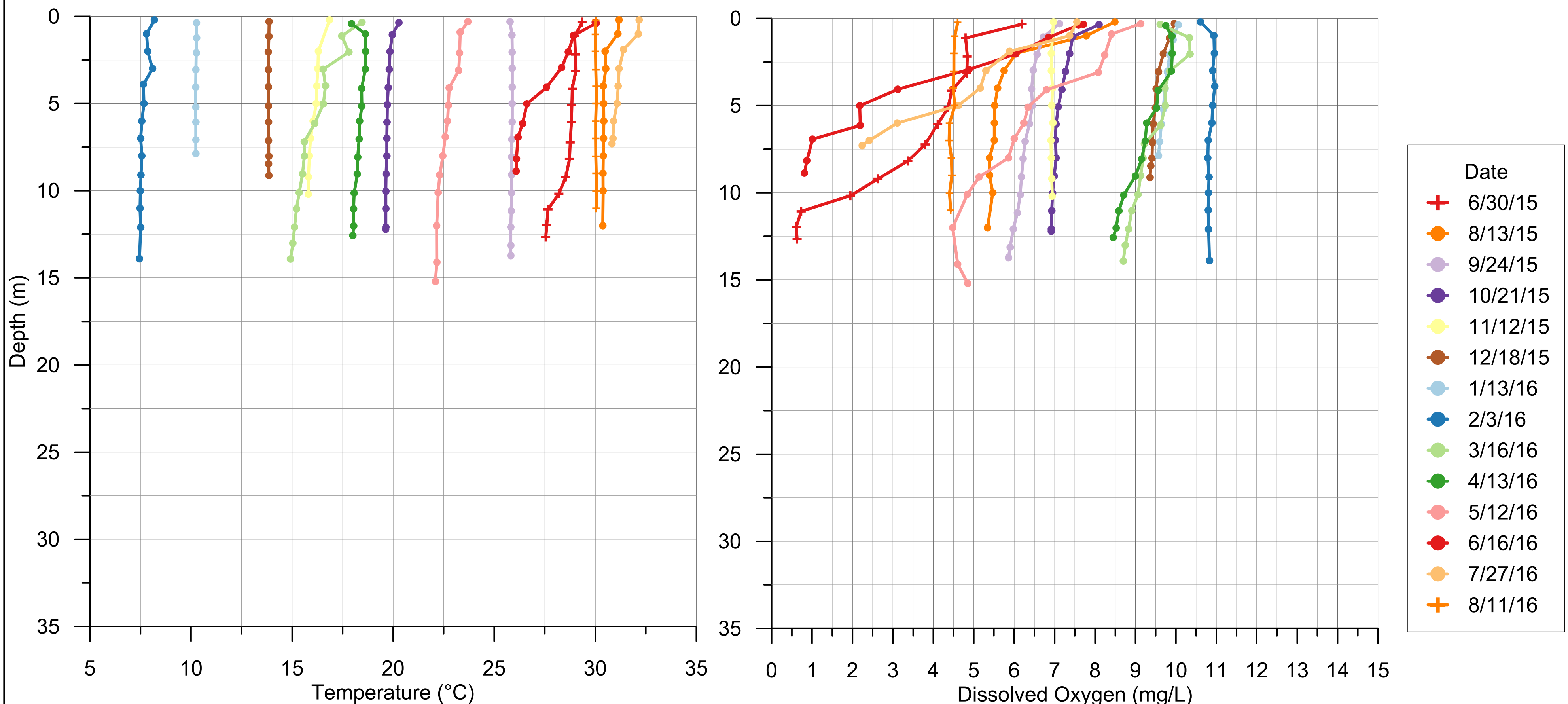

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Figure 5e
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC5
Wallace Dam Project
(FERC No. 2413)

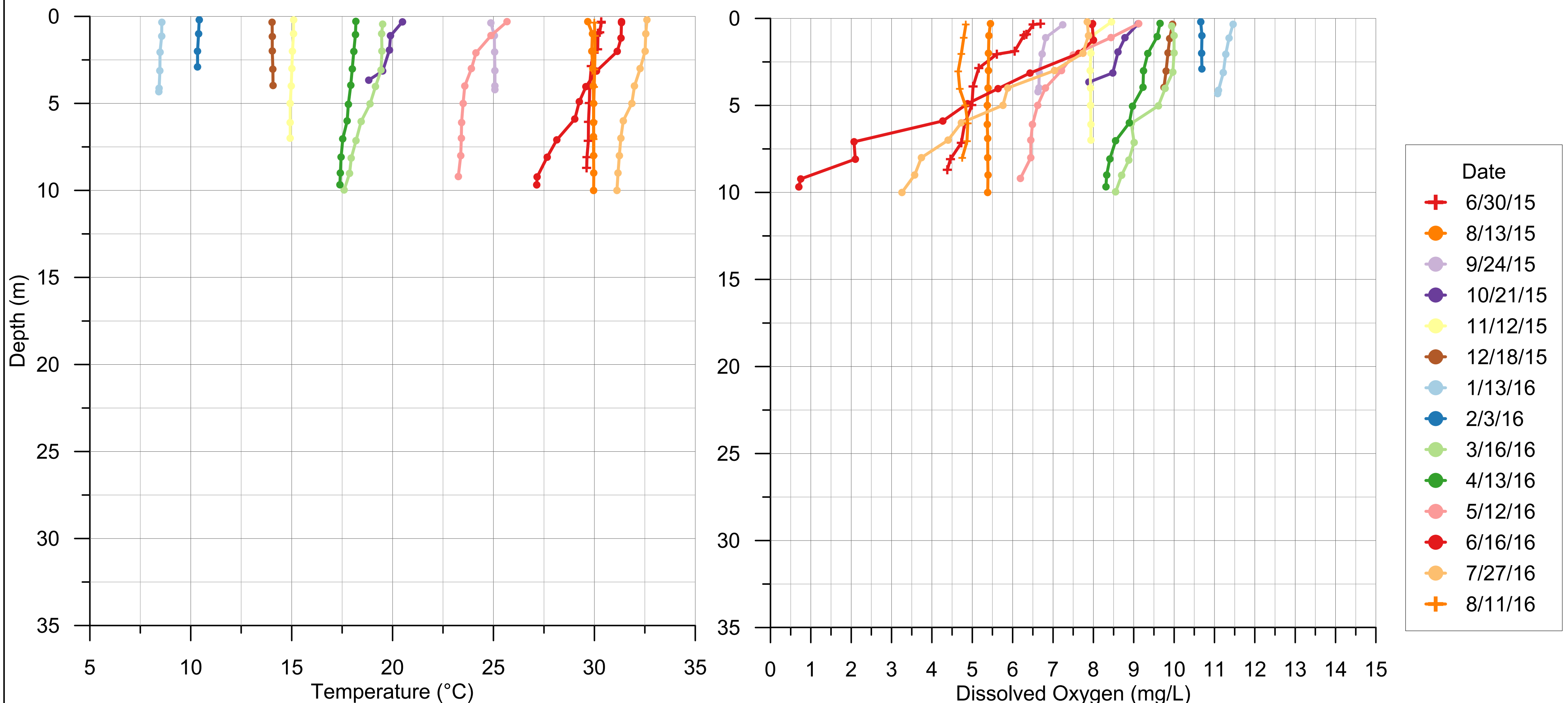

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Figure 5f
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC6
Wallace Dam Project
(FERC No. 2413)

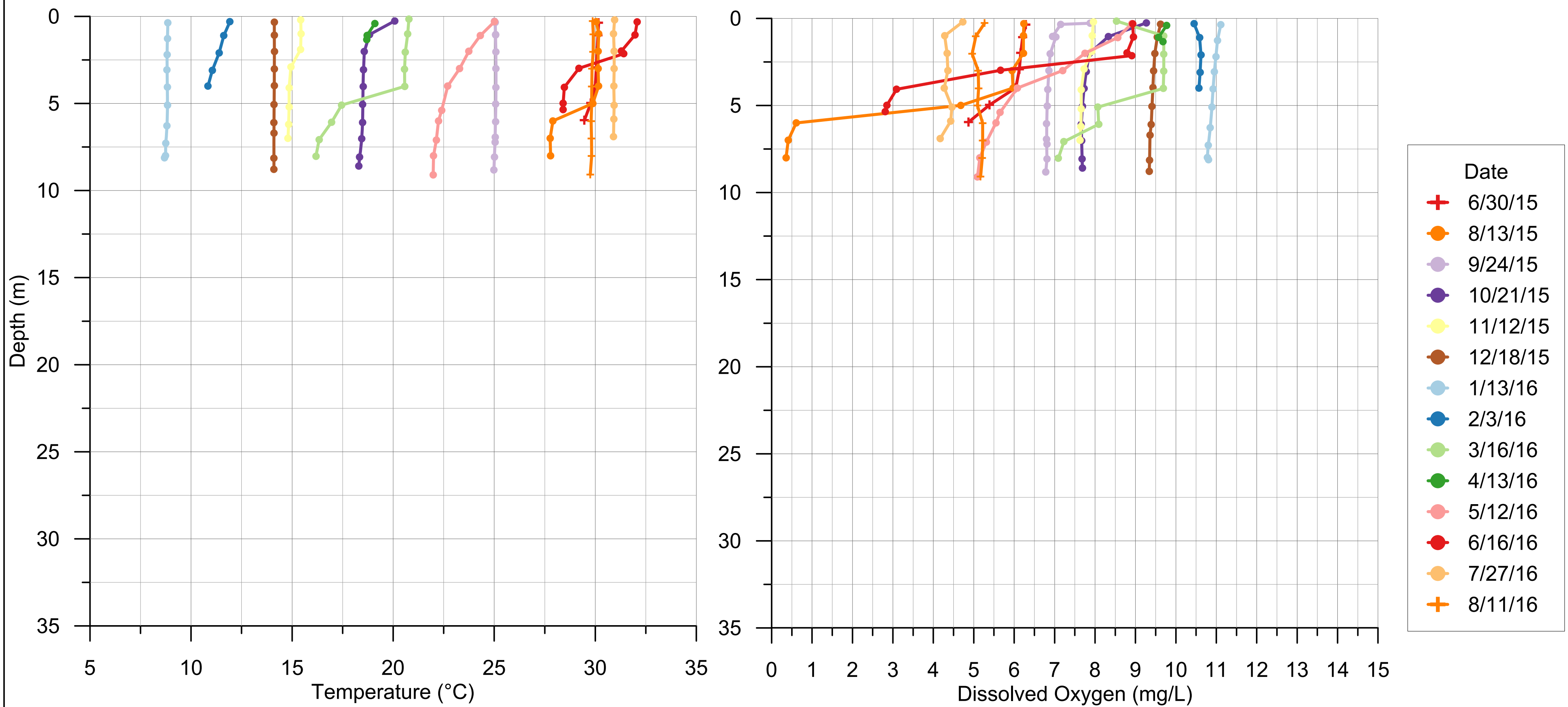

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Figure 5g

Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC7

Wallace Dam Project

(FERC No. 2413)

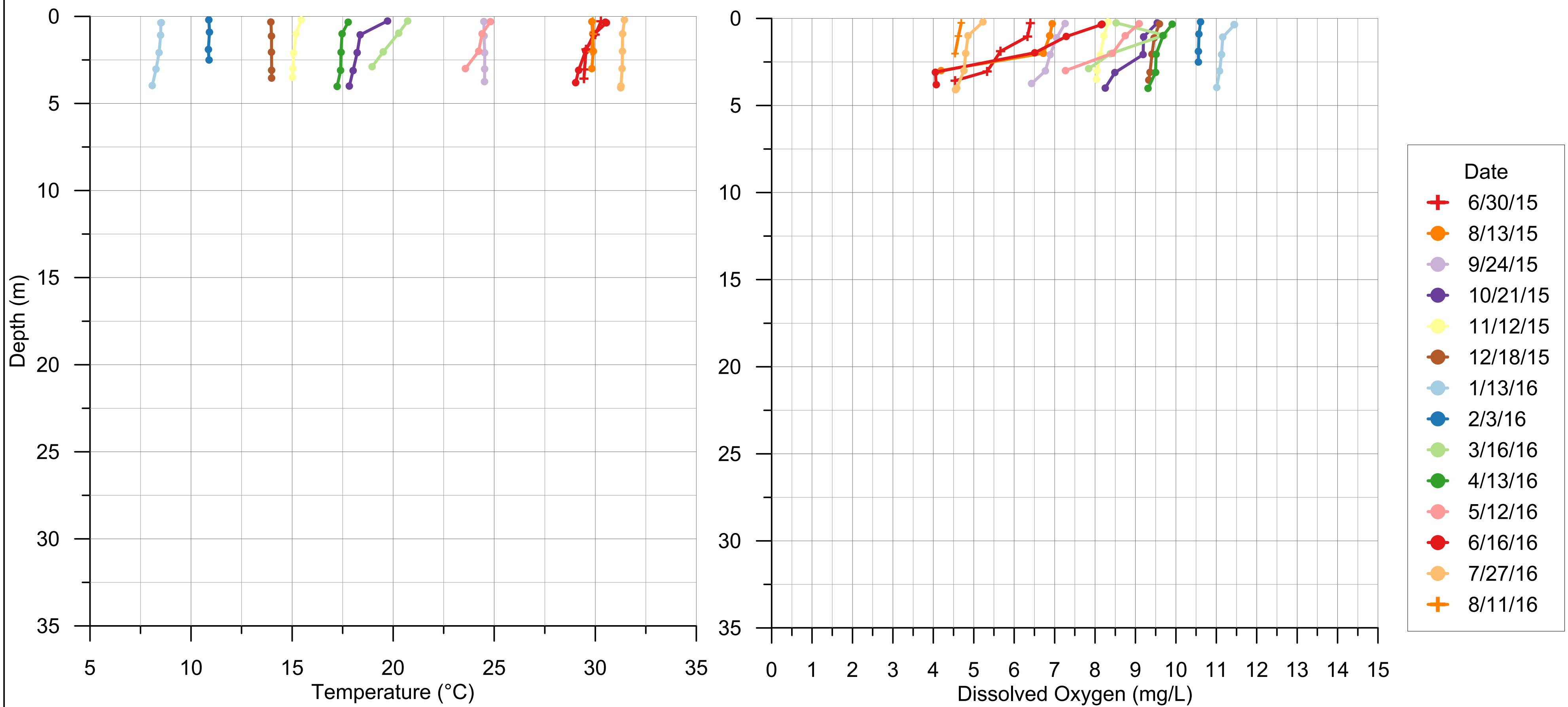

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Figure 5h
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC8
Wallace Dam Project
(FERC No. 2413)

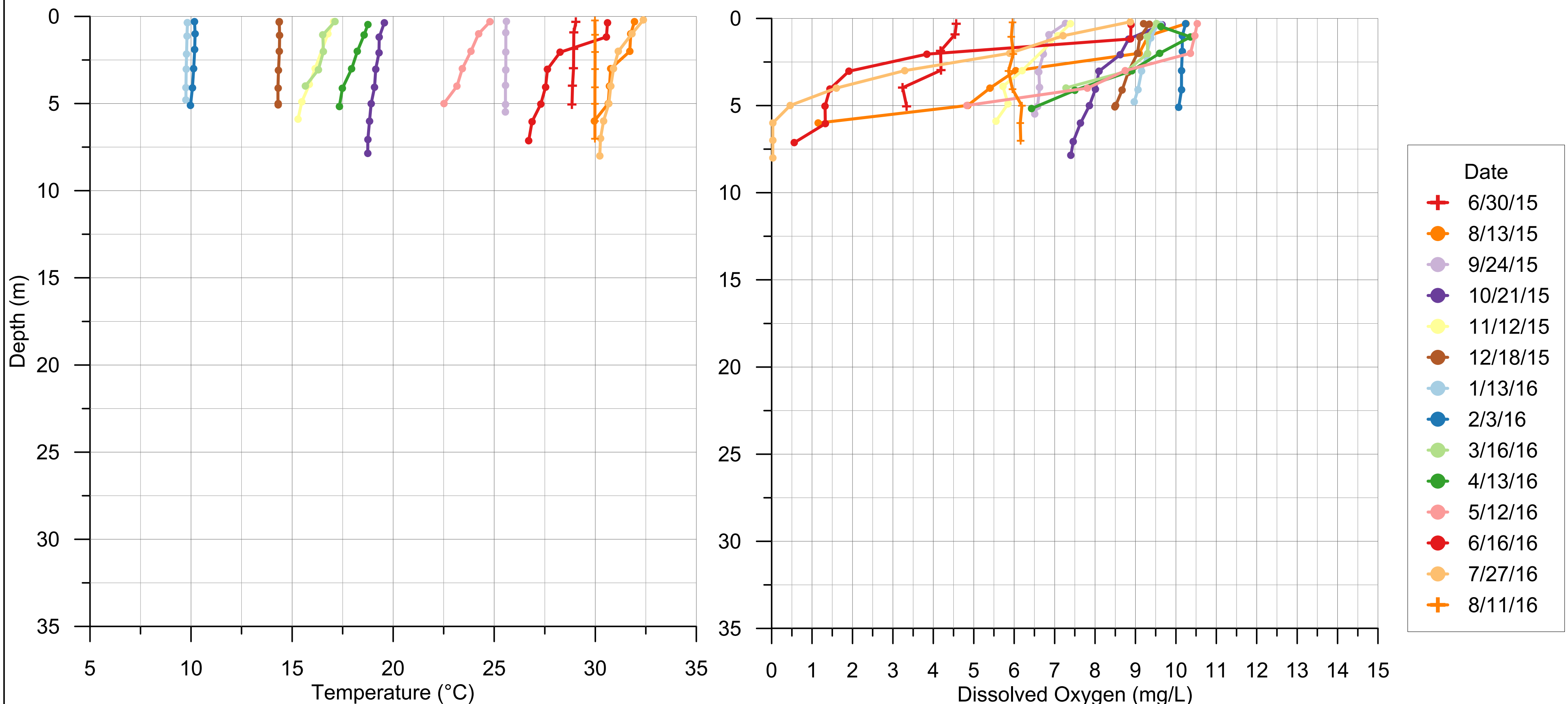

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Figure 5i
Monthly Vertical Temperature and DO Profiles at Lake Oconee Station OC9
Wallace Dam Project
(FERC No. 2413)

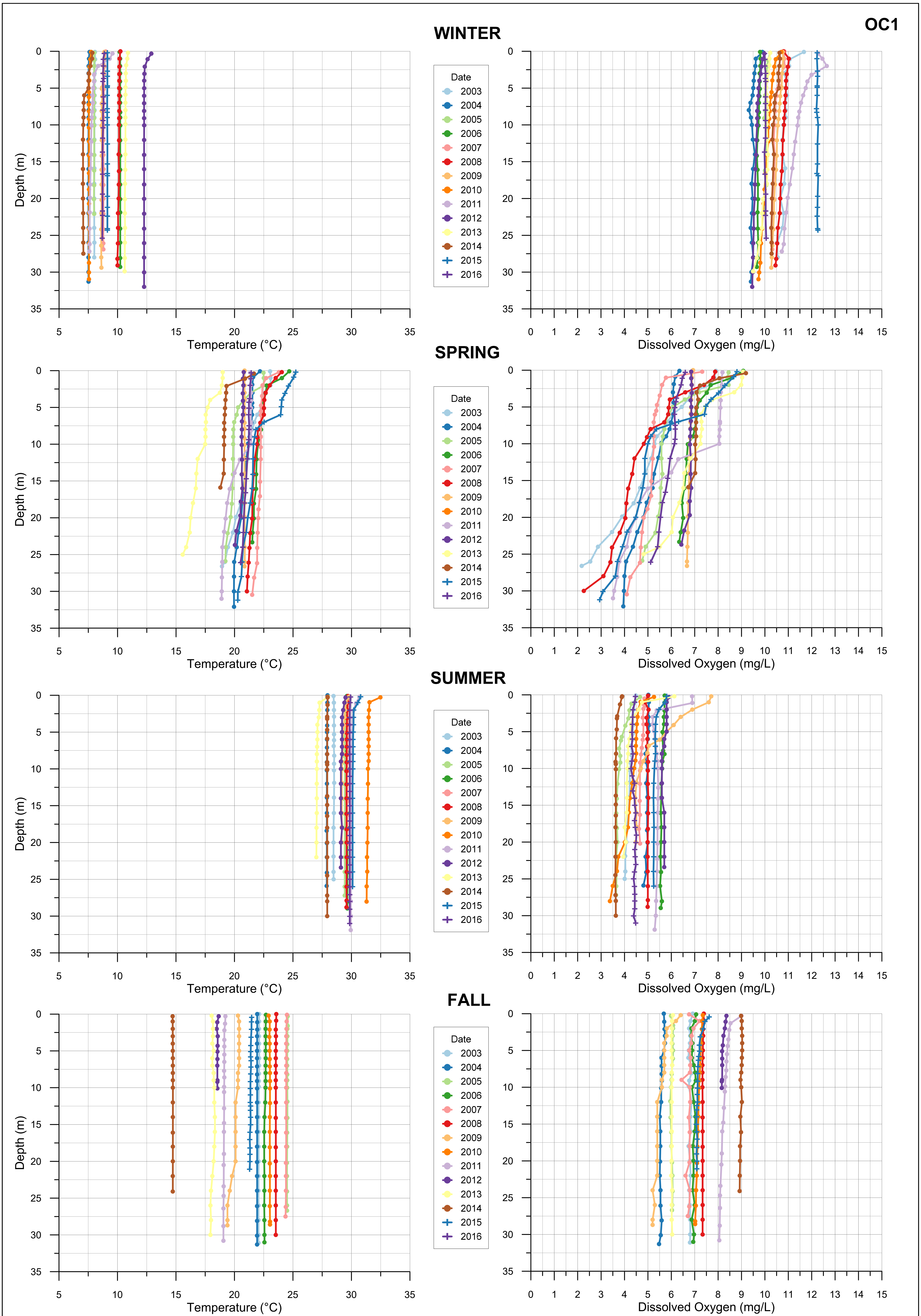

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Figure 6a
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC1 2003-2016
Wallace Dam Project
(FERC No. 2413)

OC2

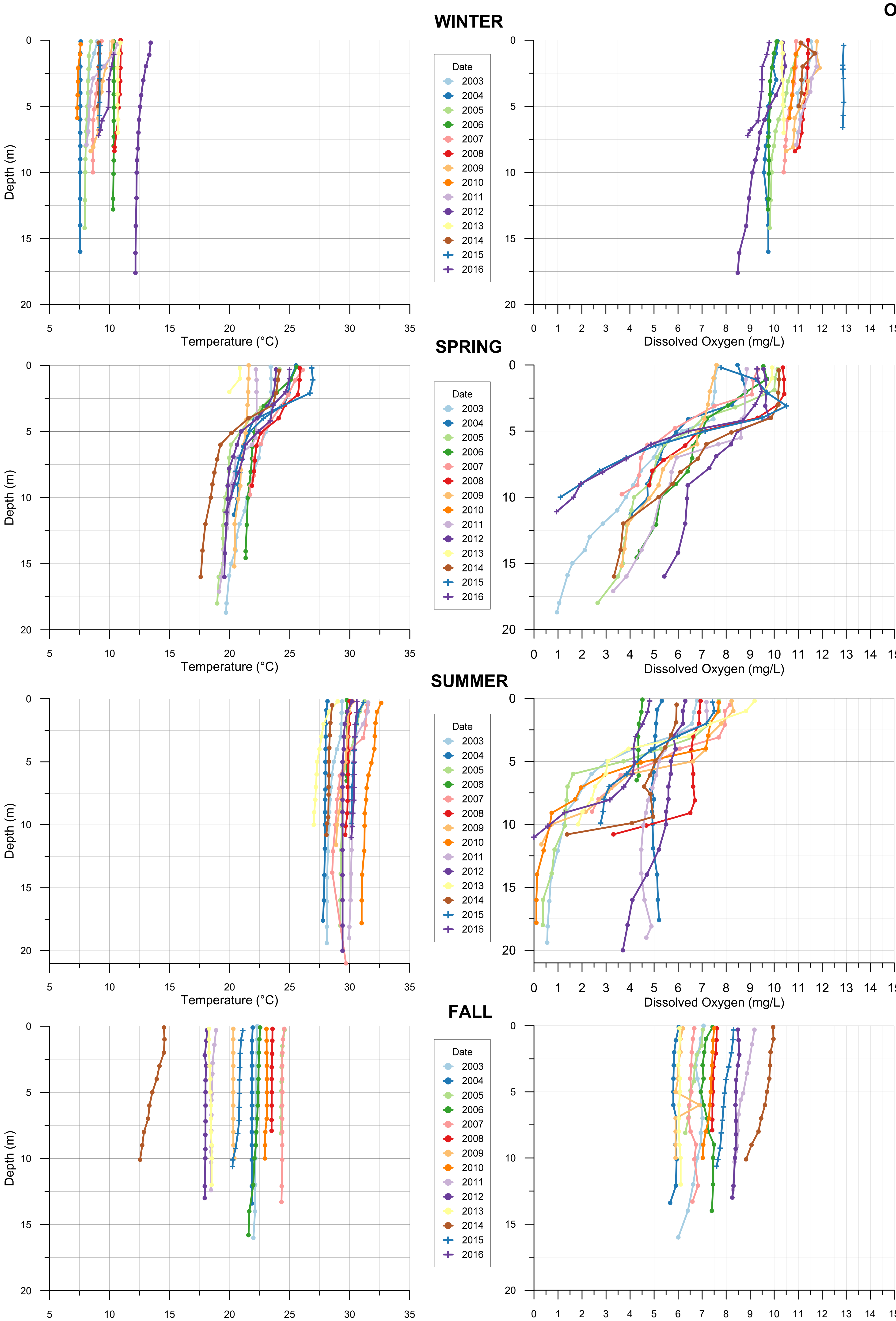

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Figure 6b
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC2 2003-2016
Wallace Dam Project
(FERC No. 2413)

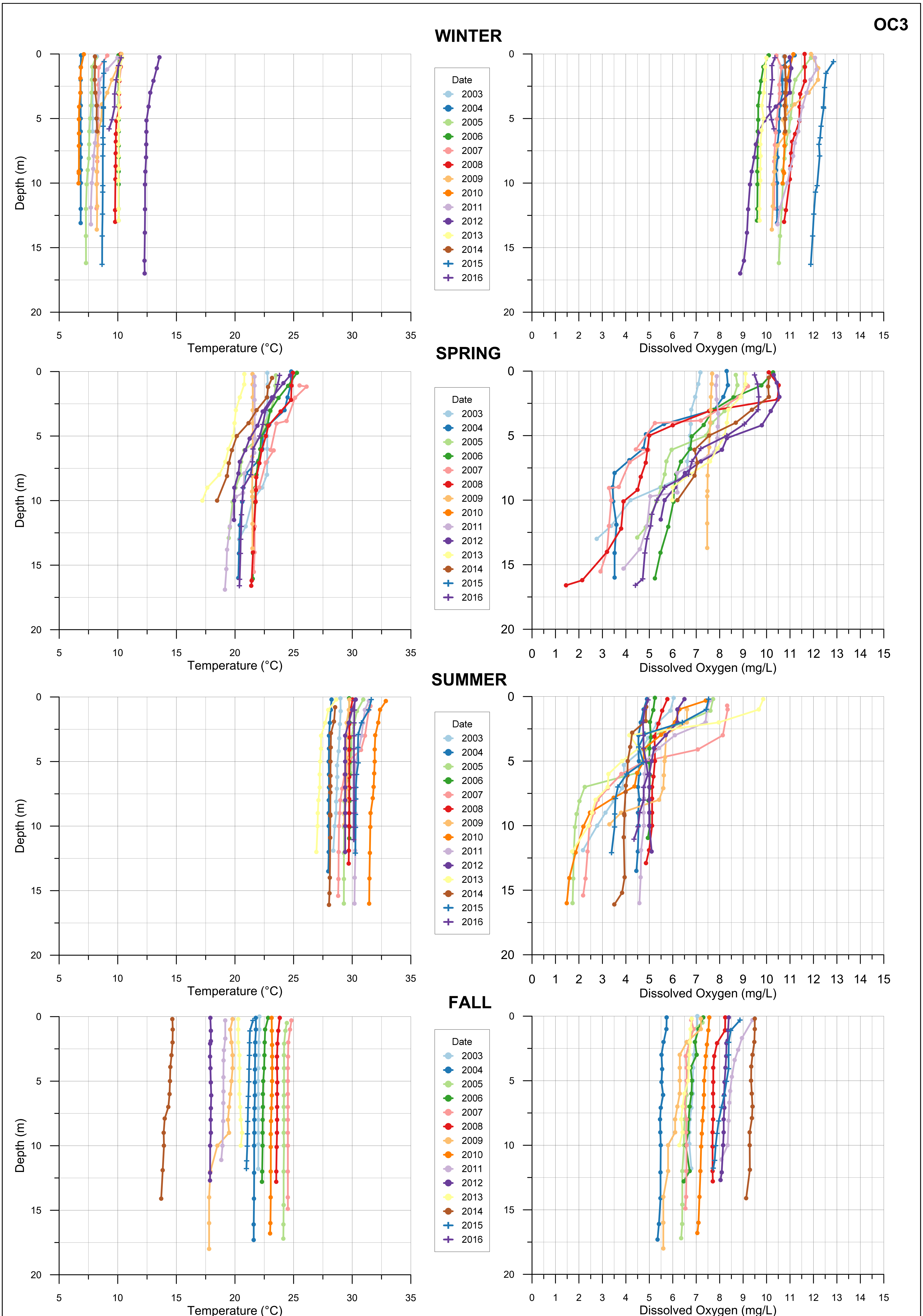

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Figure 6c
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC3 2003-2016
Wallace Dam Project
(FERC No. 2413)

OC4

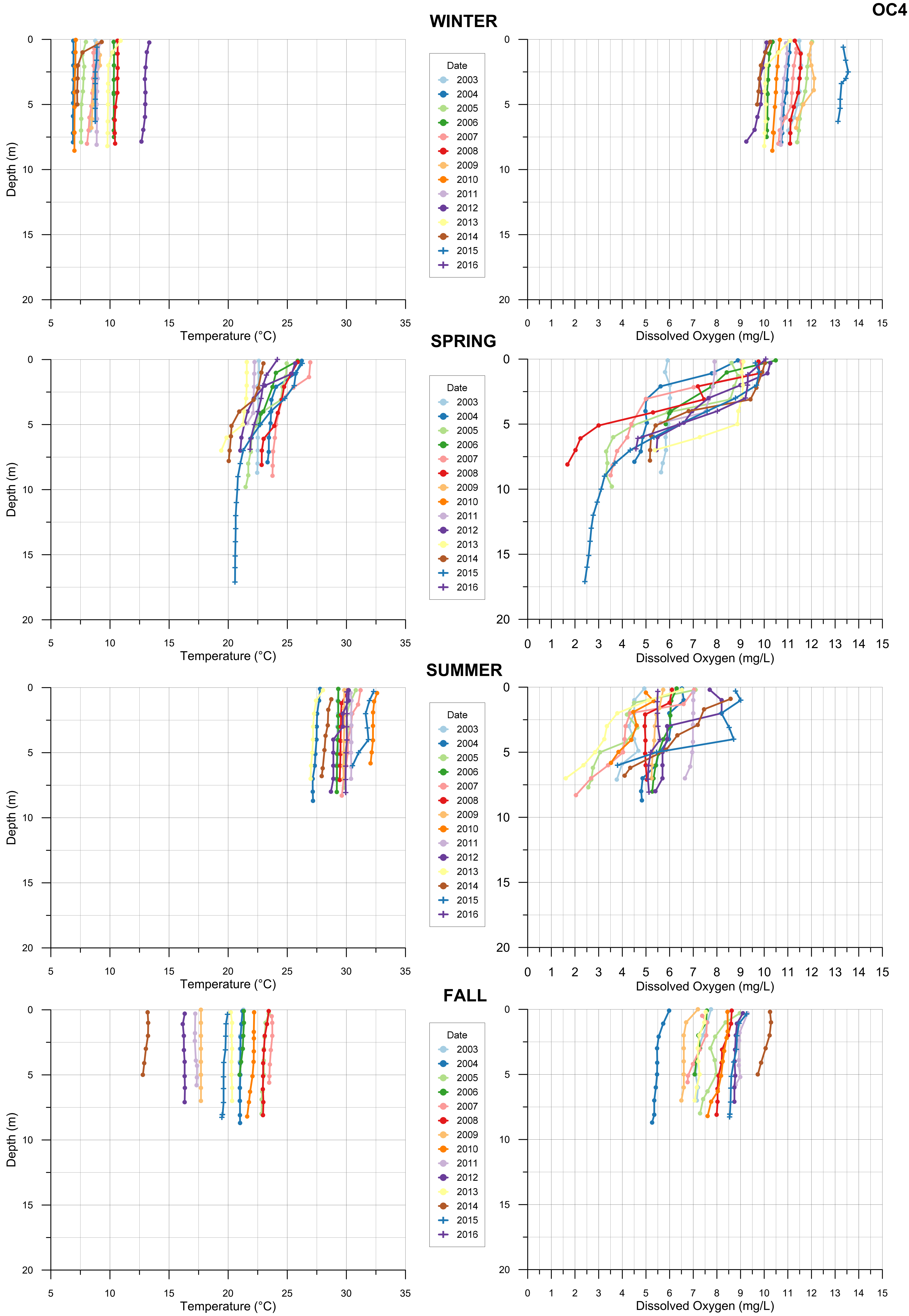

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Figure 6d
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC4 2003-2016
Wallace Dam Project
(FERC No. 2413)

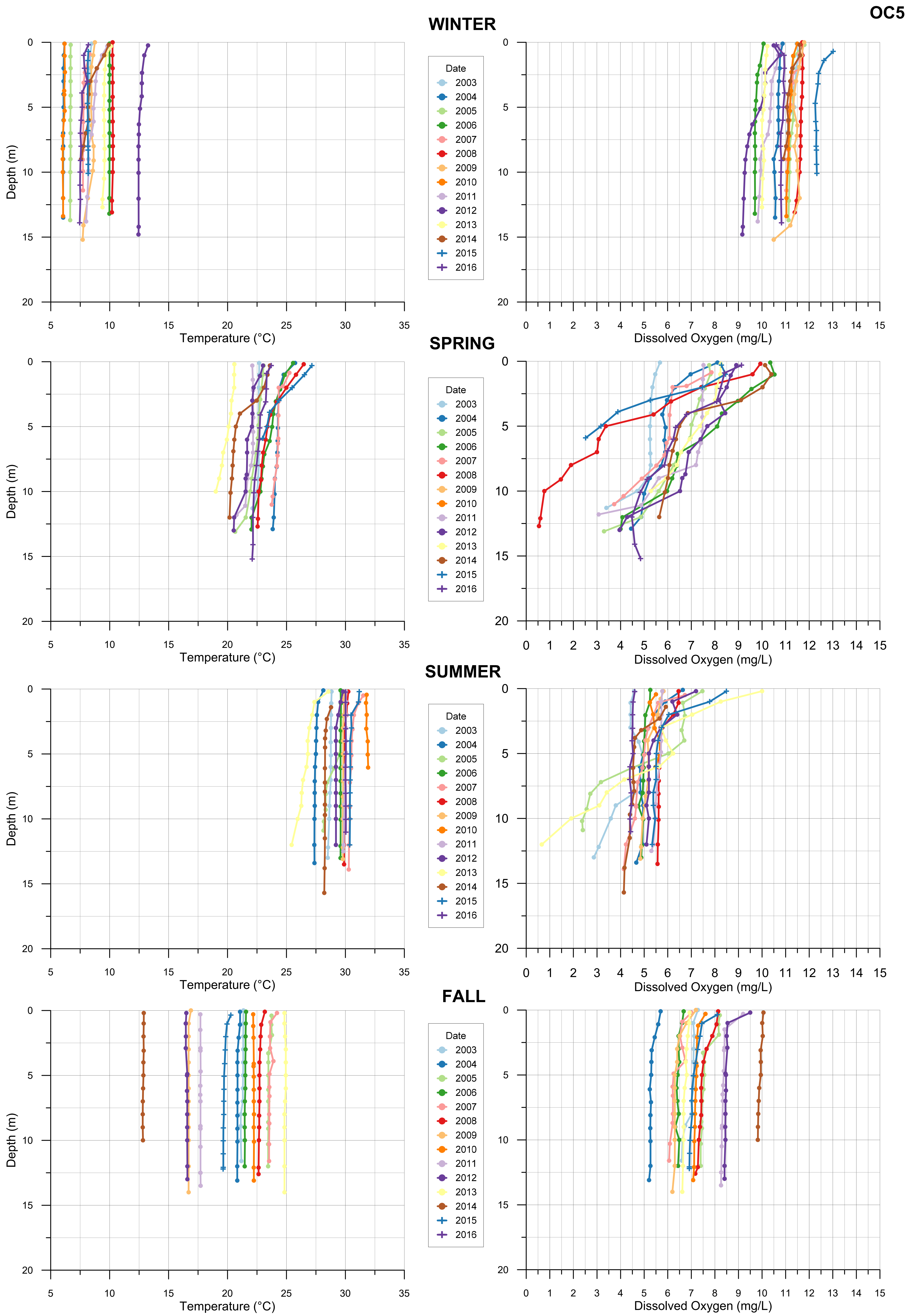

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Figure 6e
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC5 2003-2016
Wallace Dam Project
(FERC No. 2413)

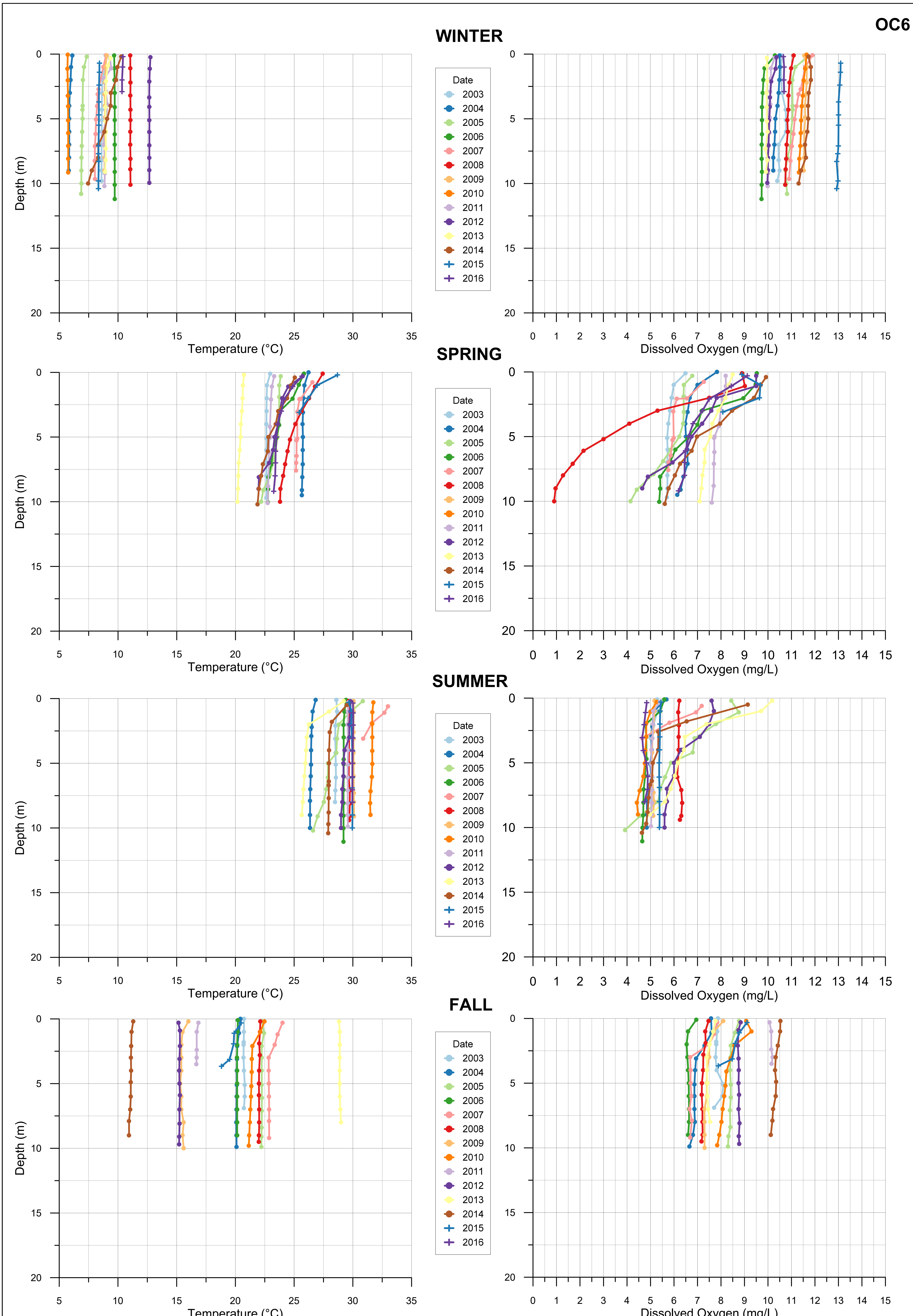

Figure 6f
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC6 2003-2016
Wallace Dam Project
(FERC No. 2413)

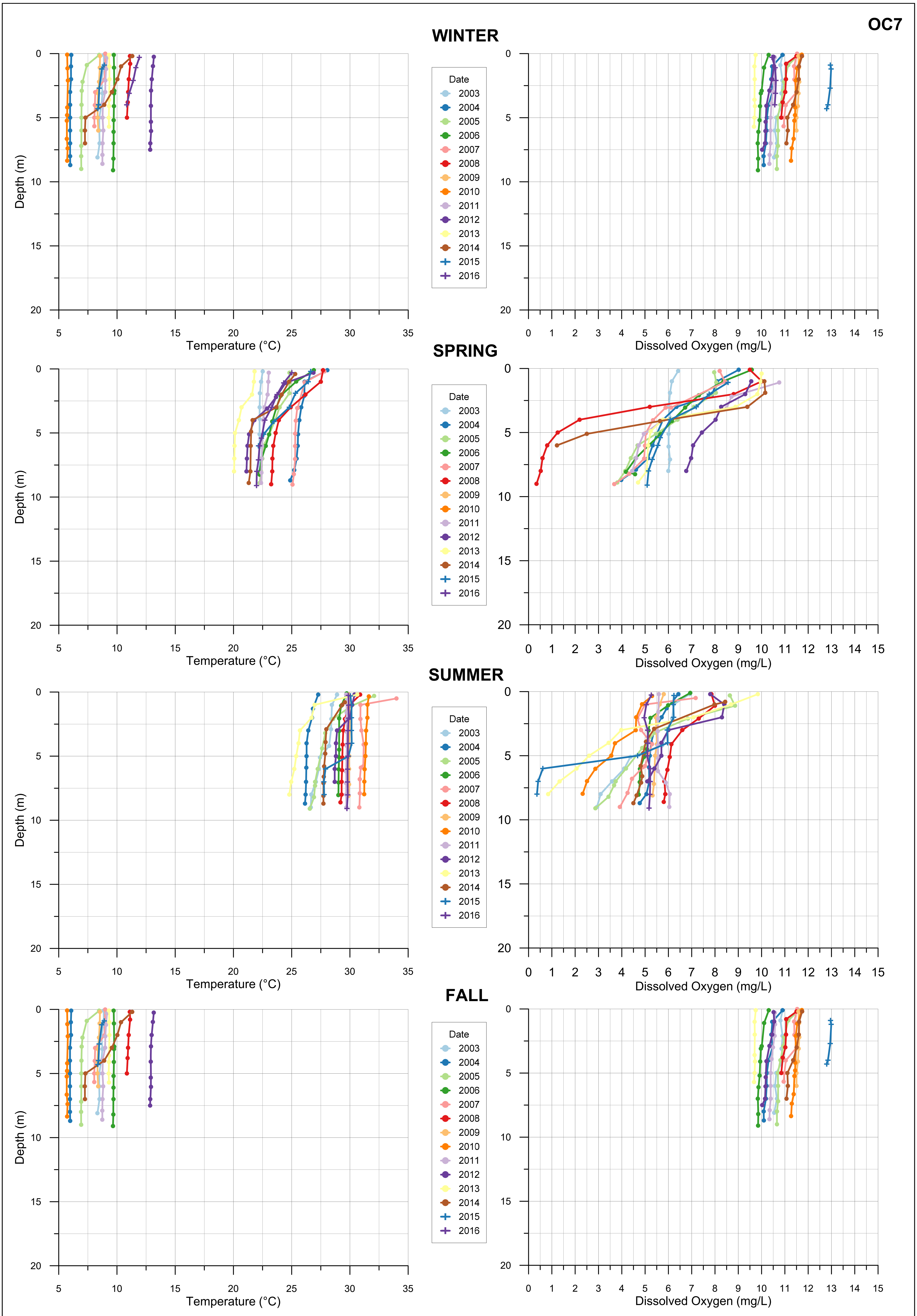

Figure 6g
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC7 2003-2016
Wallace Dam Project
(FERC No. 2413)

OC8

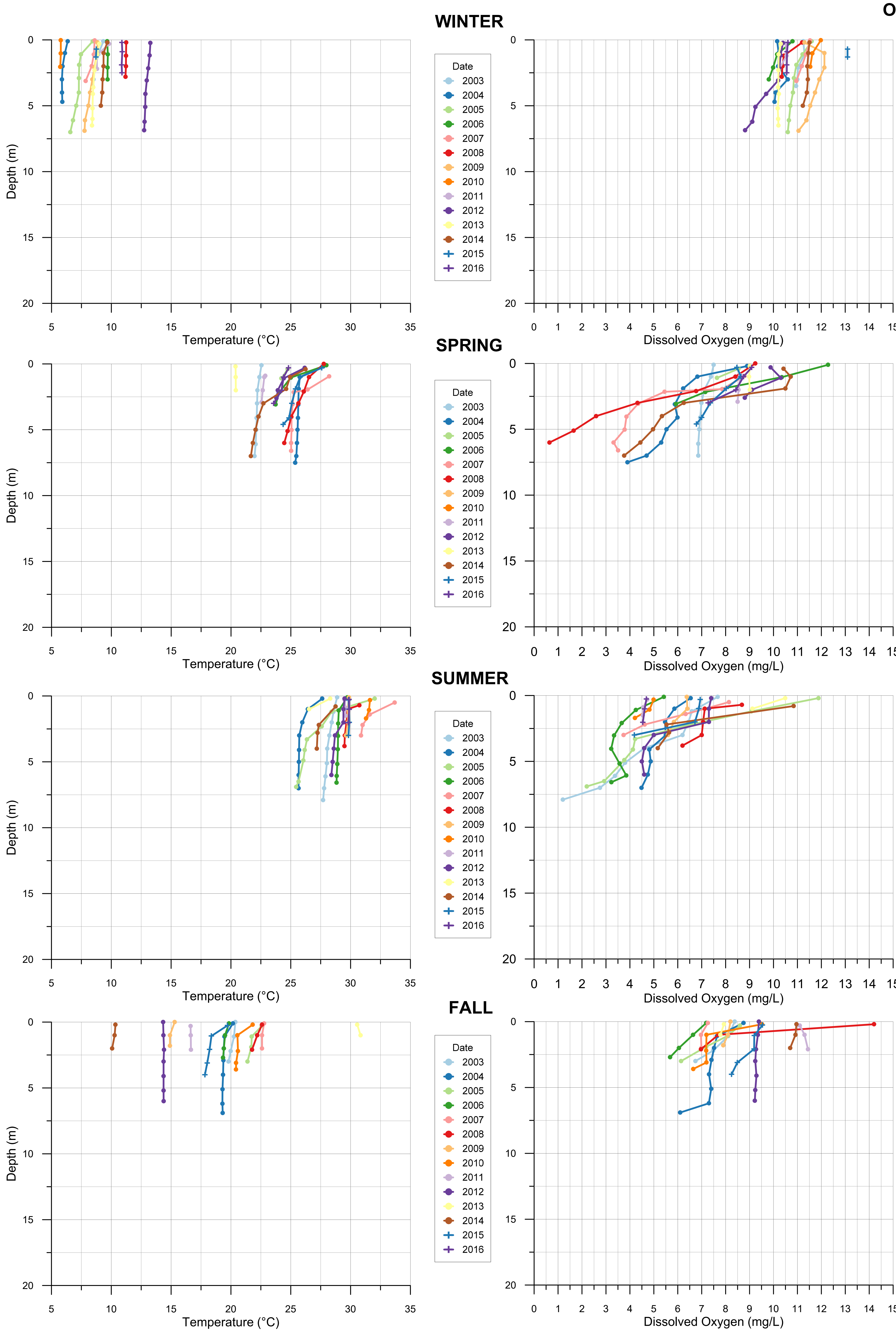

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Figure 6h
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC8 2003-2016
Wallace Dam Project
(FERC No. 2413)

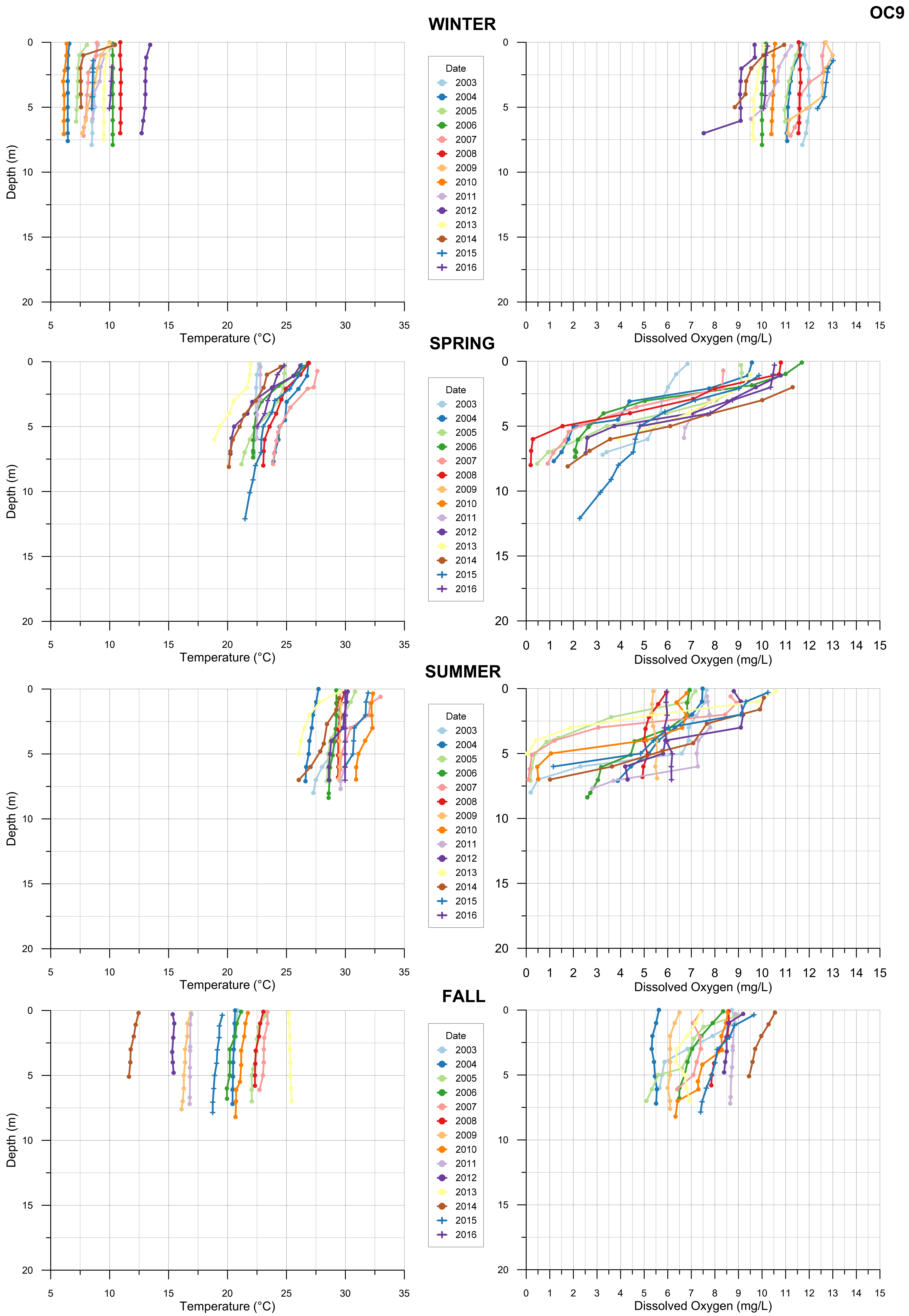

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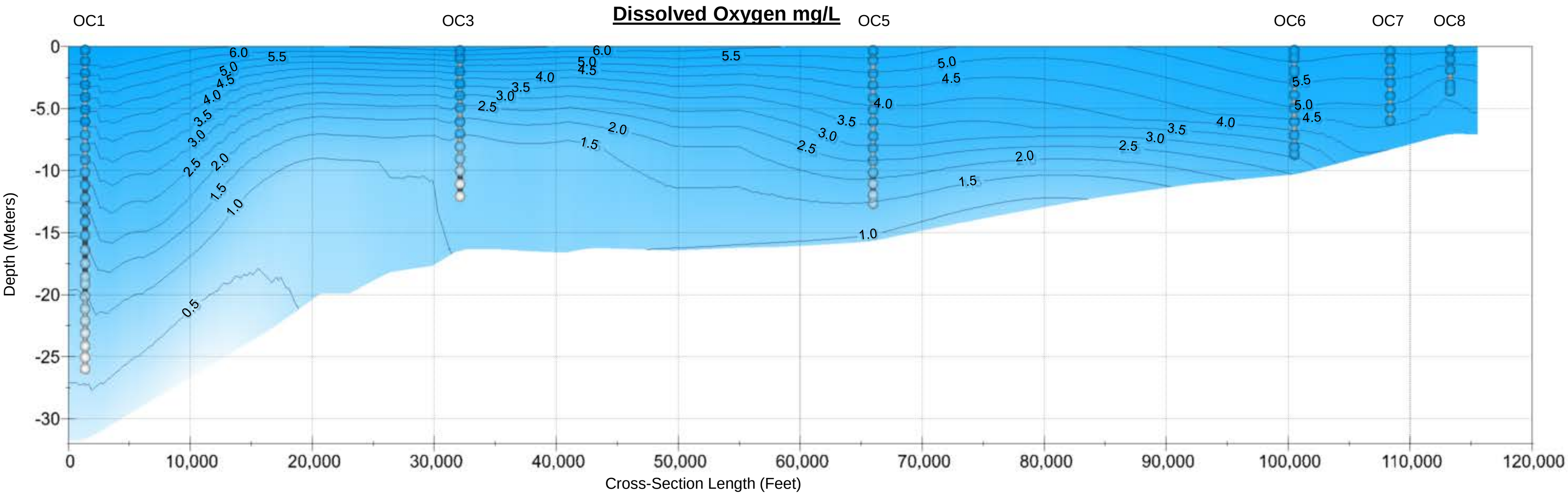
Figure 6i
Seasonal Vertical Temperature and DO Profiles at Lake Oconee
OC9 2003-2016
Wallace Dam Project
(FERC No. 2413)



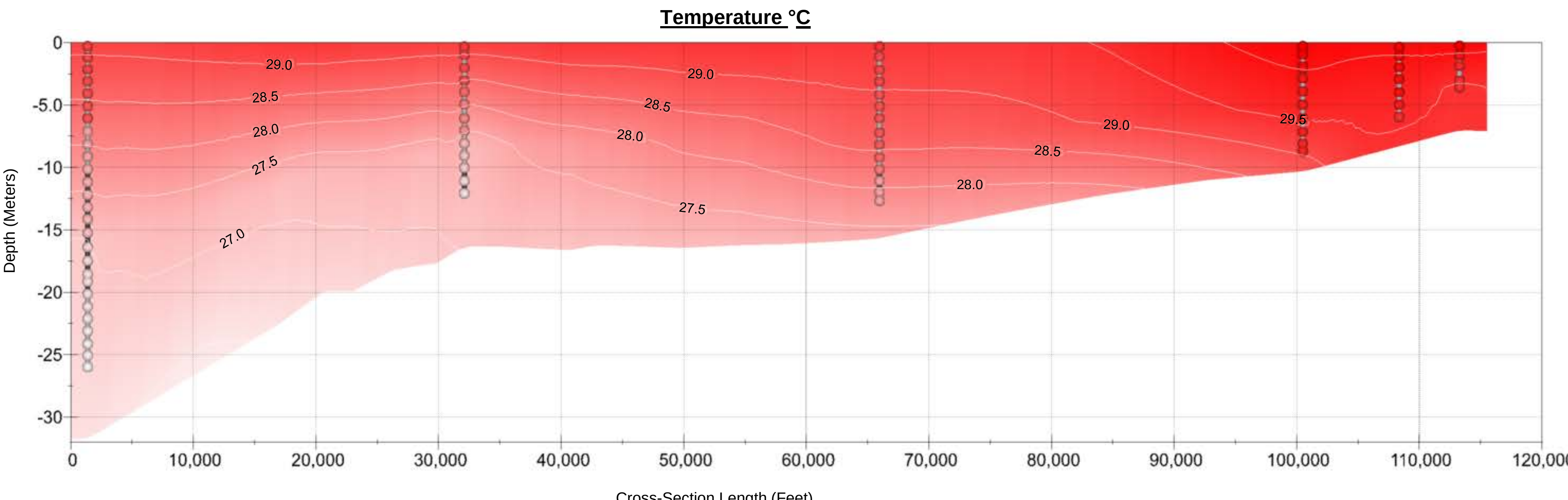


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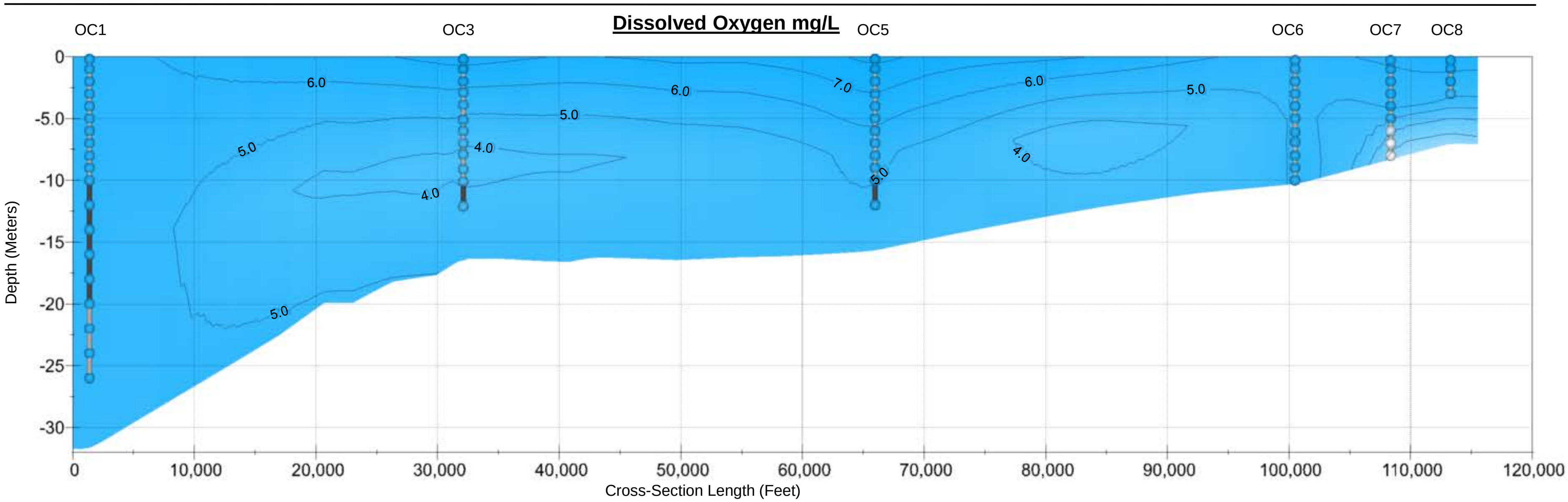
Figure 7a
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - June 2015
Wallace Dam Project
(FERC No. 2413)



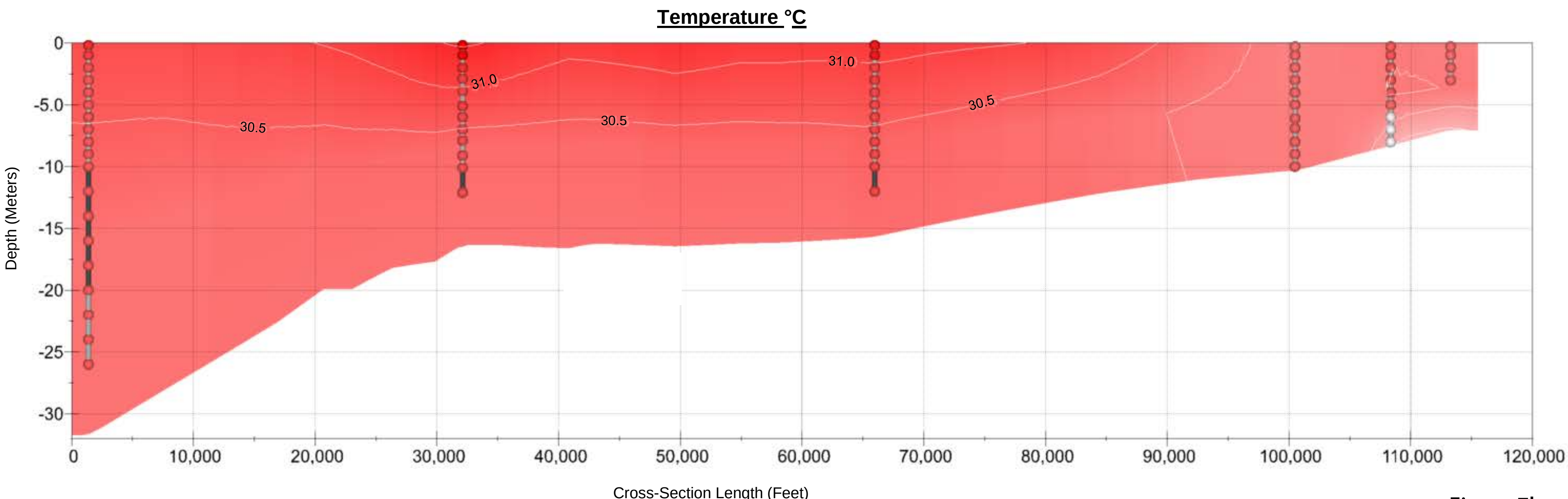


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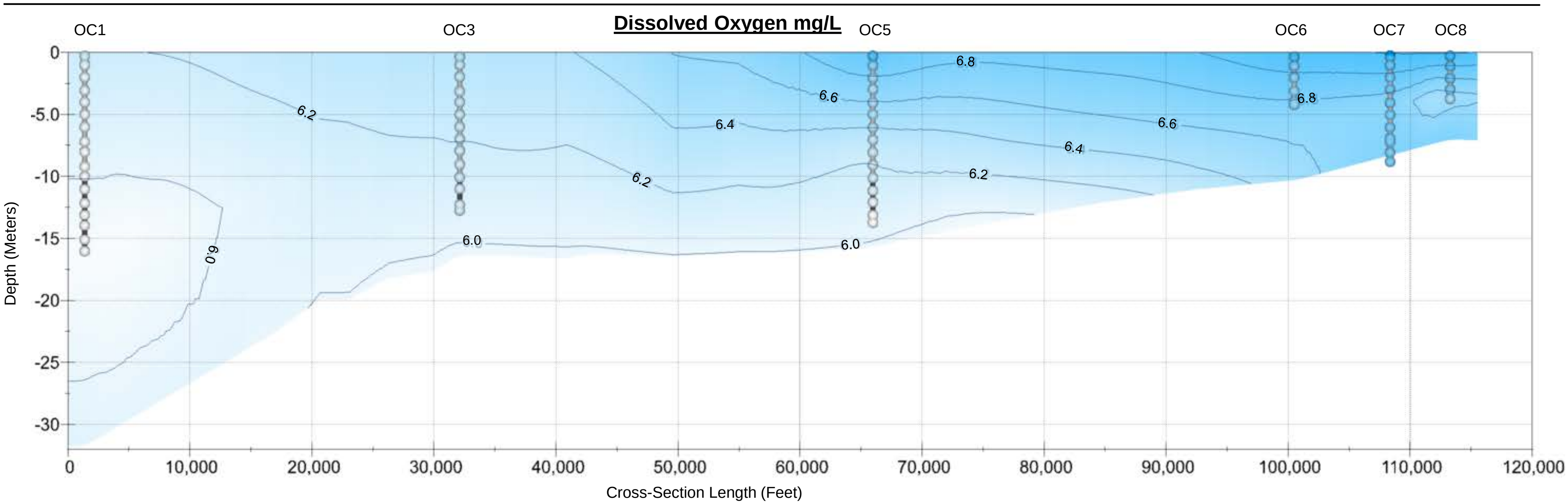
Figure 7b
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - August 2015
Wallace Dam Project
(FERC No. 2413)



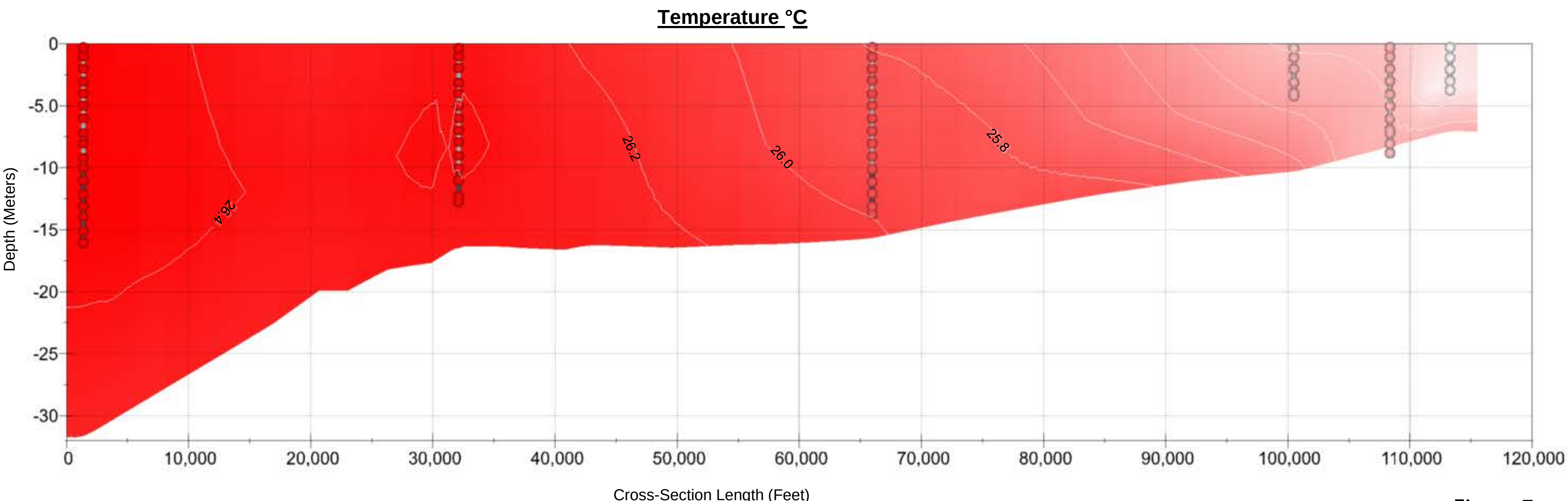


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Figure 7c
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - September 2015
Wallace Dam Project
(FERC No. 2413)

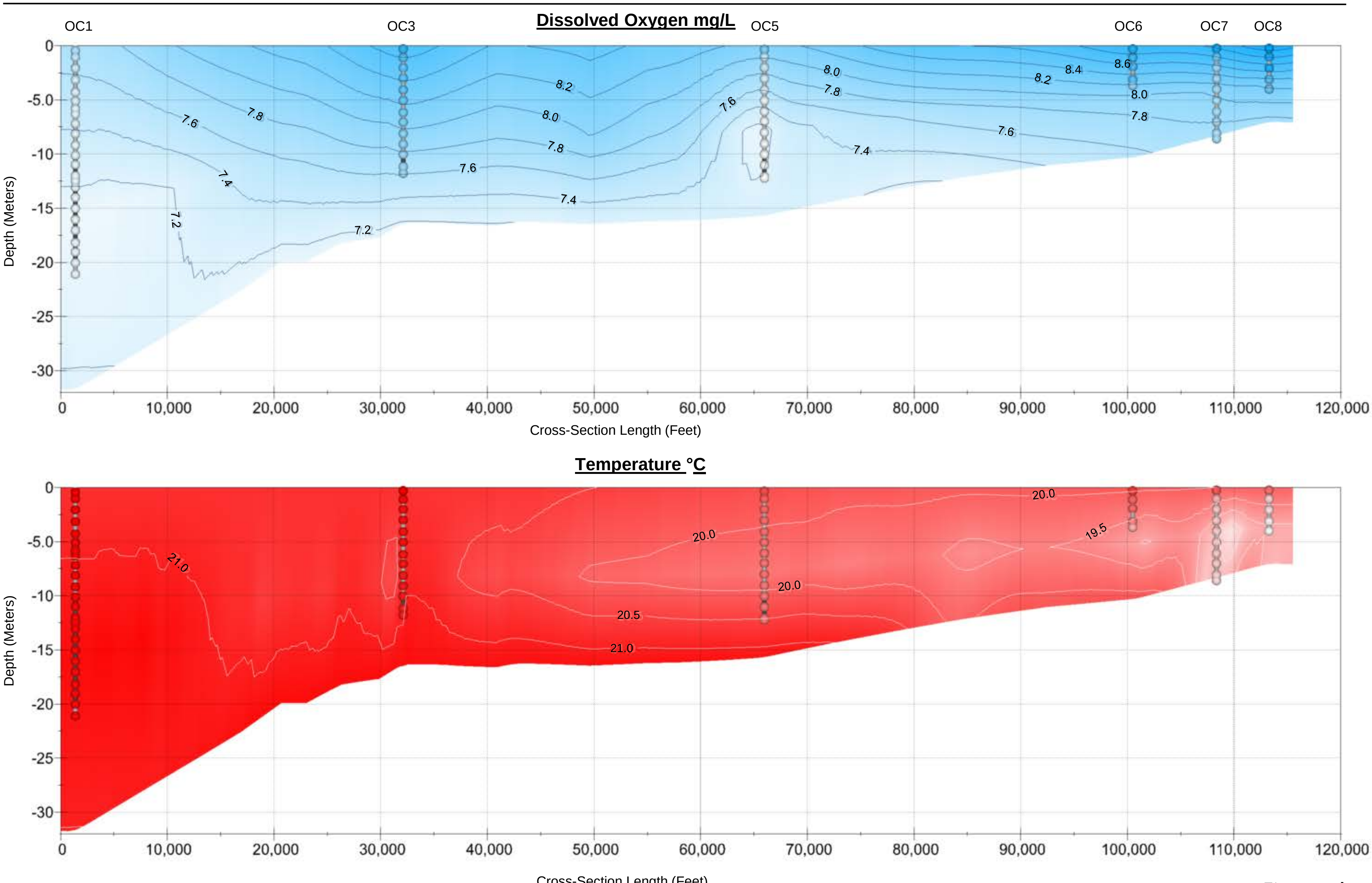

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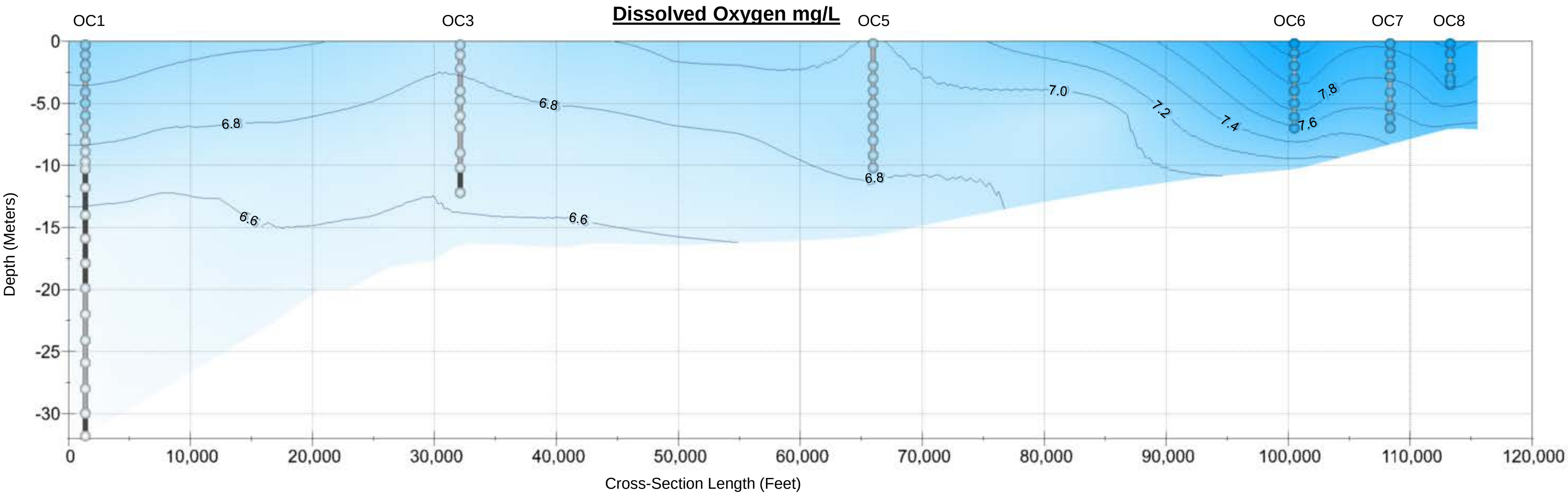
Figure 7d
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - October 2015
Wallace Dam Project
(FERC No. 2413)



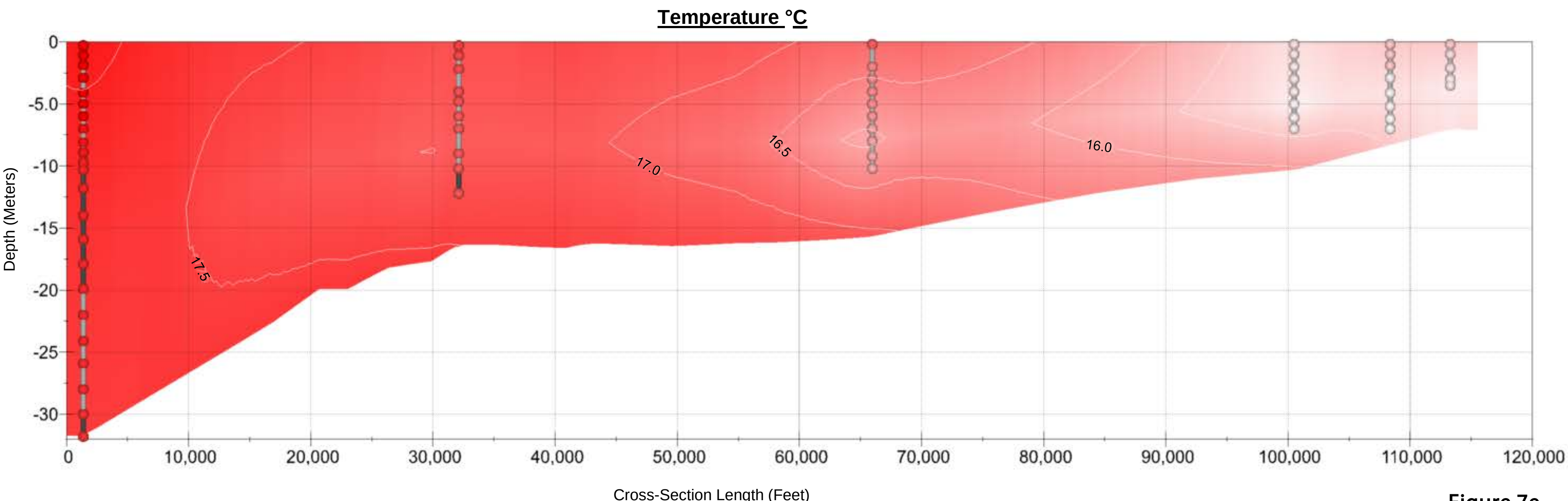


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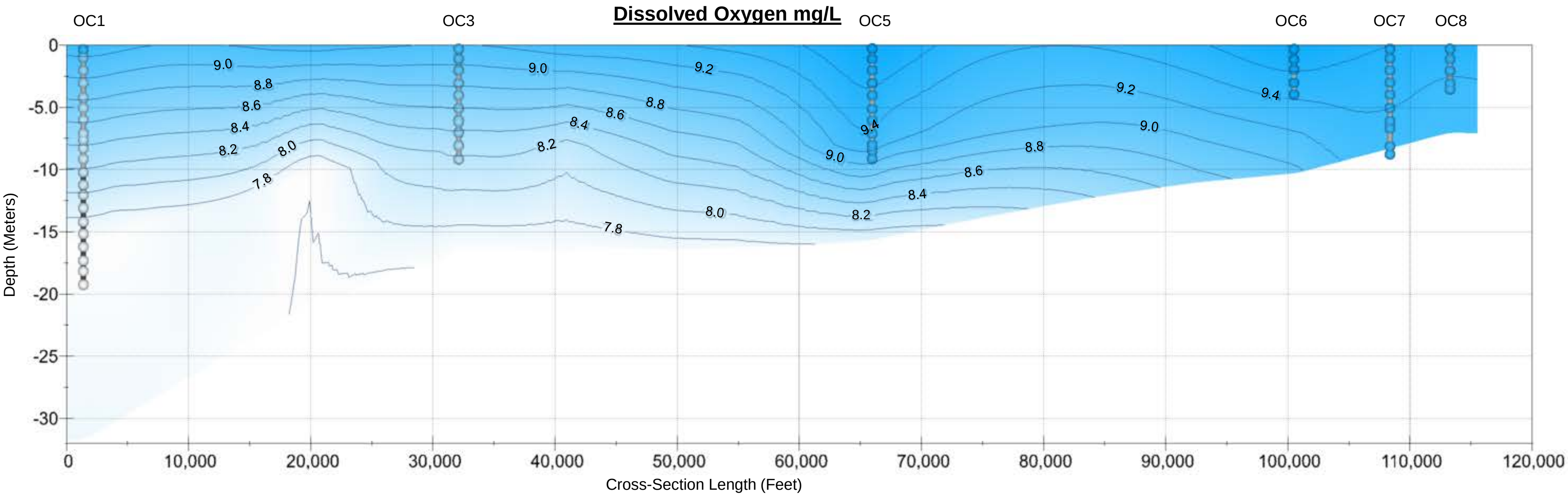
Figure 7e
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - November 2015
Wallace Dam Project
(FERC No. 2413)



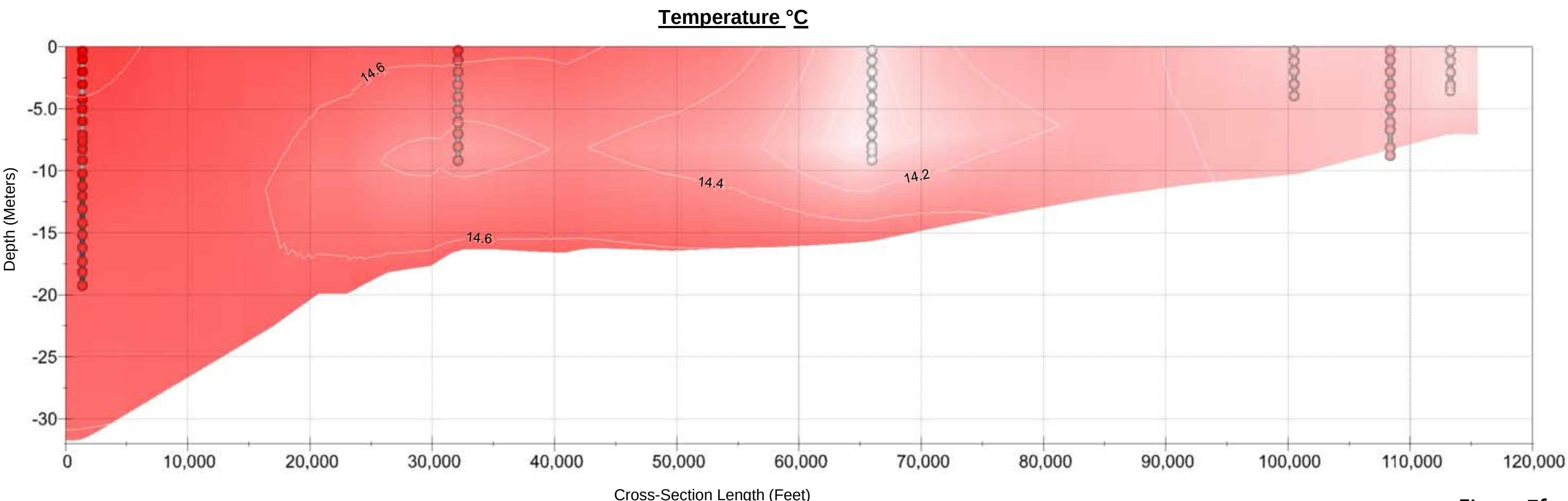


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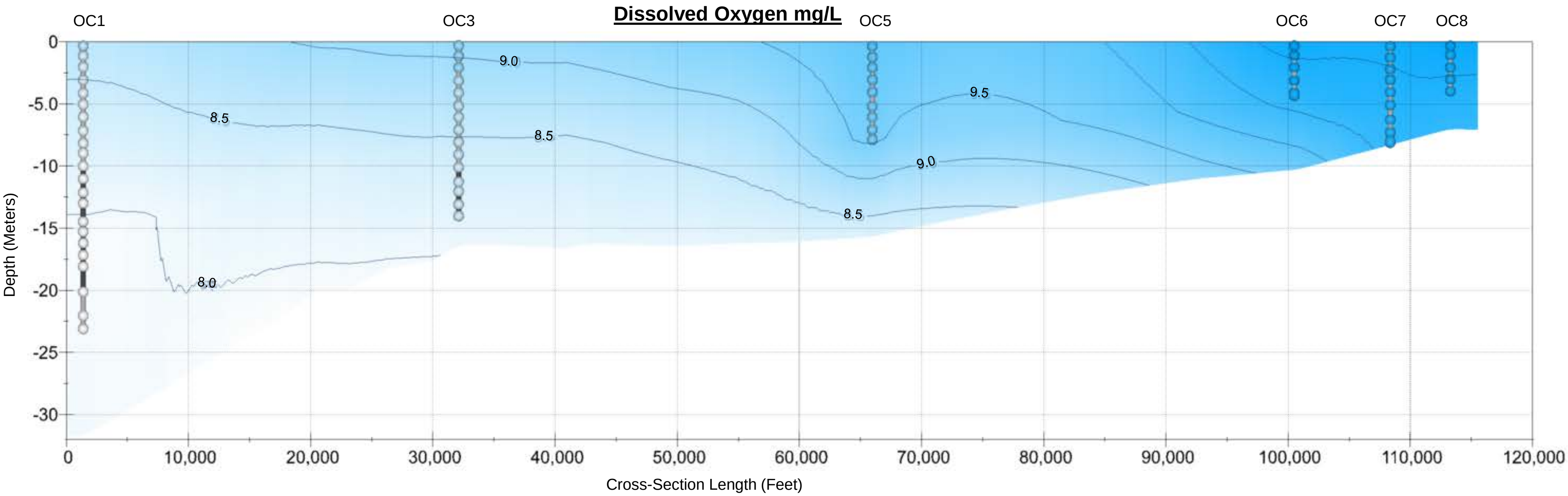
Figure 7f
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - December 2015
Wallace Dam Project
(FERC No. 2413)



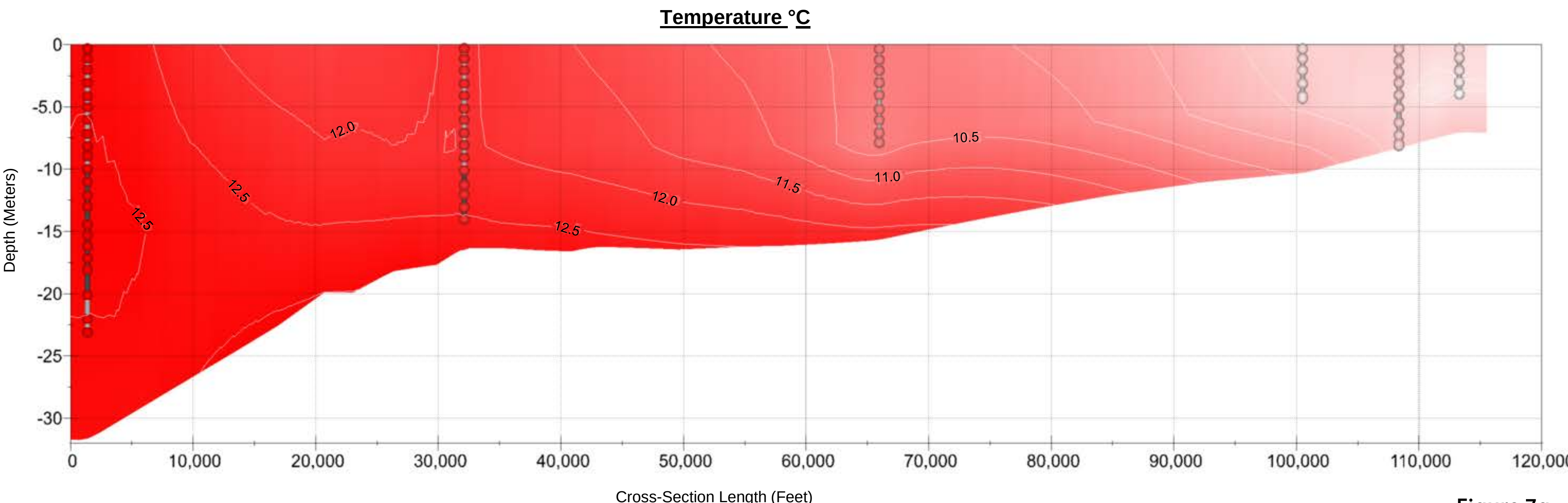


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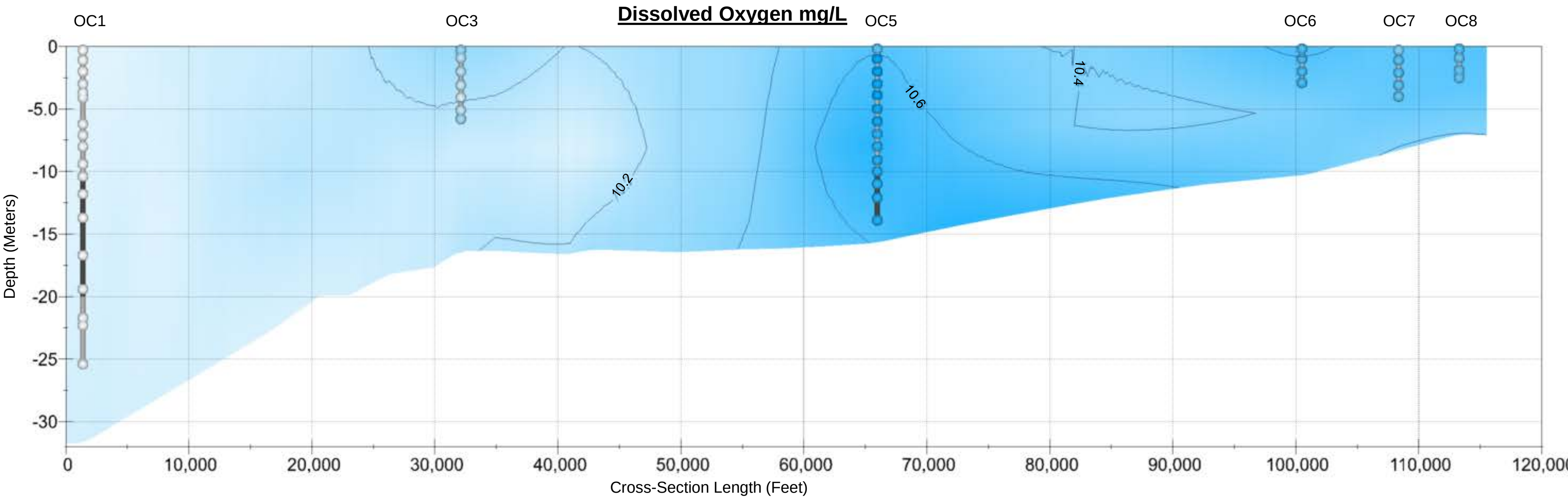
Figure 7g
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - January 2016
Wallace Dam Project
(FERC No. 2413)



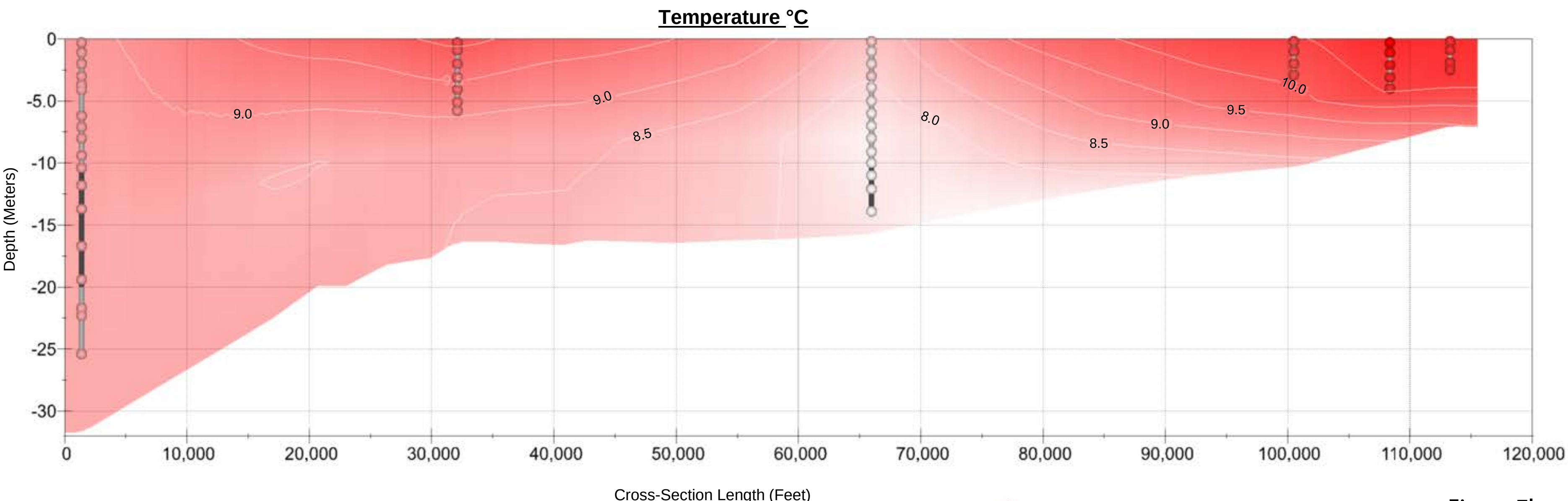


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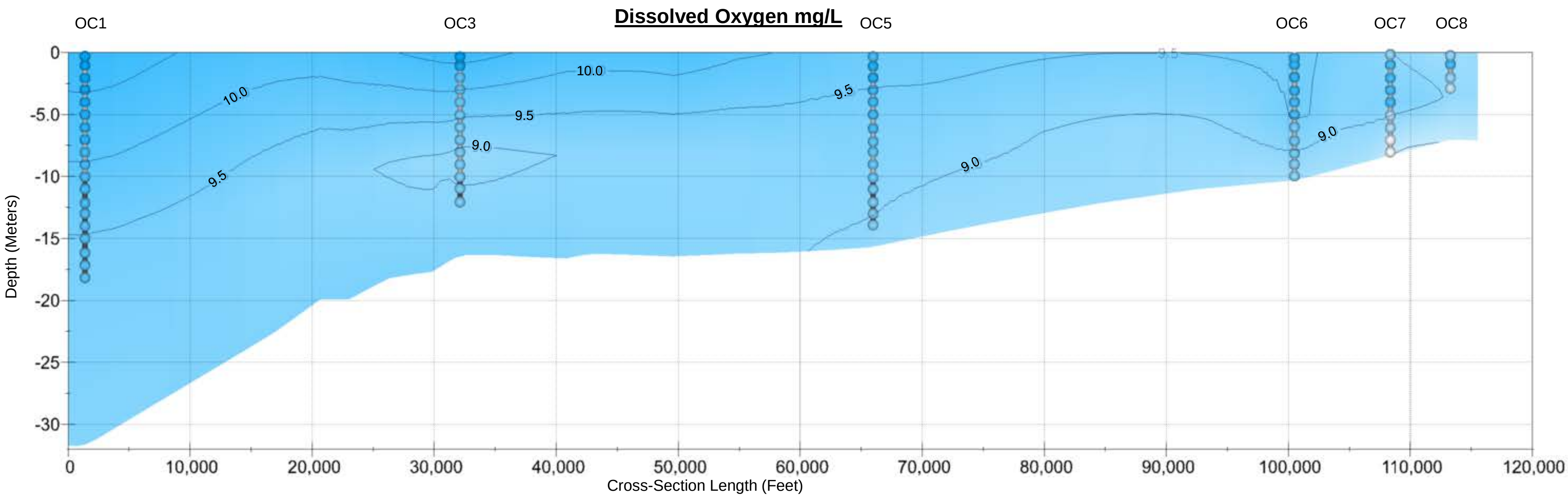
Figure 7h
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - February 2016
Wallace Dam Project
(FERC No. 2413)



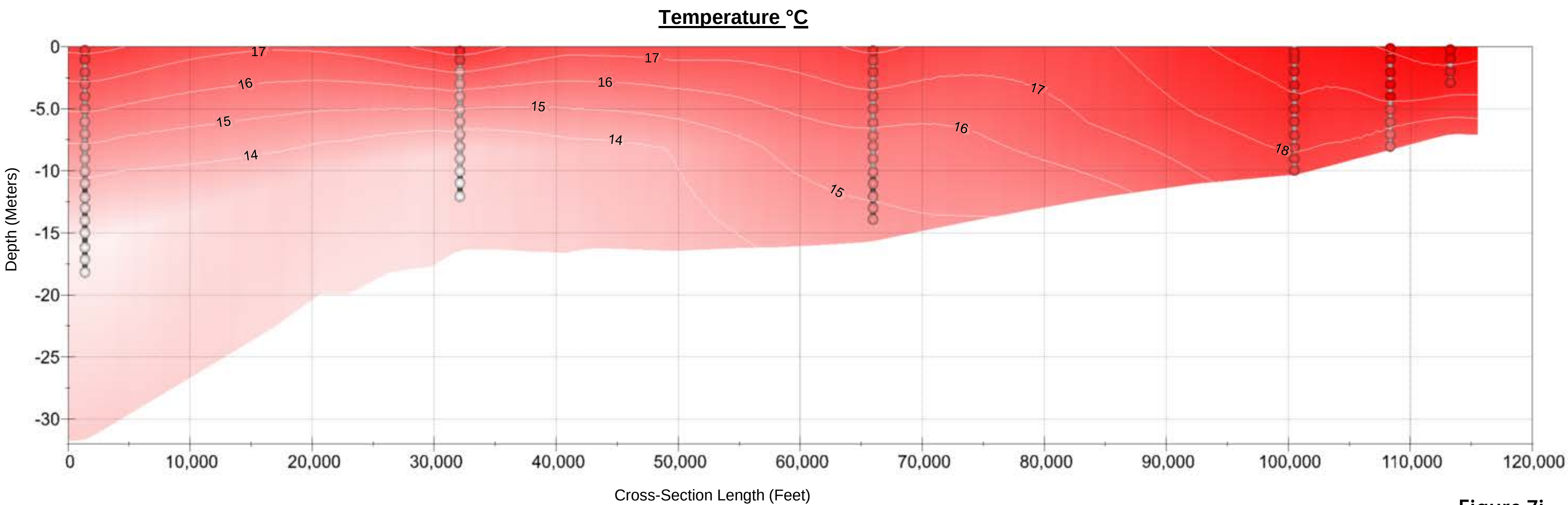


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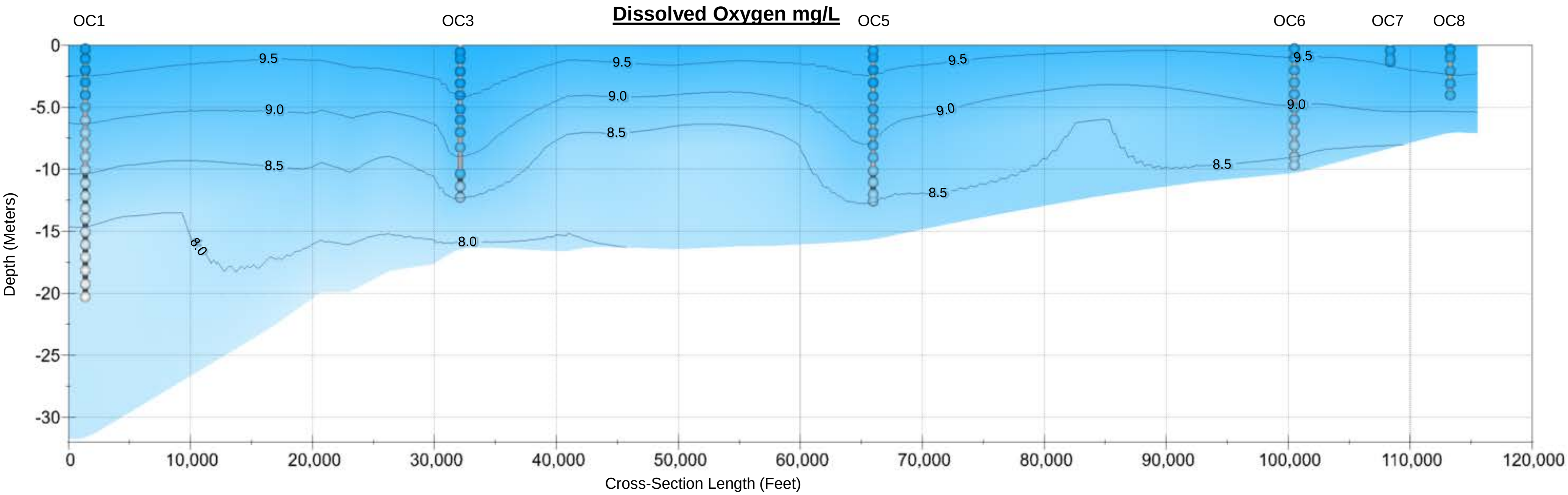
Figure 7i
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - March 2016
Wallace Dam Project
(FERC No. 2413)



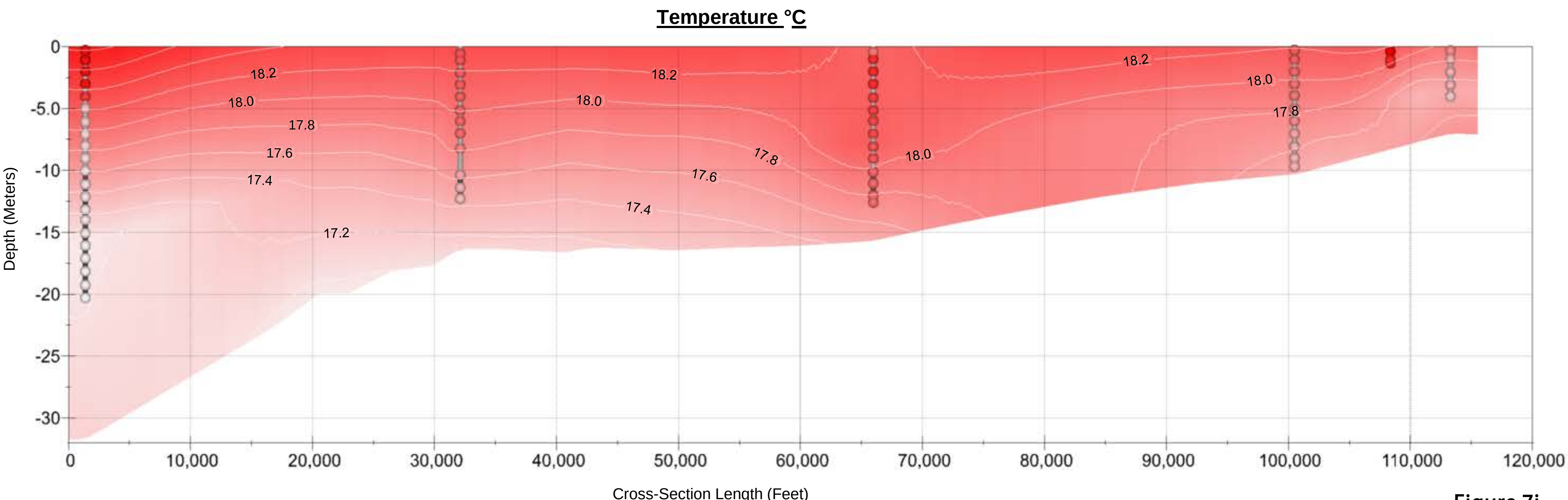


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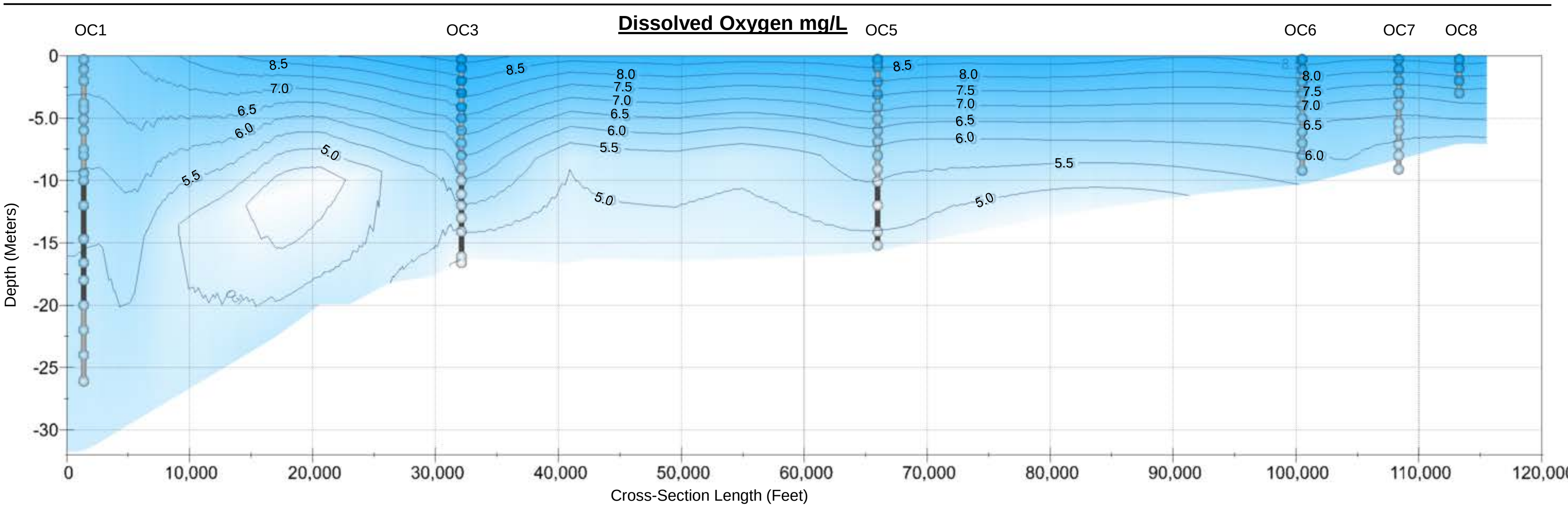
Figure 7j
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - April 2016
Wallace Dam Project
(FERC No. 2413)



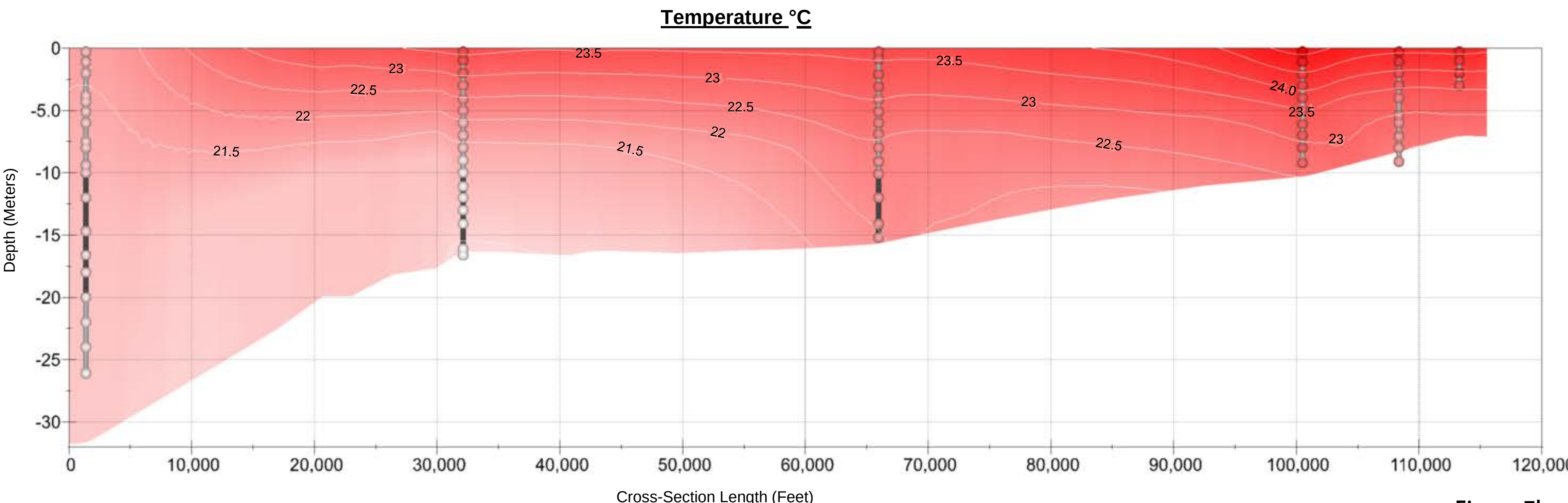


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Figure 7k
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - May 2016
Wallace Dam Project
(FERC No. 2413)

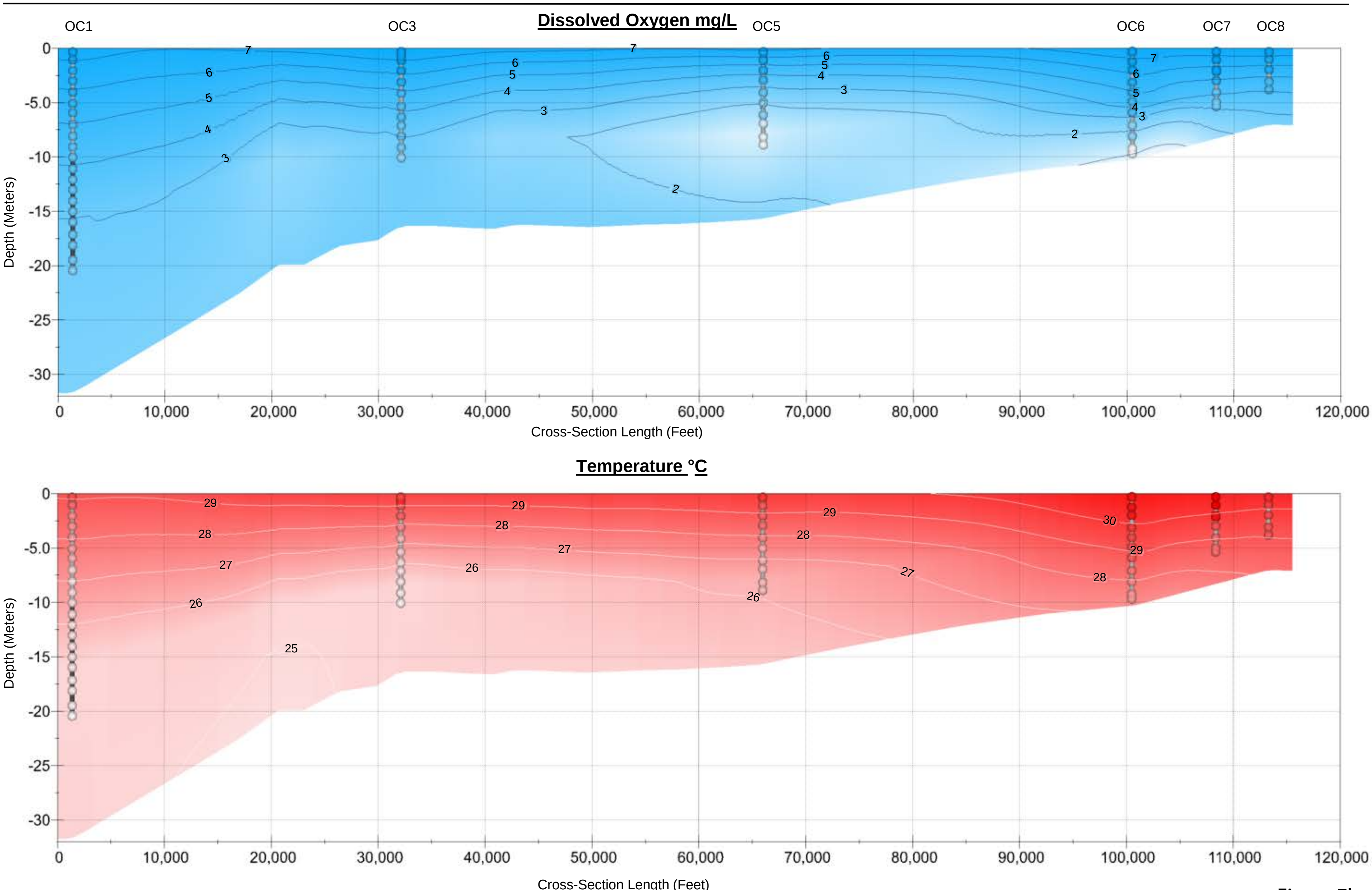
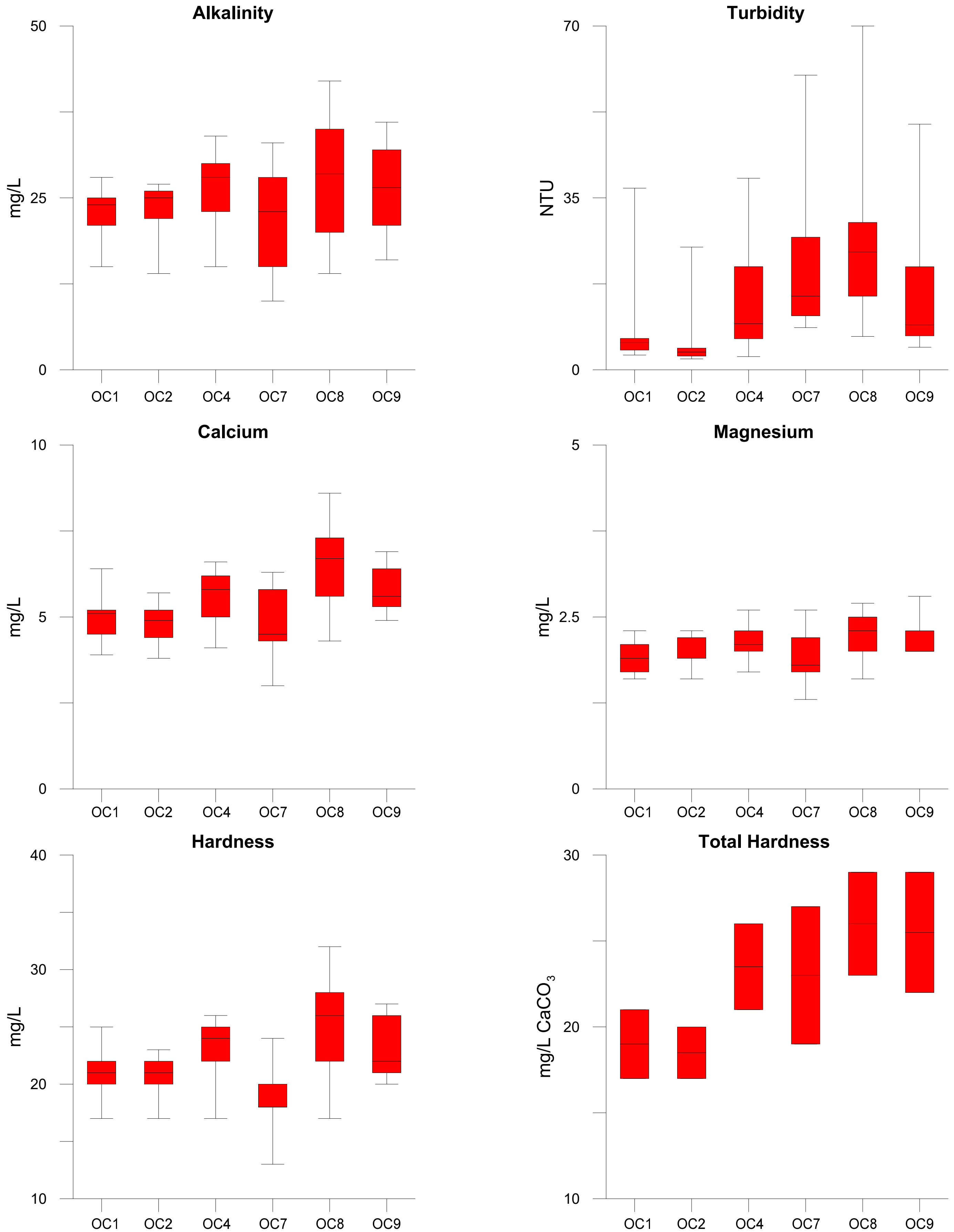


Figure 7l
Monthly Vertical Temperature and DO Isopleth Profiles at Lake Oconee - June 2016
Wallace Dam Project
(FERC No. 2413)



Box-Whisker Plot Legend

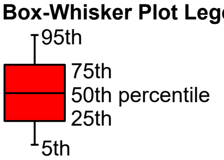


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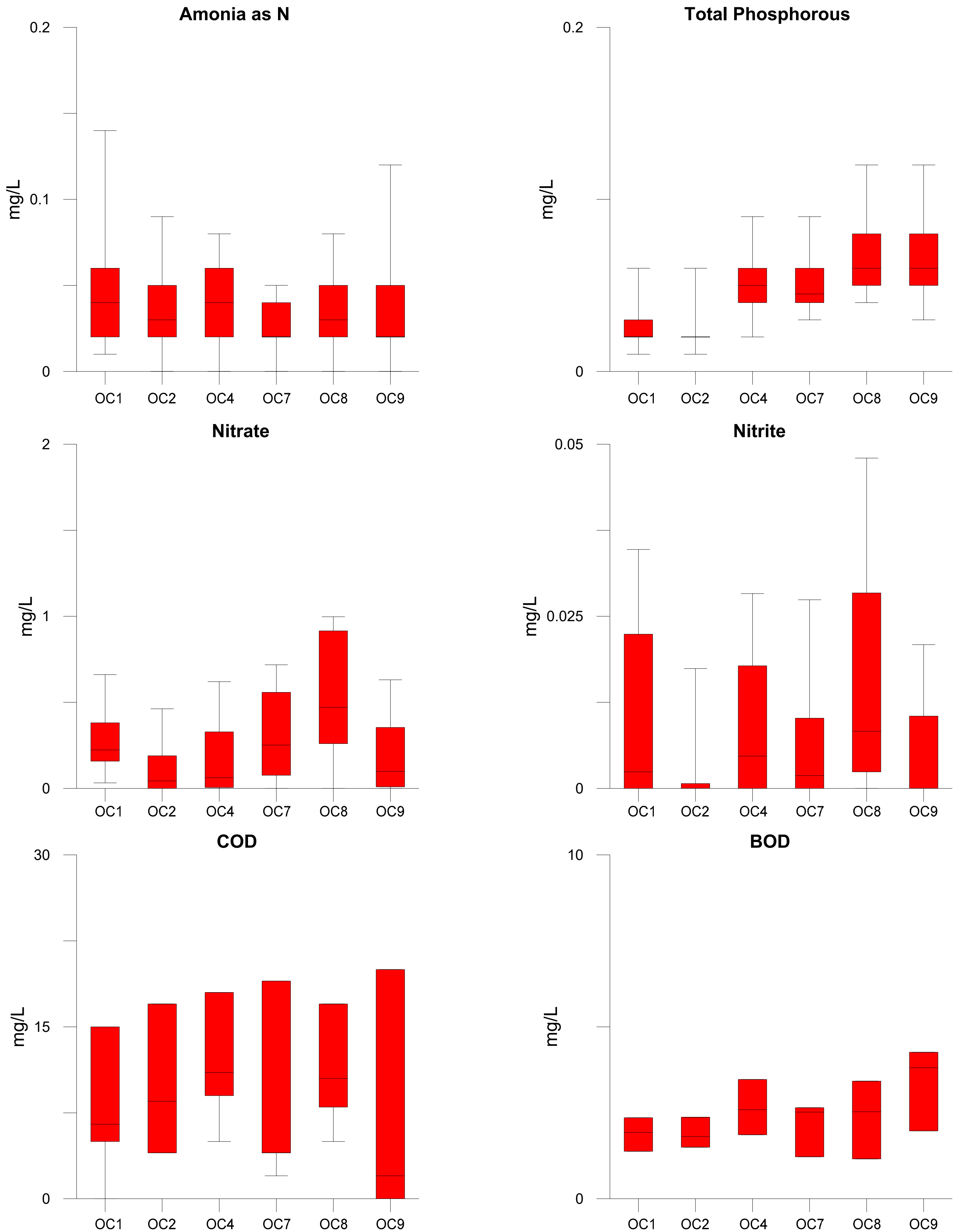
Figure 8a
Water Chemistry, 2013 - 2016
Wallace Dam Project
(FERC No. 2413)



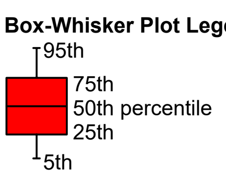
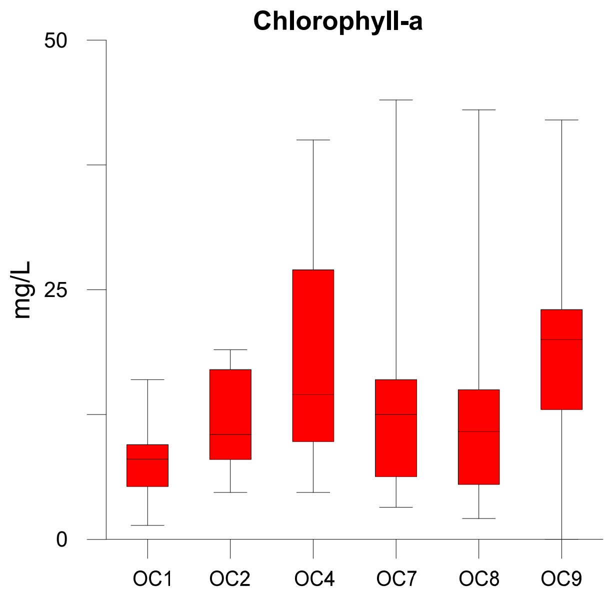
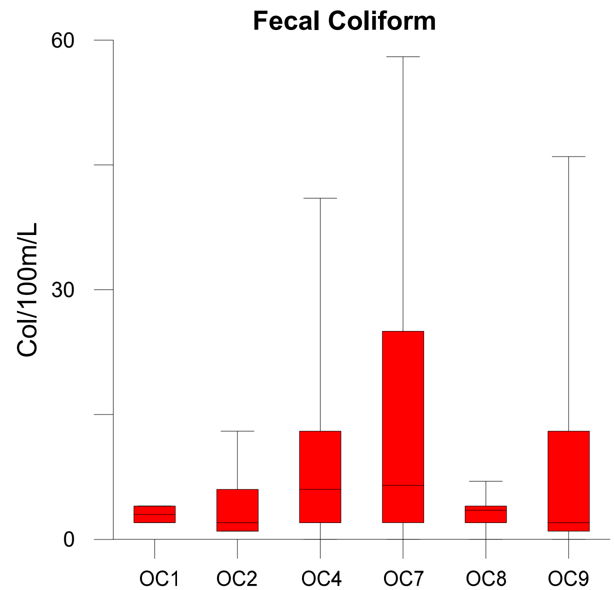


Figure 8b
Water Chemistry, 2013 - 2016
Wallace Dam Project
(FERC No. 2413)





Box-Whisker Plot Legend

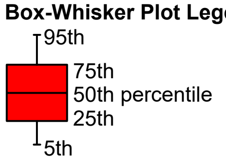


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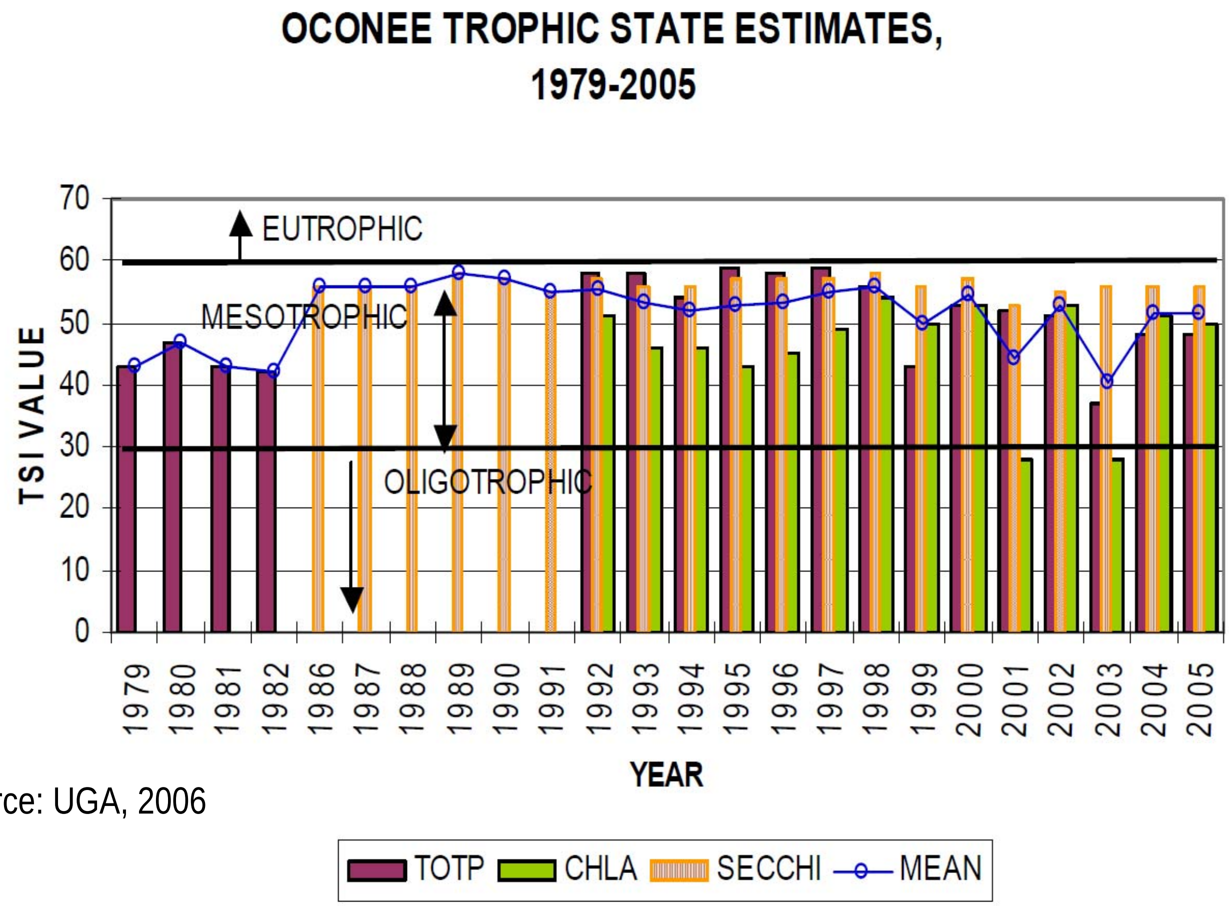
Figure 8c
Water Chemistry, 2013 - 2016
Wallace Dam Project
(FERC No. 2413)



Source: UGA, 2006

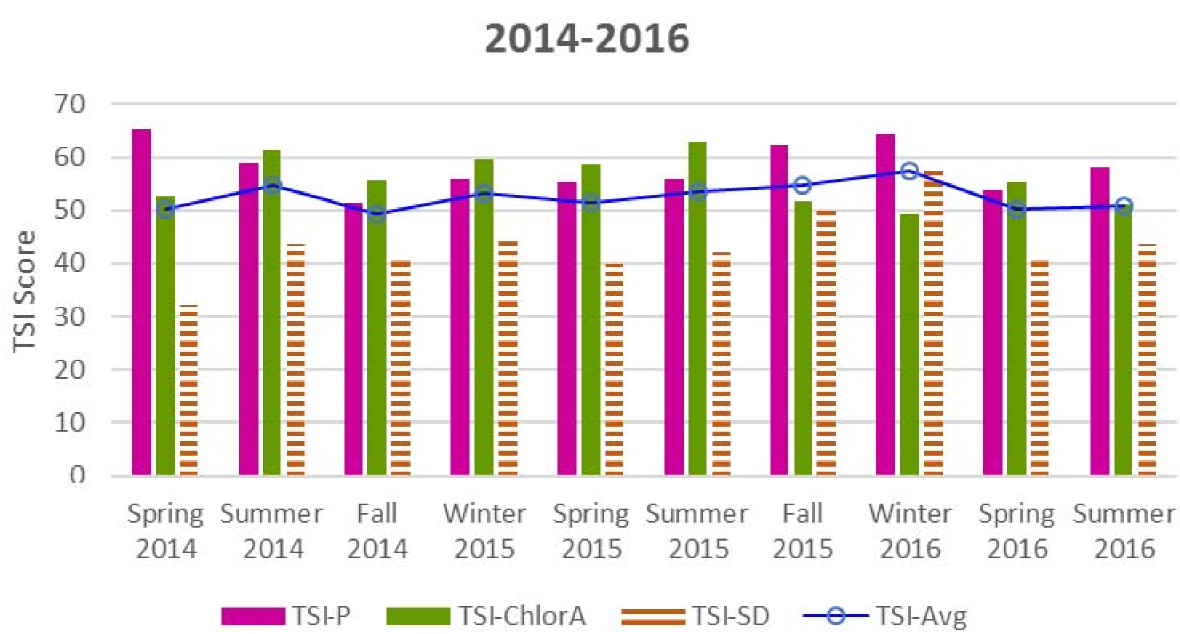


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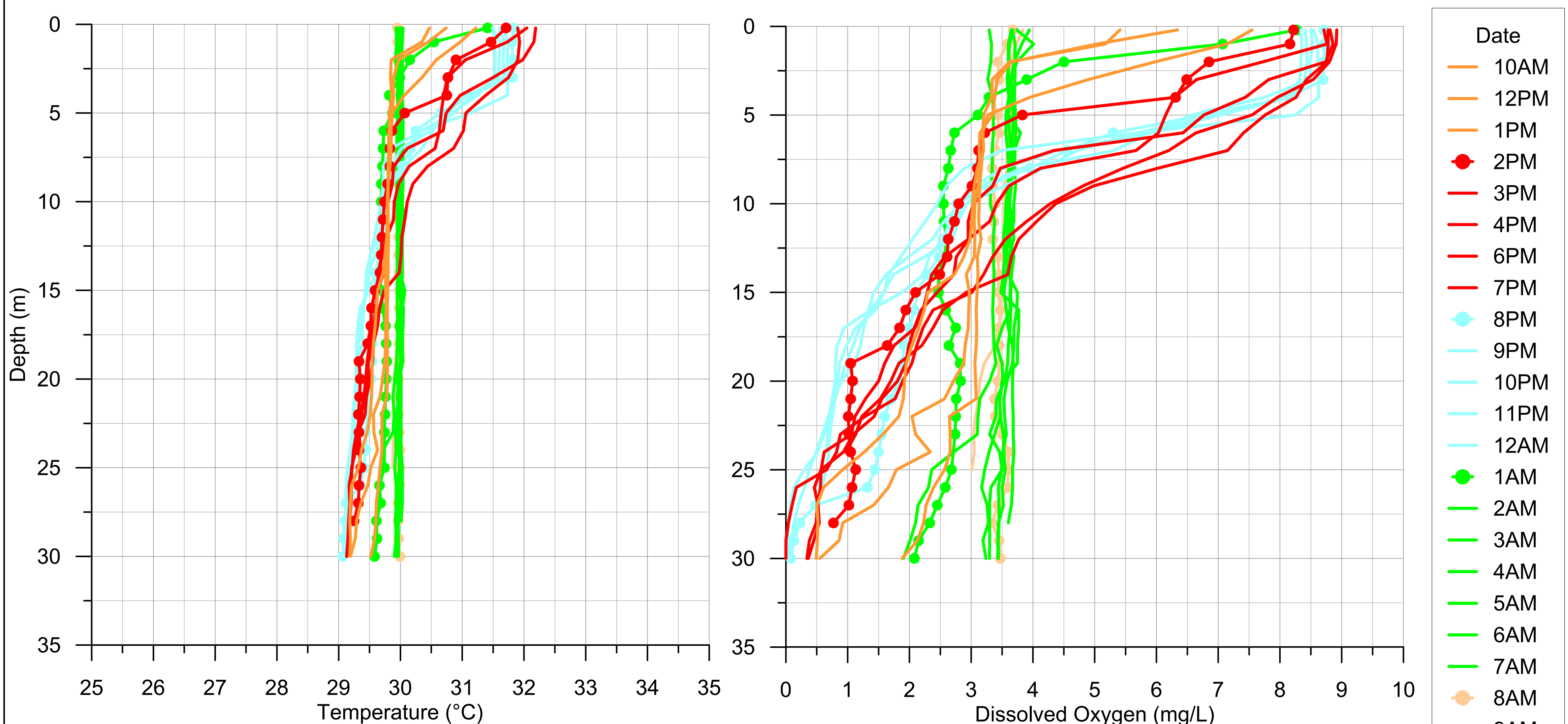
Figure 9
Trophic State Index for Lake Oconee
Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on July 27-28

Interim (10AM-2PM)

Generation (2PM-7PM)

Interim (7PM-12:45AM)

Pumpack (12:45AM-7:15AM)

Interim (7:15AM-2PM)

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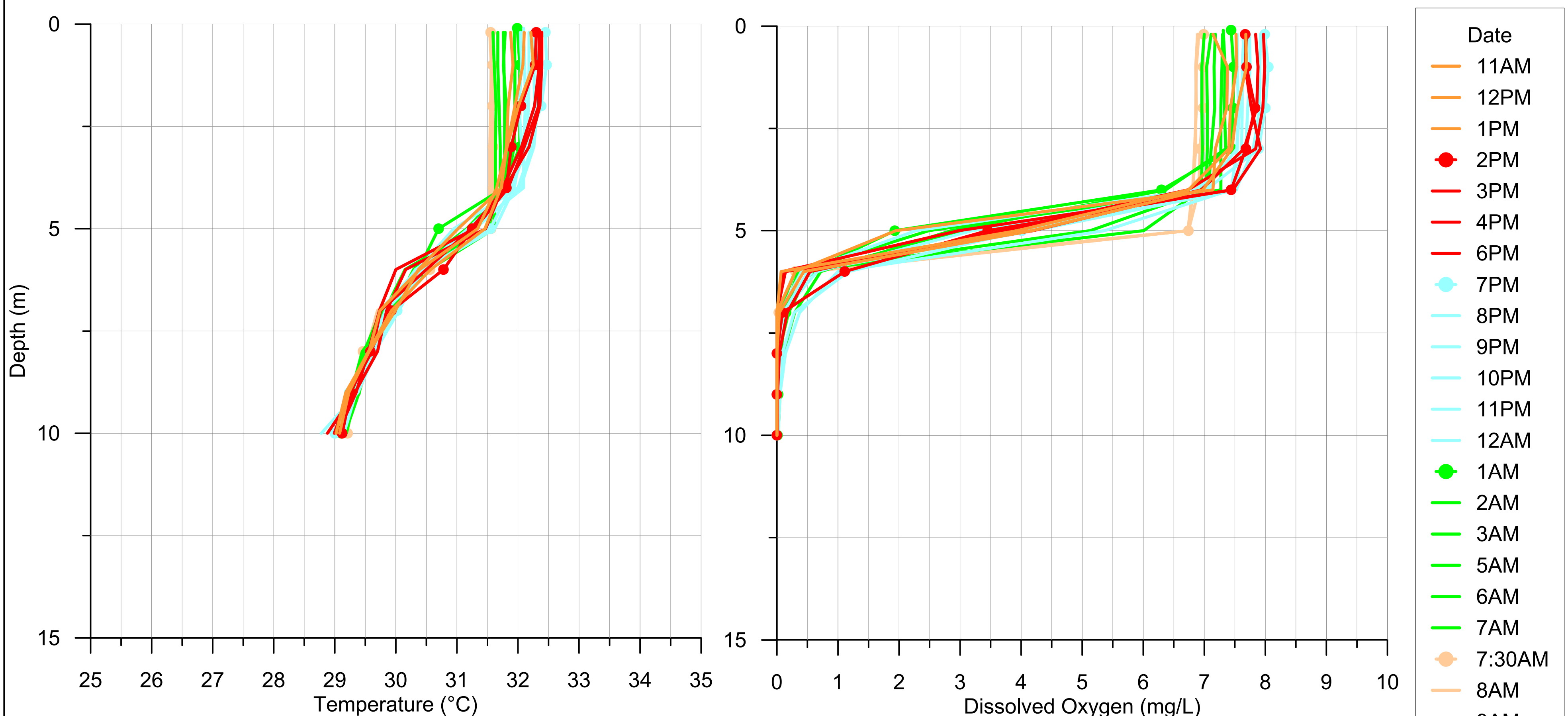
Figure 10a

24-Hour Vertical Temperature and DO Profiles in July from Station OC1

Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on July 27-28
Interim (10AM-2PM)
Generation (2PM-7PM)
Interim (7PM-12:45AM)
Pumpack (12:45AM-7:15AM)
Interim (7:15AM-2PM)

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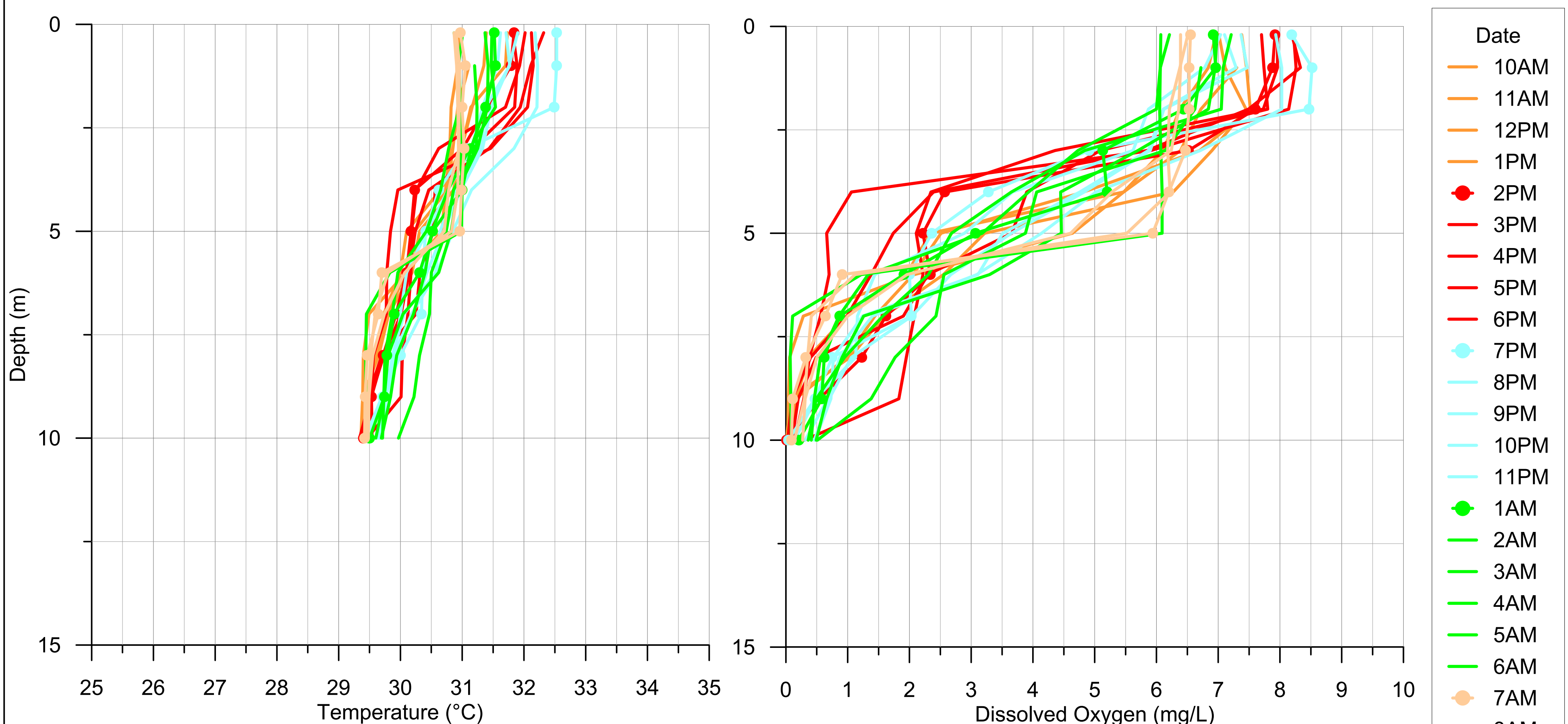
Figure 10b
24-Hour Vertical Temperature and DO Profiles in July from Station OC2
Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on July 27-28
Interim (10AM-2PM)
Generation (2PM-7PM)
Interim (7PM-12:45AM)
Pumpack (12:45AM-7:15AM)
Interim (7:15AM-2PM)

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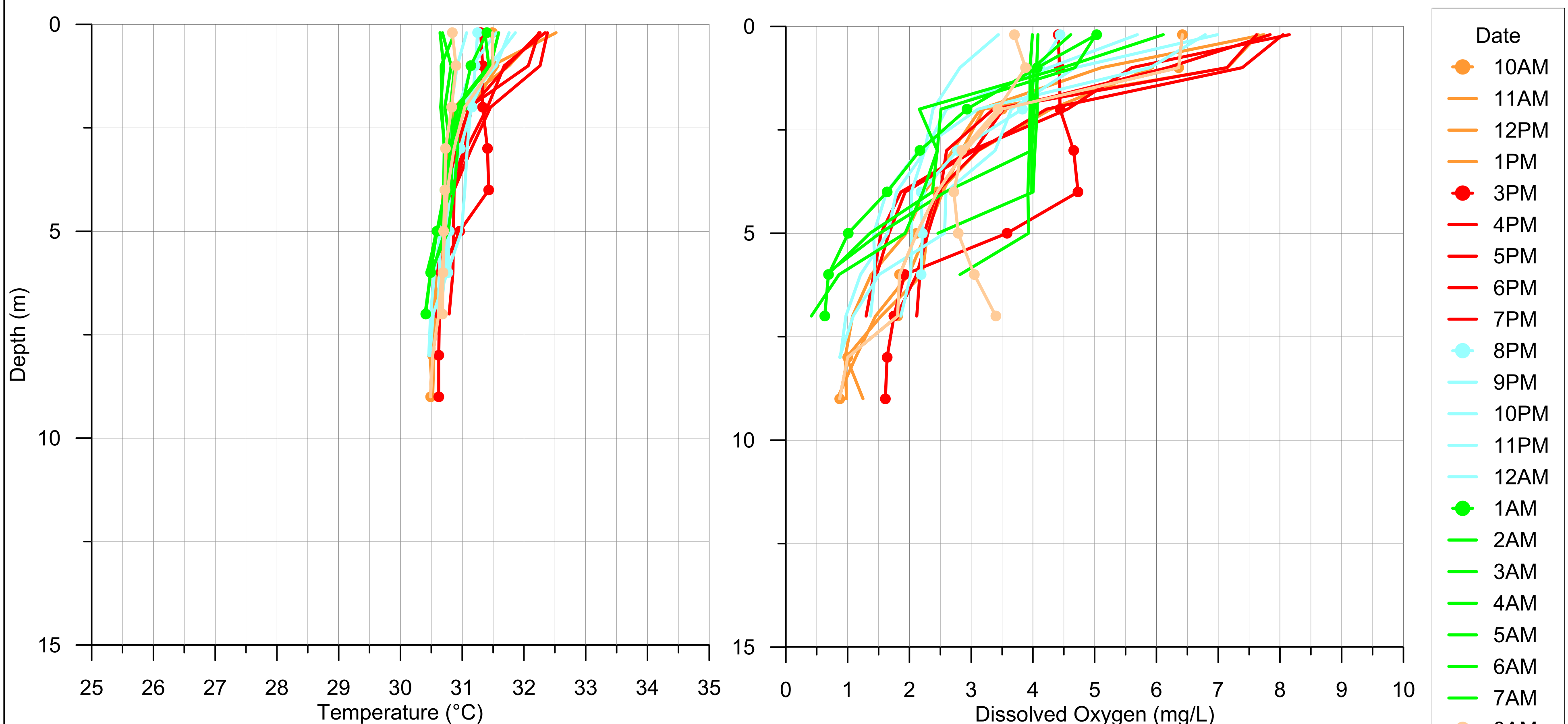
Figure 10c
24-Hour Vertical Temperature and DO Profiles in July from Station OC3
Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on July 27-28

Interim (10AM-2PM)

Generation (2PM-7PM)

Interim (7PM-12:45AM)

Pumpack (12:45AM-7:15AM)

Interim (7:15AM-2PM)

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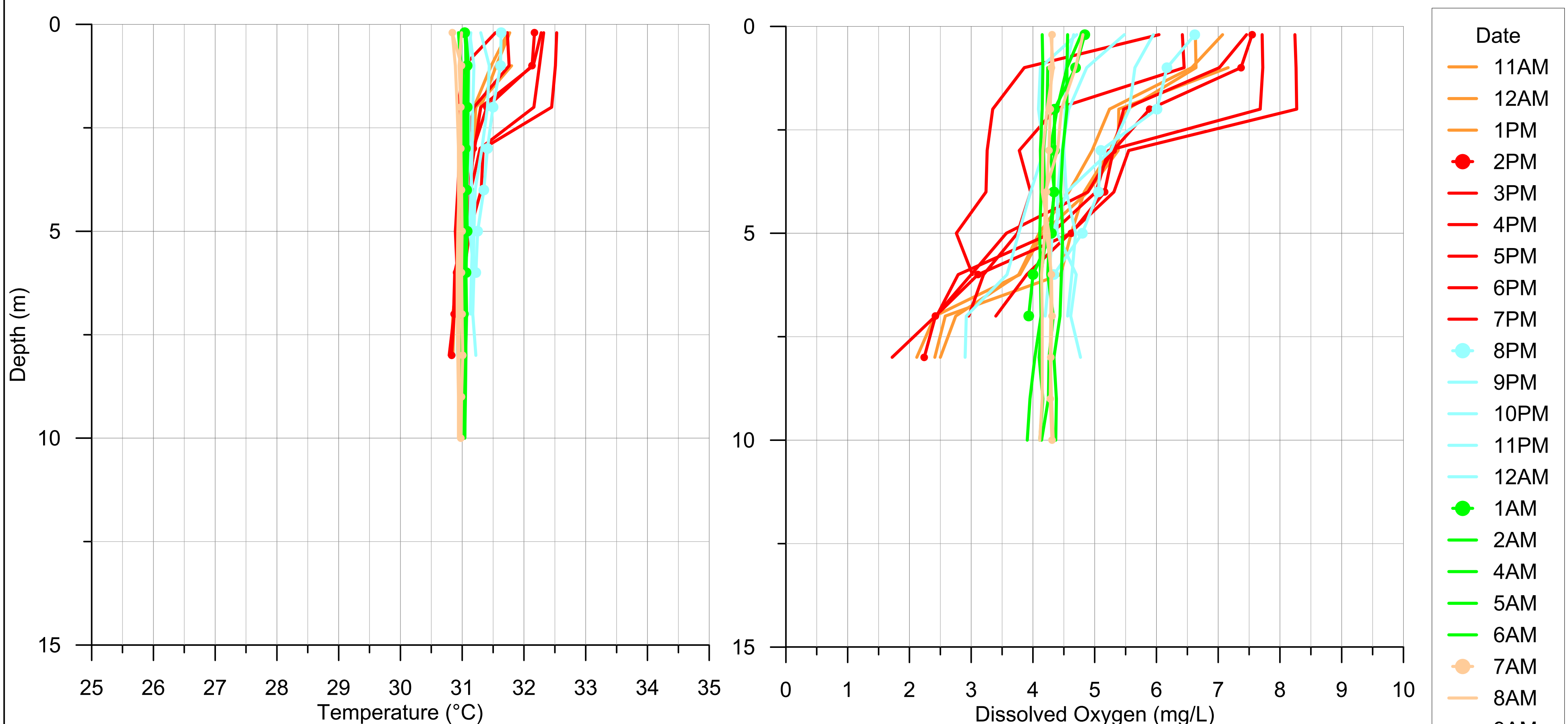
Figure 10d

24-Hour Vertical Temperature and DO Profiles in July from Station OC4

Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on July 27-28
Interim (10AM-2PM)
Generation (2PM-7PM)
Interim (7PM-12:45AM)
Pumpack (12:45AM-7:15AM)
Interim (7:15AM-2PM)

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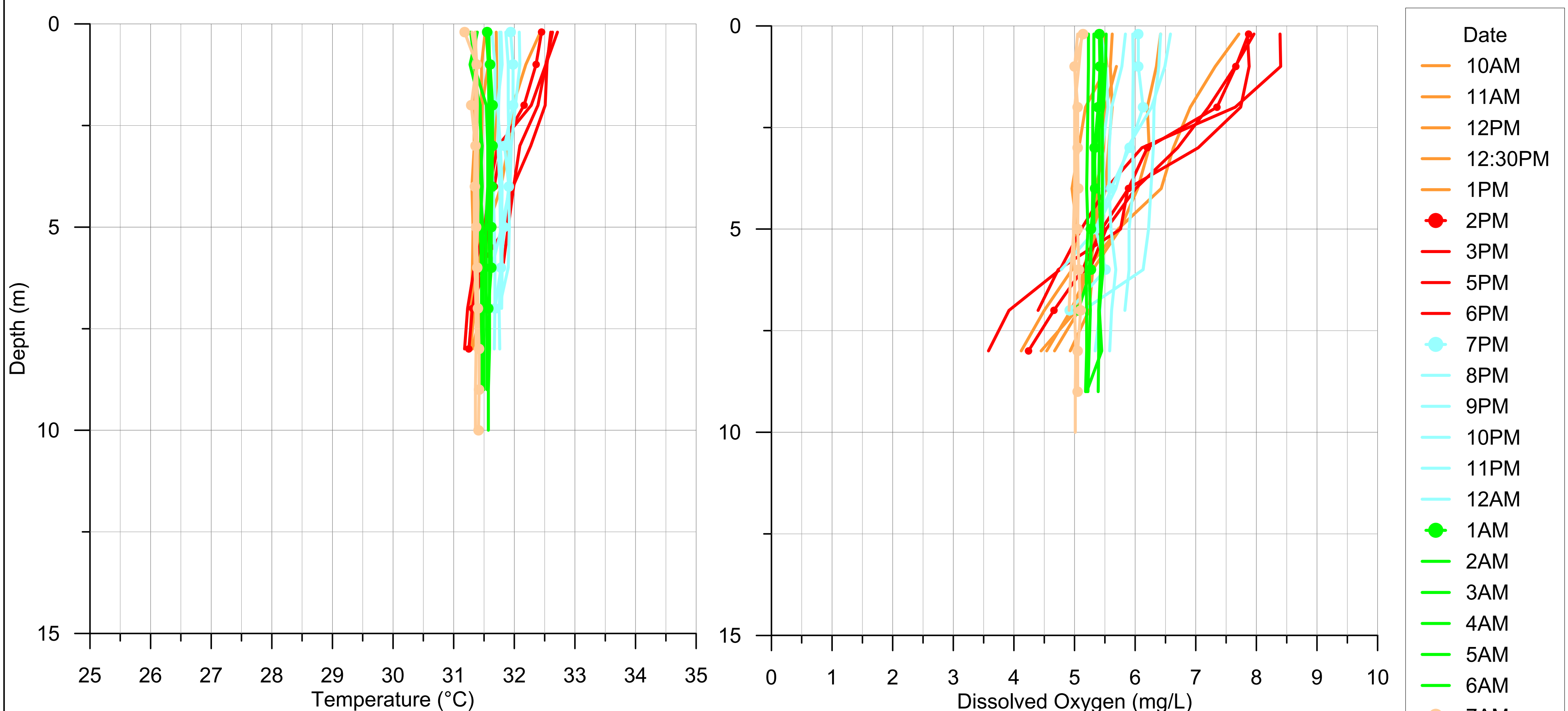
Figure 10e
24-Hour Vertical Temperature and DO Profiles in July from Station OC5
Wallace Dam Project
(FERC No. 2413)



<u>Wallace Dam Operations on July 27-28</u>

Interim (10AM-2PM)

Generation (2PM-7PM)

Interim (7PM-12:45AM)

Pumpack (12:45AM-7:15AM)

Interim (7:15AM-2PM)

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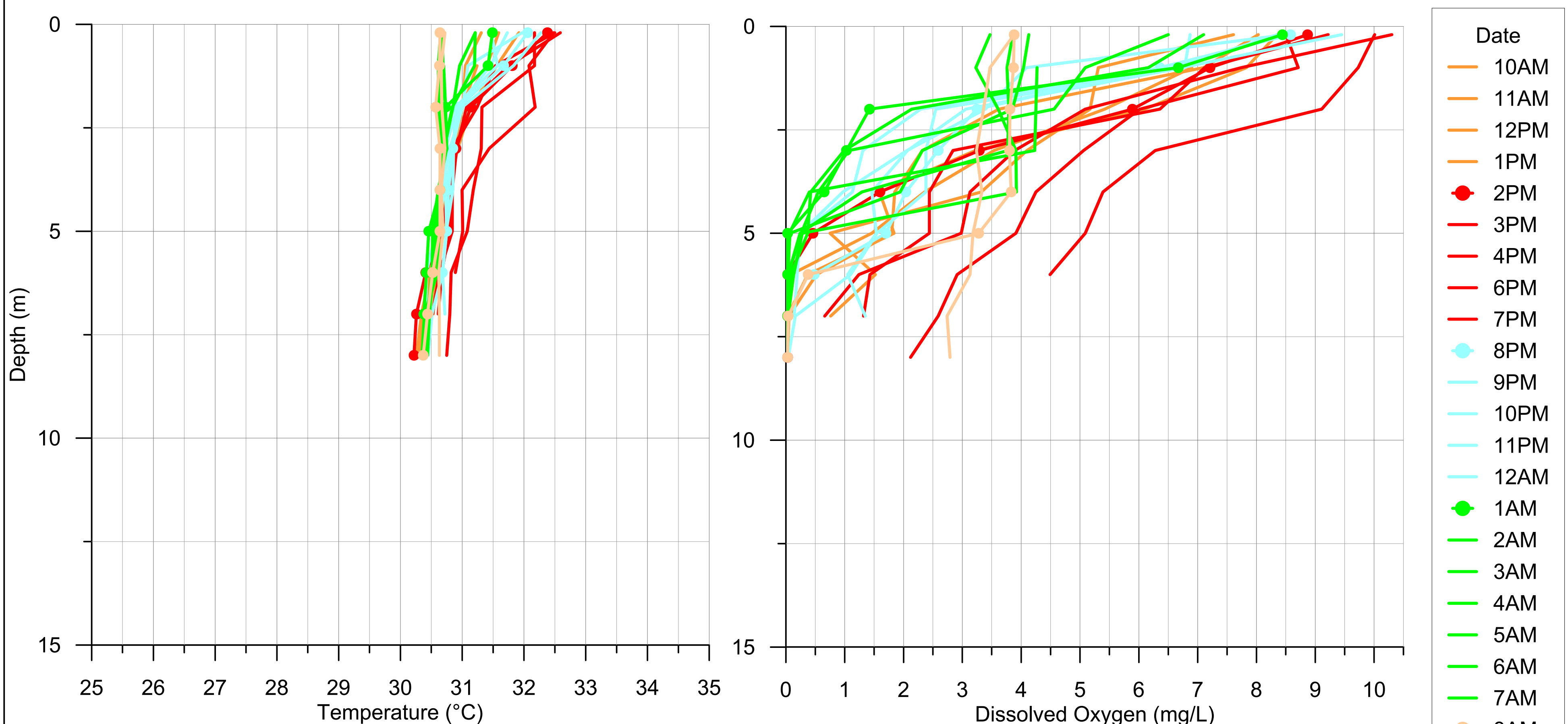
Figure 10f

24-Hour Vertical Temperature and DO Profiles in July from Station OC6

Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on July 27-28
Interim (10AM-2PM)
Generation (2PM-7PM)
Interim (7PM-12:45AM)
Pumpack (12:45AM-7:15AM)
Interim (7:15AM-2PM)

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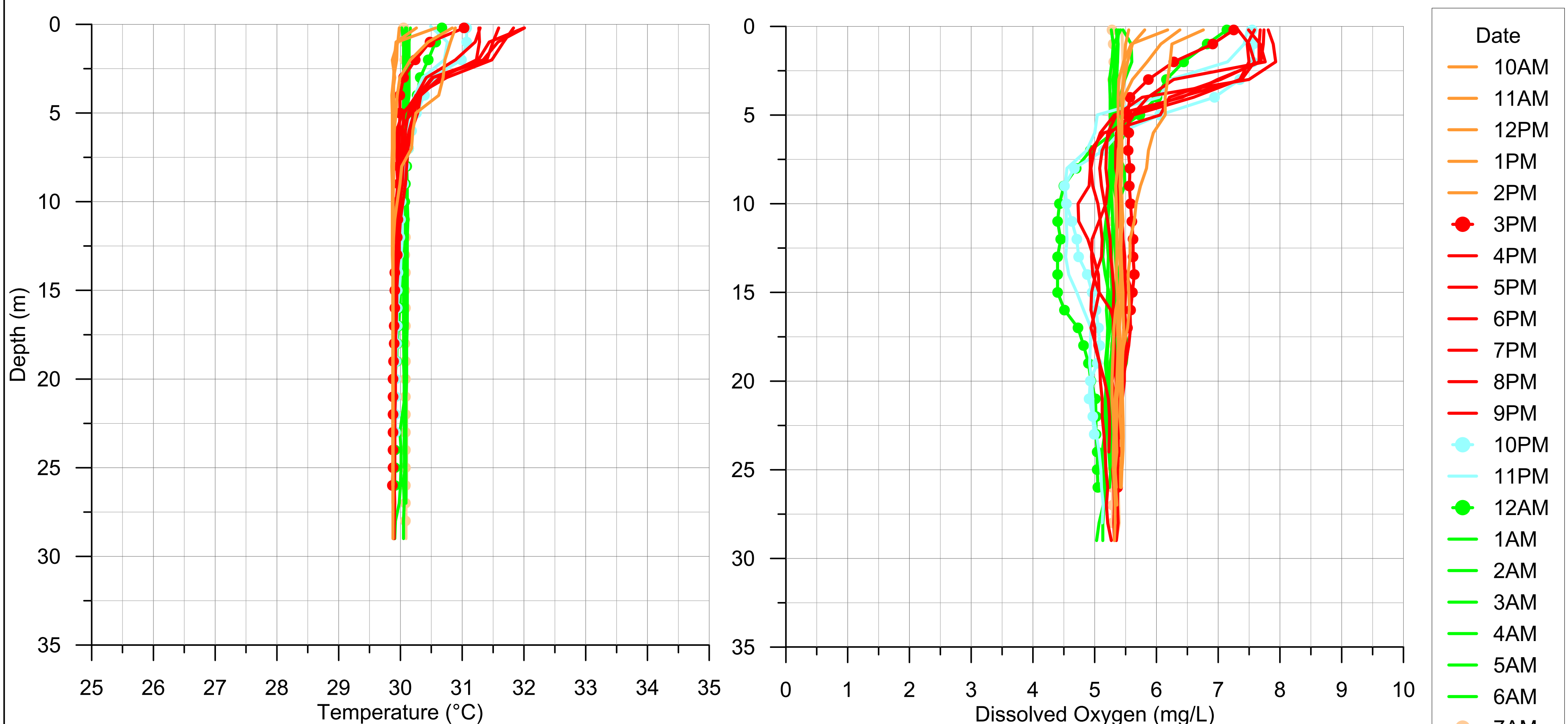
Figure 10g
24-Hour Vertical Temperature and DO Profiles in July from Station OC9
Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on August 15-16

Interim (10AM-2PM)

Generation (2:15PM-9:30PM)

Interim (9:45PM-12:00AM)

Pumpack (12:15AM-6:15AM)

Interim (6:30AM-10AM)

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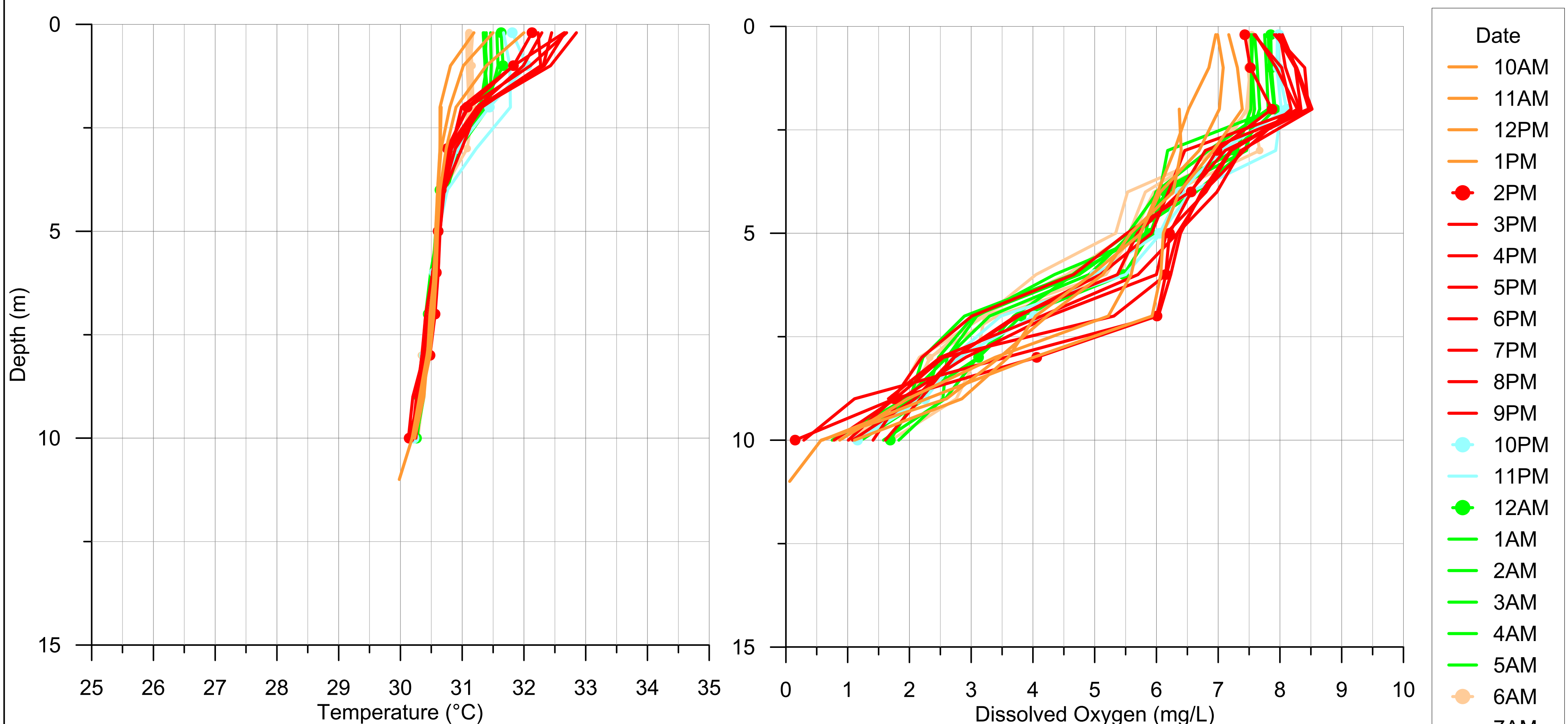
Figure 11a

24-Hour Vertical Temperature and DO Profiles in August from Station OC1

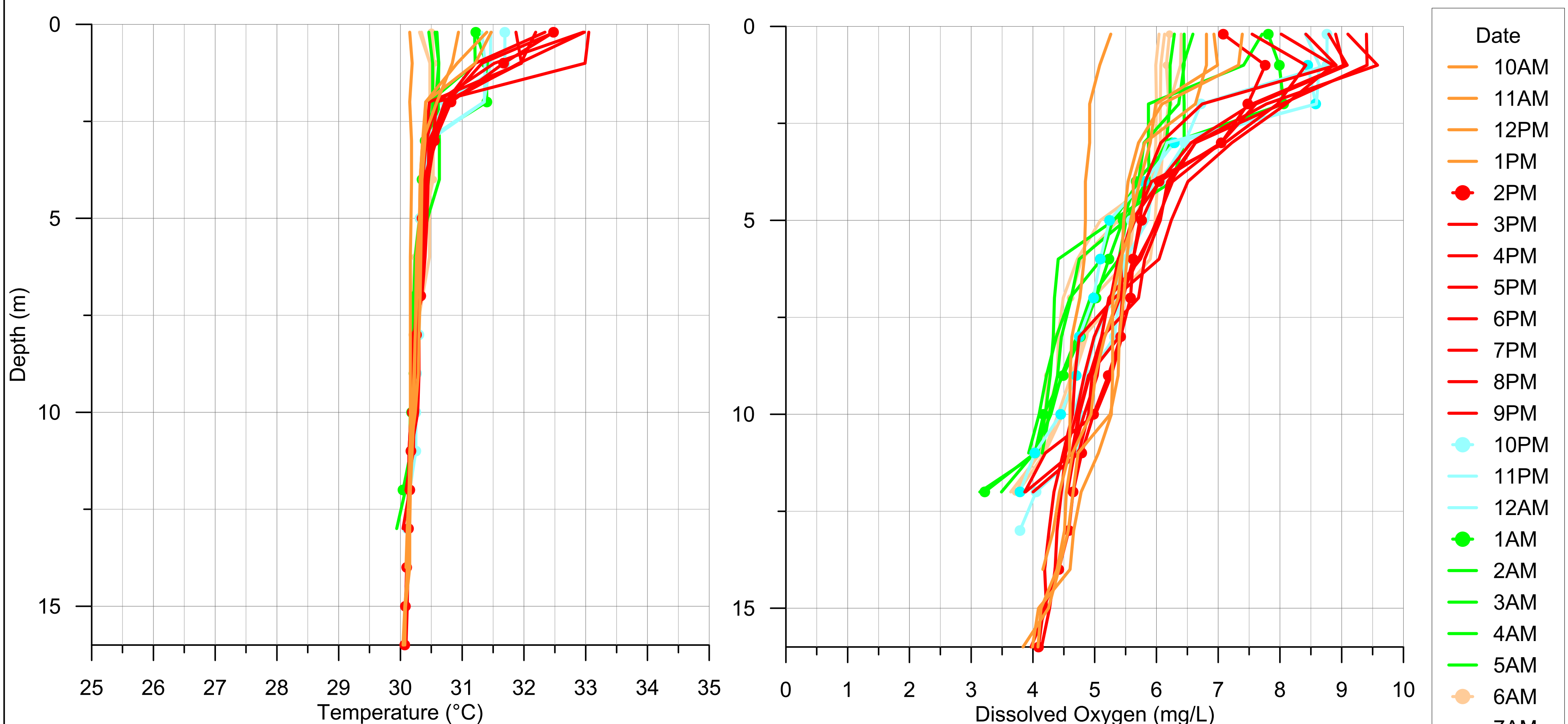
Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on August 15-16
Interim (10AM-2PM)
Generation (2:15PM-9:30PM)
Interim (9:45PM-12:00AM)
Pumpack (12:15AM-6:15AM)
Interim (6:30AM-10AM)

Figure 11b
24-Hour Vertical Temperature and DO Profiles in August from Station OC2
Wallace Dam Project
(FERC No. 2413)



<u>Wallace Dam Operations on August 15-16</u>
Interim (10AM-2PM)
Generation (2:15PM-9:30PM)
Interim (9:45PM-12:00AM)
Pumpack (12:15AM-6:15AM)
Interim (6:30AM-10AM)

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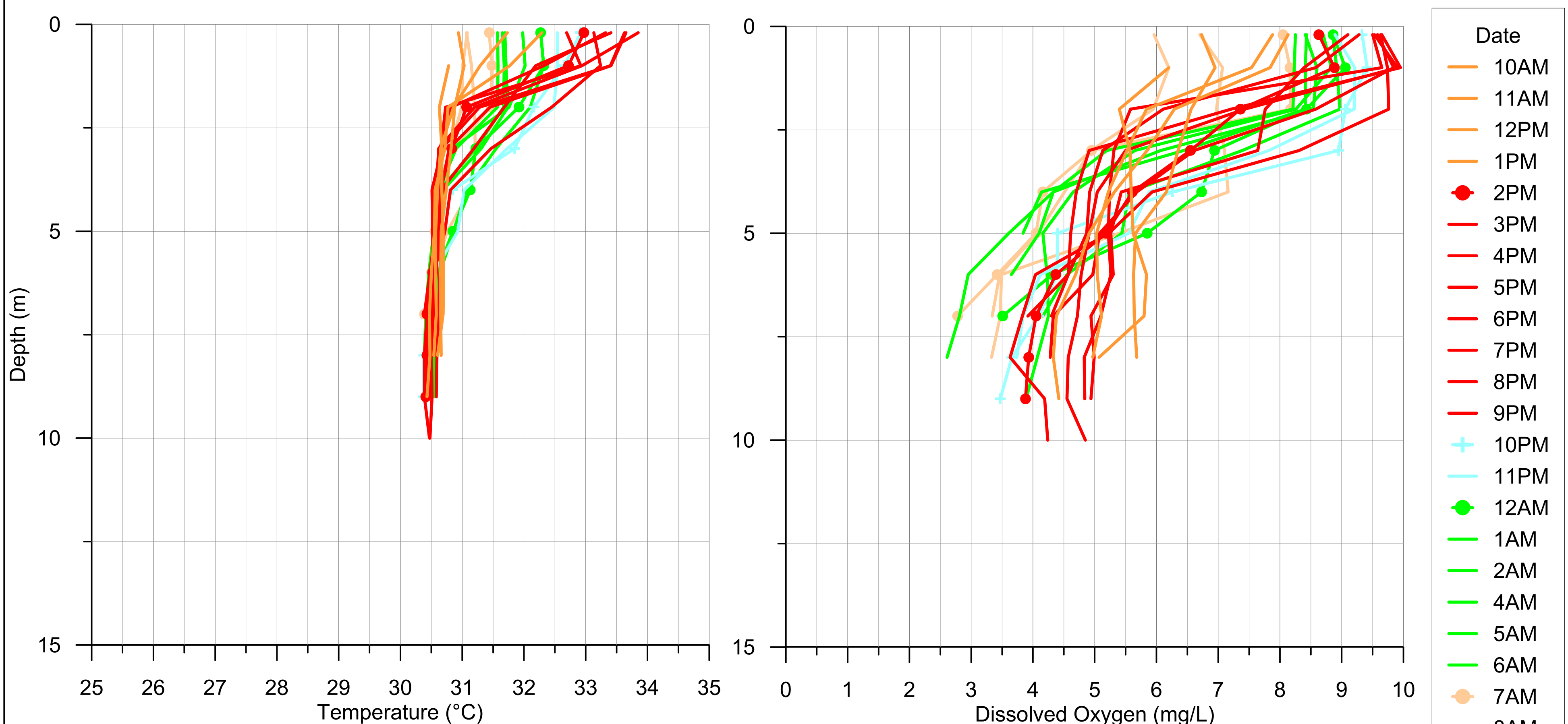
Figure 11c
24-Hour Vertical Temperature and DO Profiles in August from Station OC3
Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on August 15-16

Interim (10AM-2PM)

Generation (2:15PM-9:30PM)

Interim (9:45PM-12:00AM)

Pumpack (12:15AM-6:15AM)

Interim (6:30AM-10AM)

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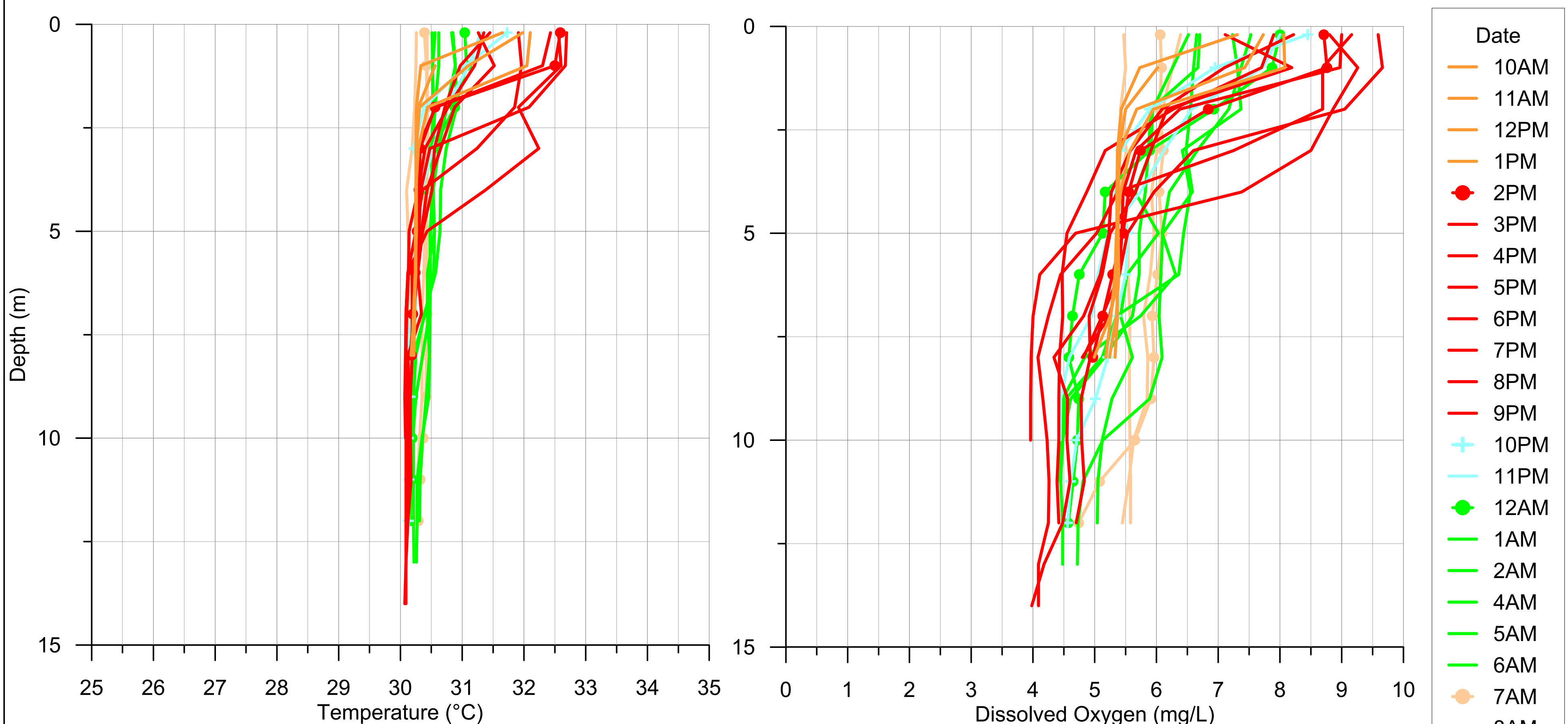
Figure 11d

24-Hour Vertical Temperature and DO Profiles in August from Station OC4

Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on August 15-16

Interim (10AM-2PM)

Generation (2:15PM-9:30PM)

Interim (9:45PM-12:00AM)

Pumpack (12:15AM-6:15AM)

Interim (6:30AM-10AM)

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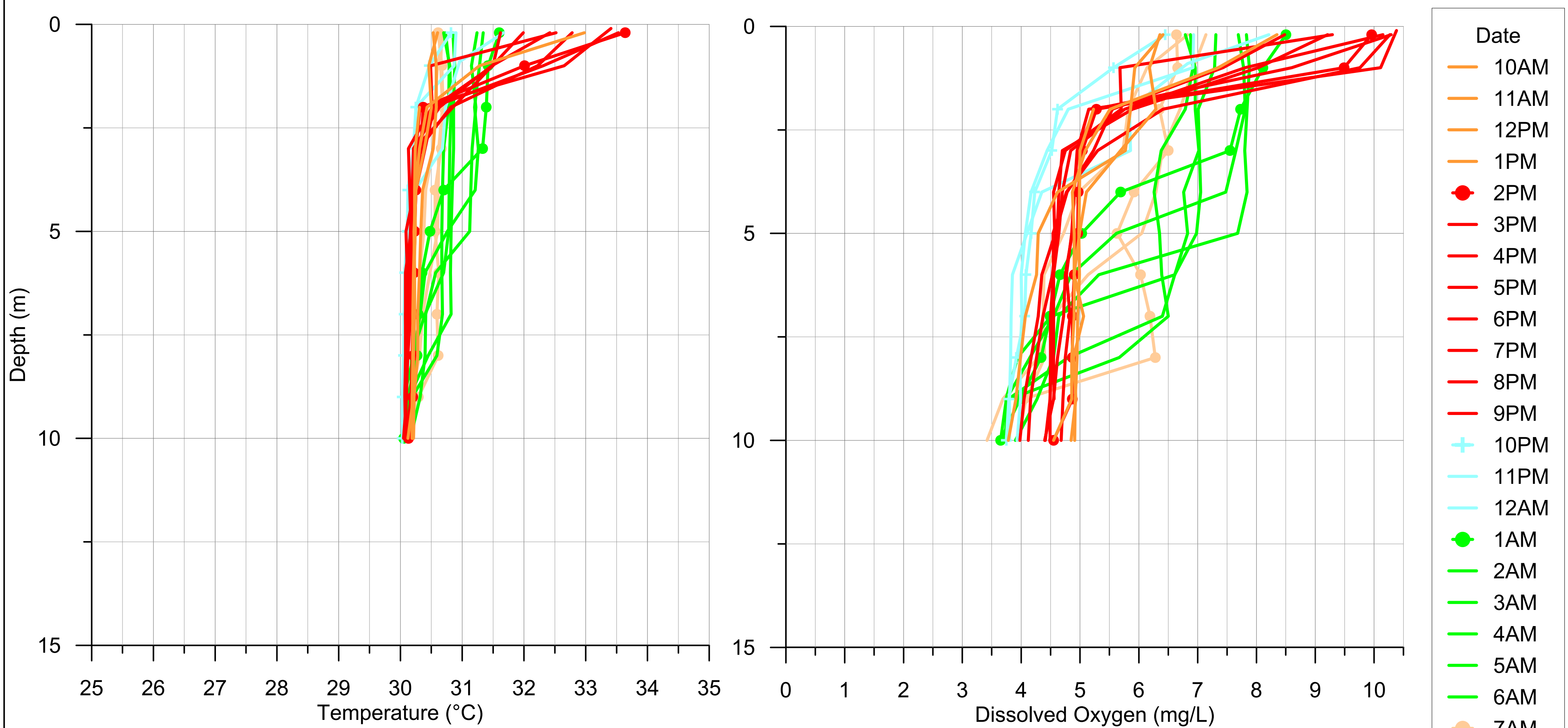
Figure 11e
24-Hour Vertical Temperature and DO Profiles in August from Station OC5

Wallace Dam Project
(FERC No. 2413)



Wallace Dam Operations on August 15-16

Interim (10AM-2PM)

Generation (2:15PM-9:30PM)

Interim (9:45PM-12:00AM)

Pumpack (12:15AM-6:15AM)

Interim (6:30AM-10AM)

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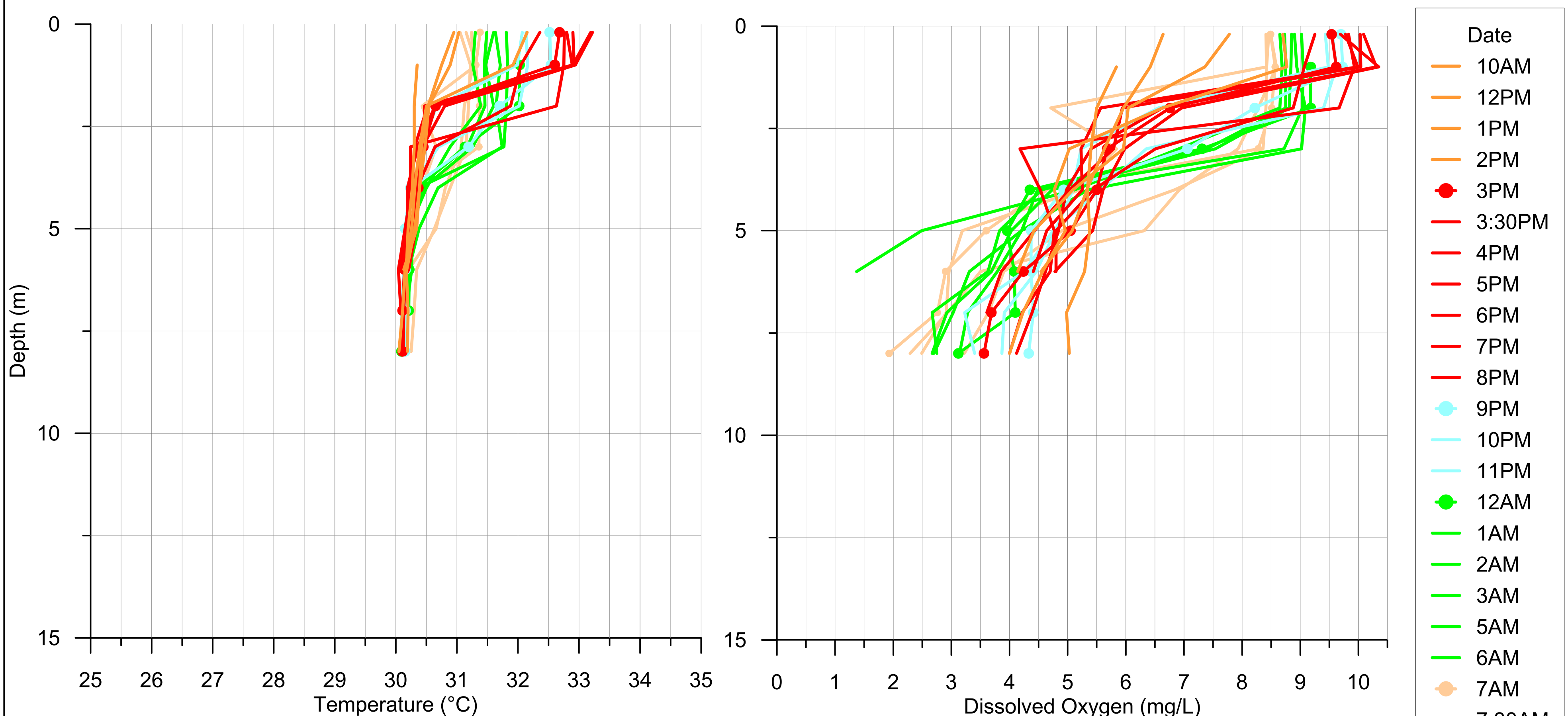
Figure 11f

24-Hour Vertical Temperature and DO Profiles in August from Station OC6

Wallace Dam Project

(FERC No. 2413)



Wallace Dam Operations on August 15-16
Interim (10AM-2PM)
Generation (2:15PM-9:30PM)
Interim (9:45PM-12:00AM)
Pumpack (12:15AM-6:15AM)
Interim (6:30AM-10AM)

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Figure 11g
24-Hour Vertical Temperature and DO Profiles in August from Station OC9
Wallace Dam Project
(FERC No. 2413)

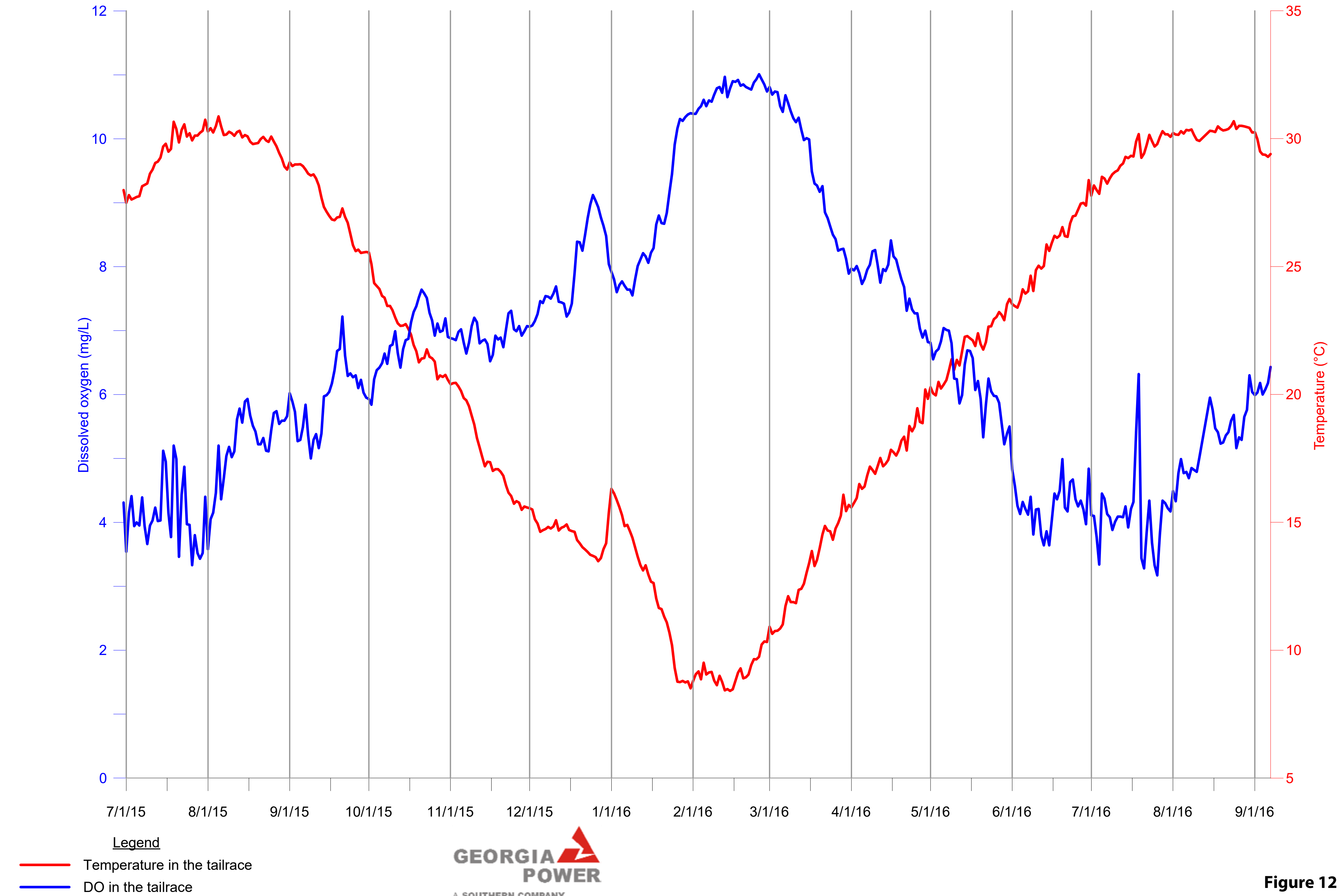

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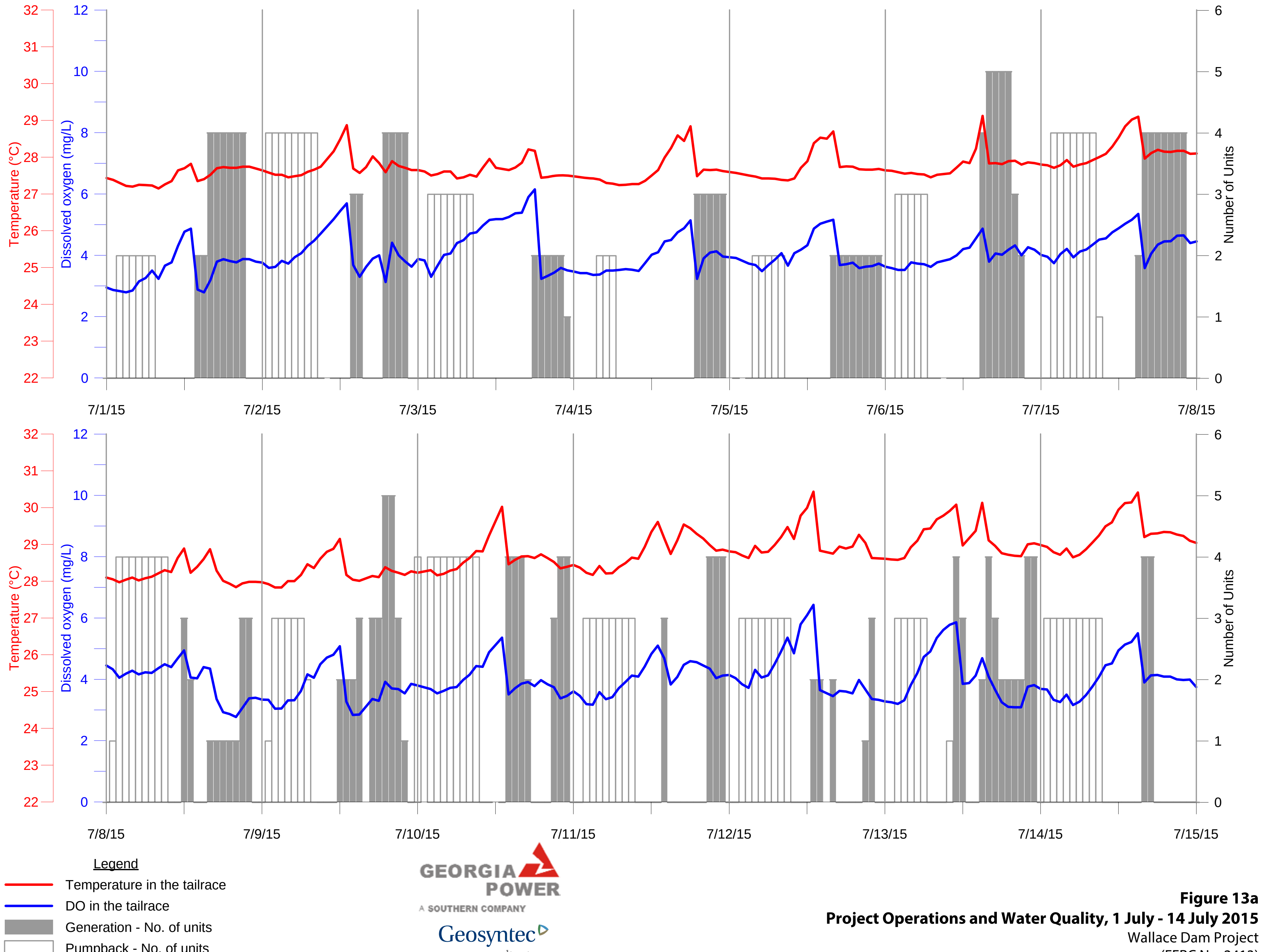
Figure 12
Daily Average Water Temperature and DO, 2015-2016
Wallace Dam Project
(FERC No. 2413)



GEORGIA POWER
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Figure 13a

Project Operations and Water Quality, 1 July - 14 July 2015

Wallace Dam Project

(FERC No. 2413)

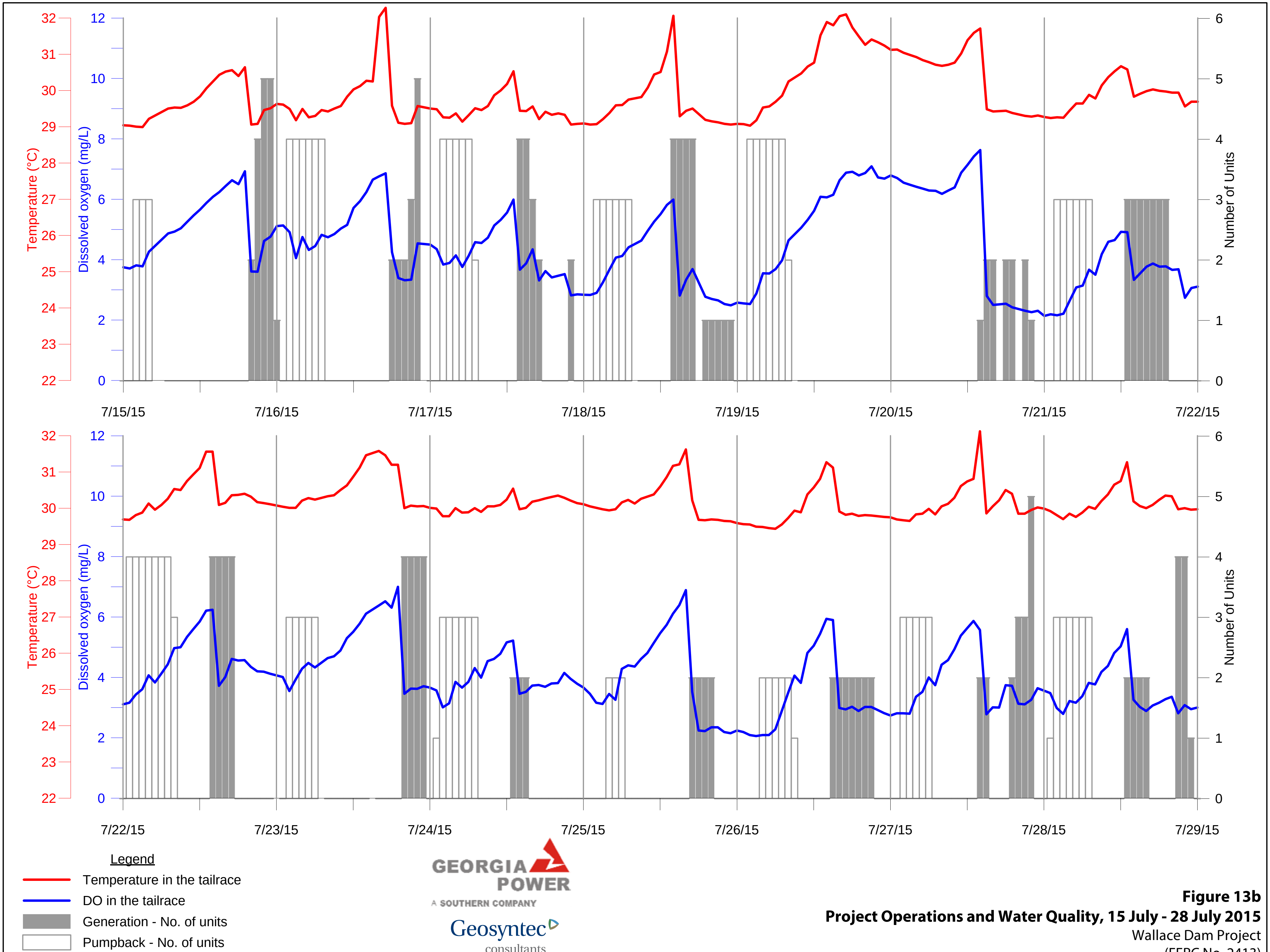

Figure 13b
Project Operations and Water Quality, 15 July - 28 July 2015
Wallace Dam Project
(FERC No. 2413)

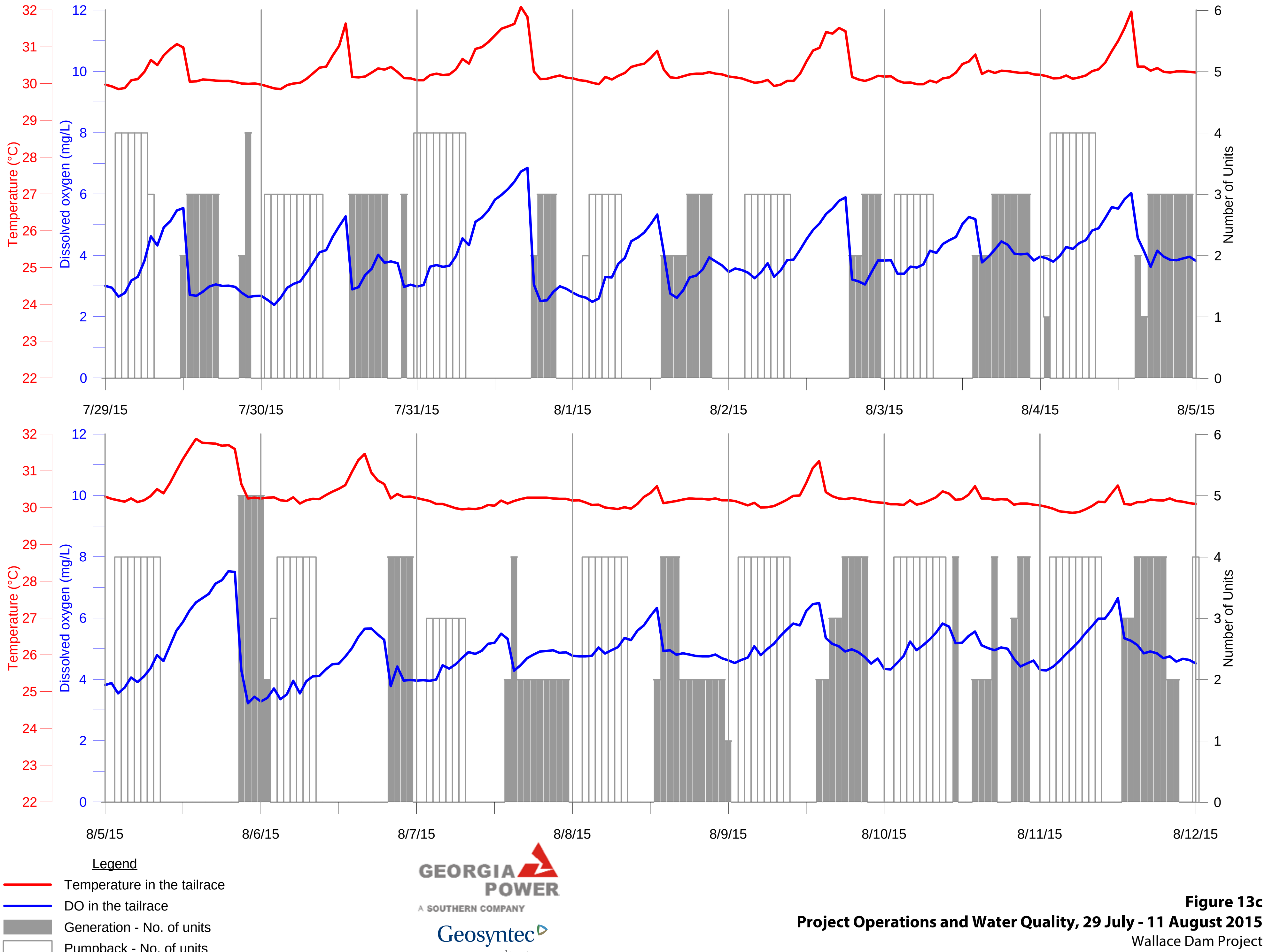

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Figure 13c

Project Operations and Water Quality, 29 July - 11 August 2015

Wallace Dam Project

(FERC No. 2413)

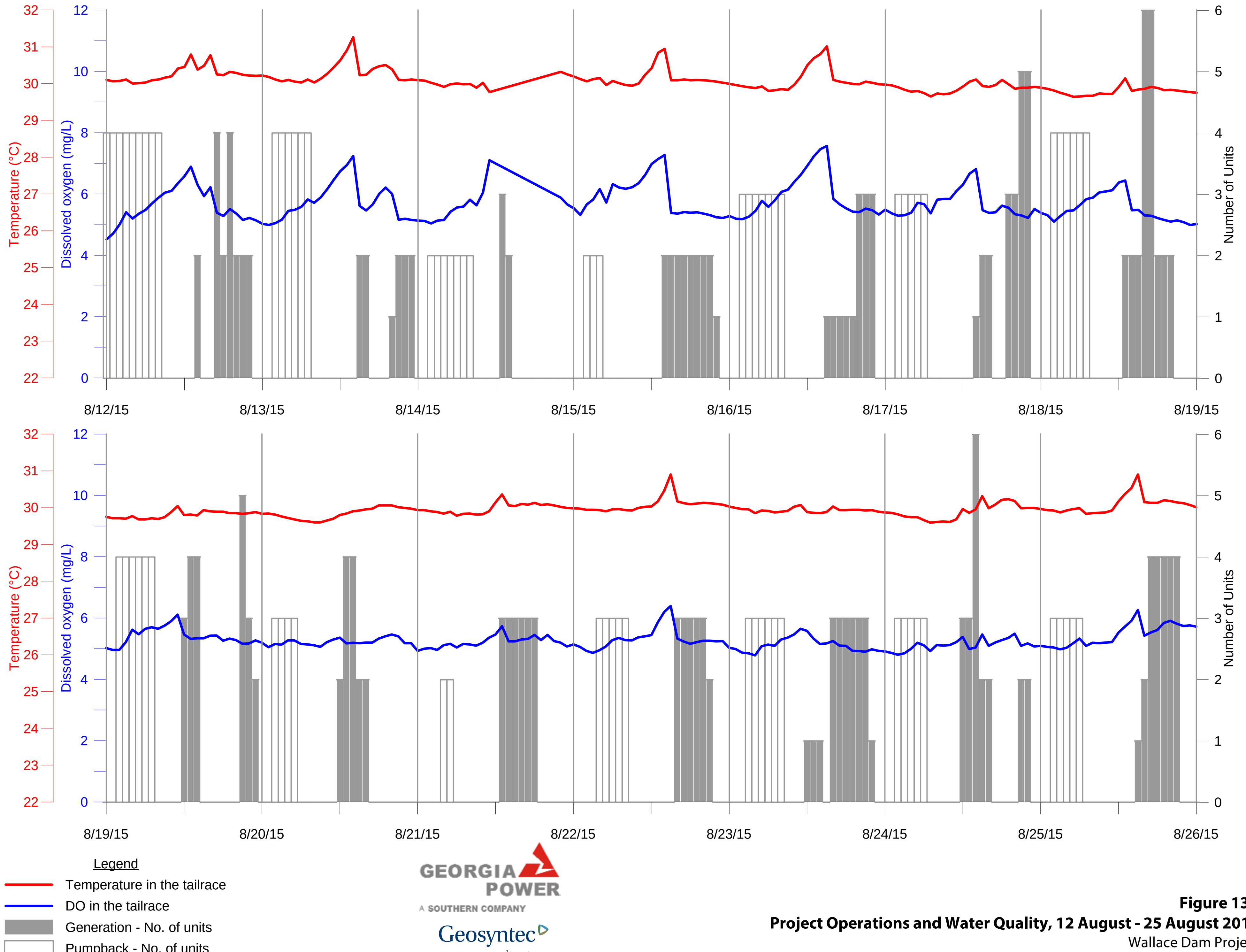

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Figure 13d

Project Operations and Water Quality, 12 August - 25 August 2015

Wallace Dam Project

(FERC No. 2413)

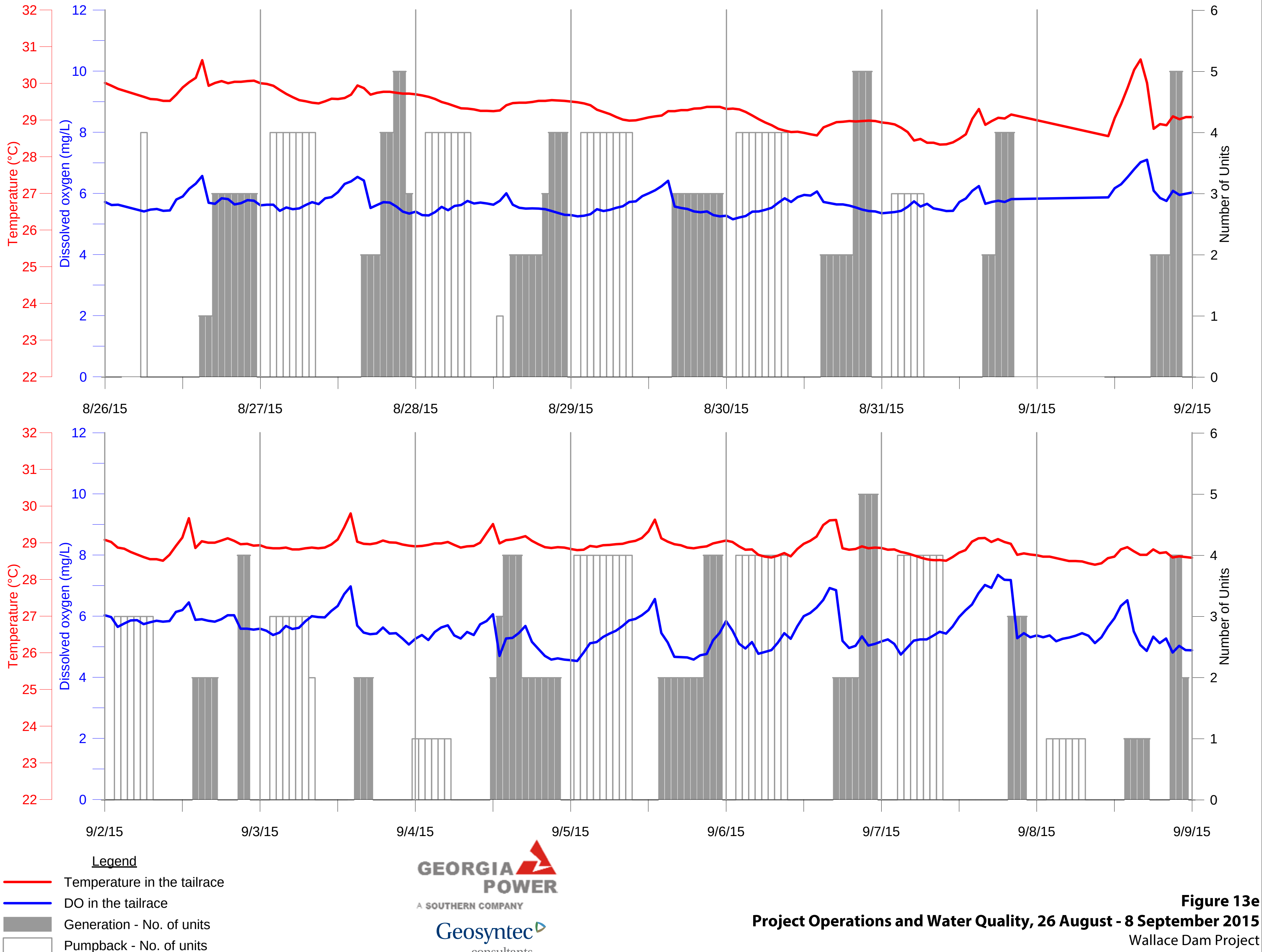

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Figure 13e

Project Operations and Water Quality, 26 August - 8 September 2015

Wallace Dam Project

(FERC No. 2413)

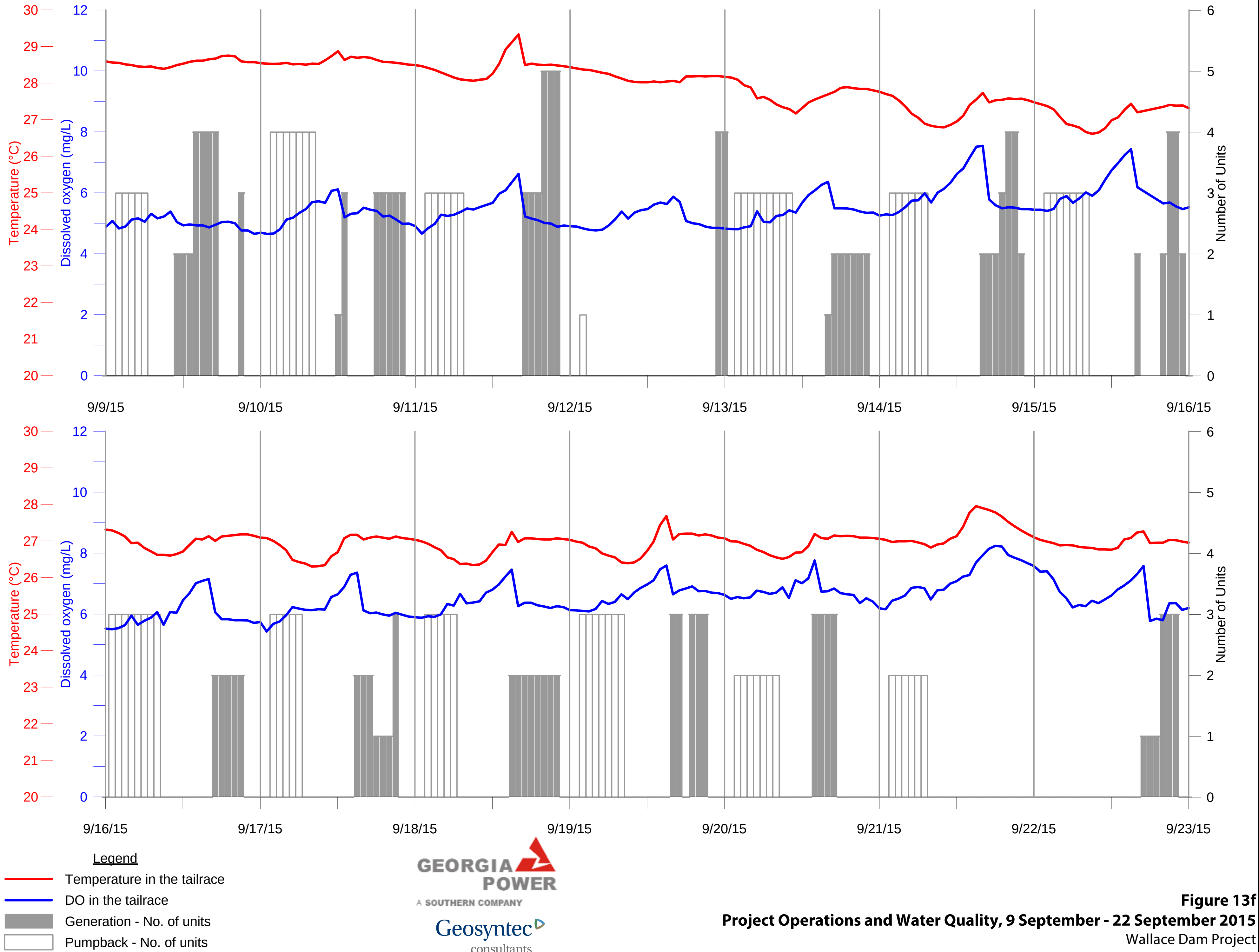

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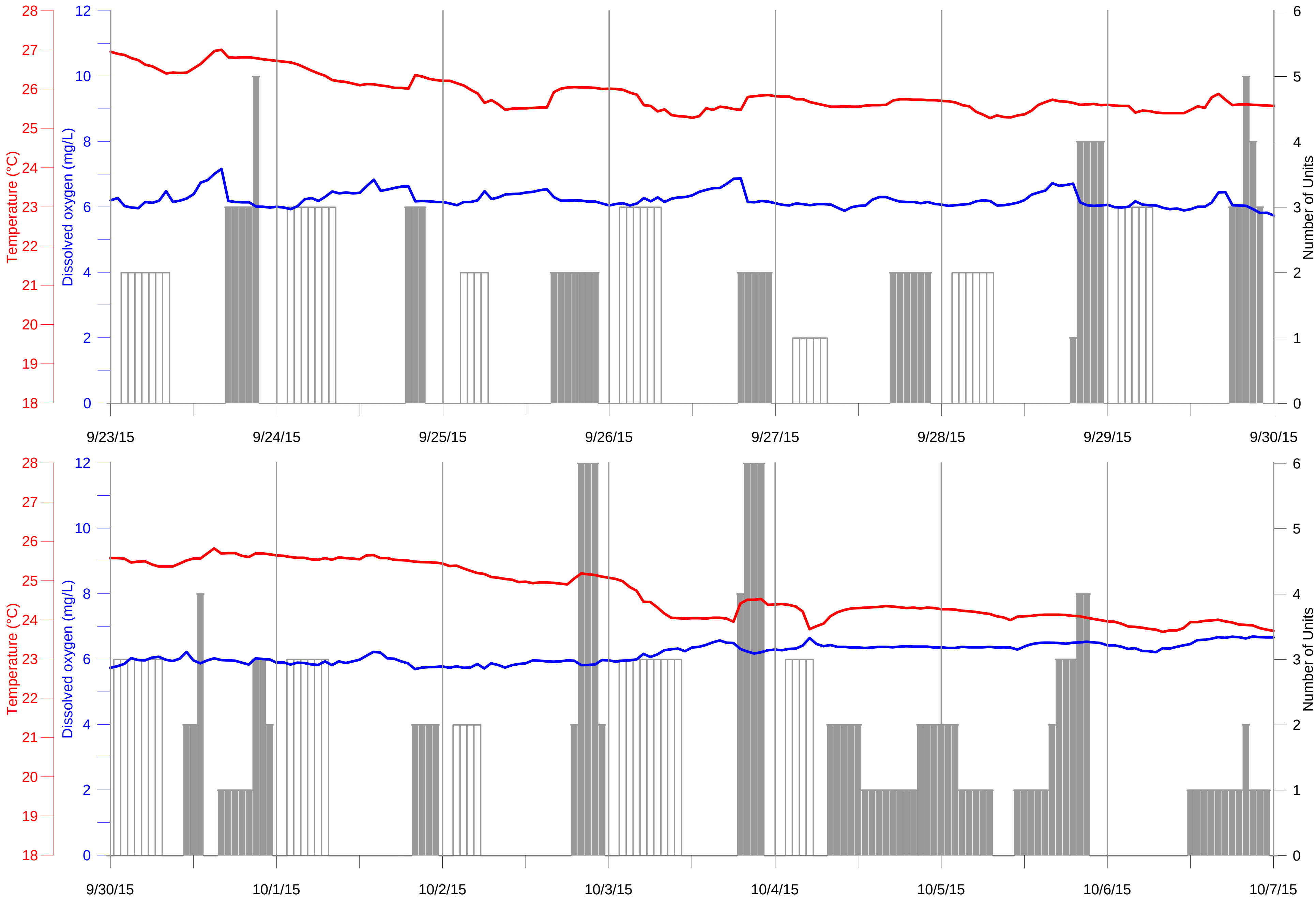
Figure 13f

Project Operations and Water Quality, 9 September - 22 September 2015

Wallace Dam Project

(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

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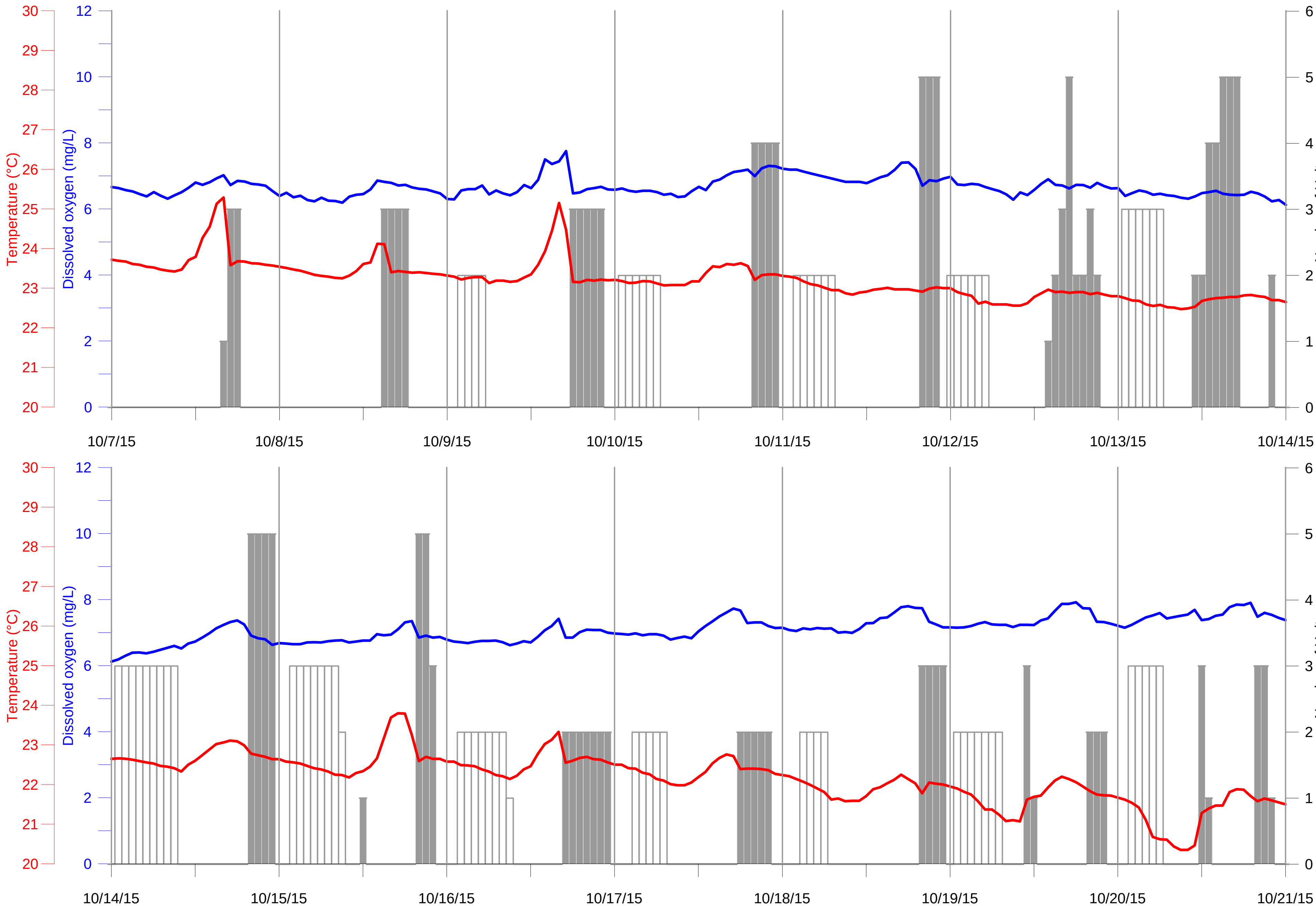
Figure 13g

Project Operations and Water Quality, 23 September - 6 October 2015

Wallace Dam Project

(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

GEORGIA POWER

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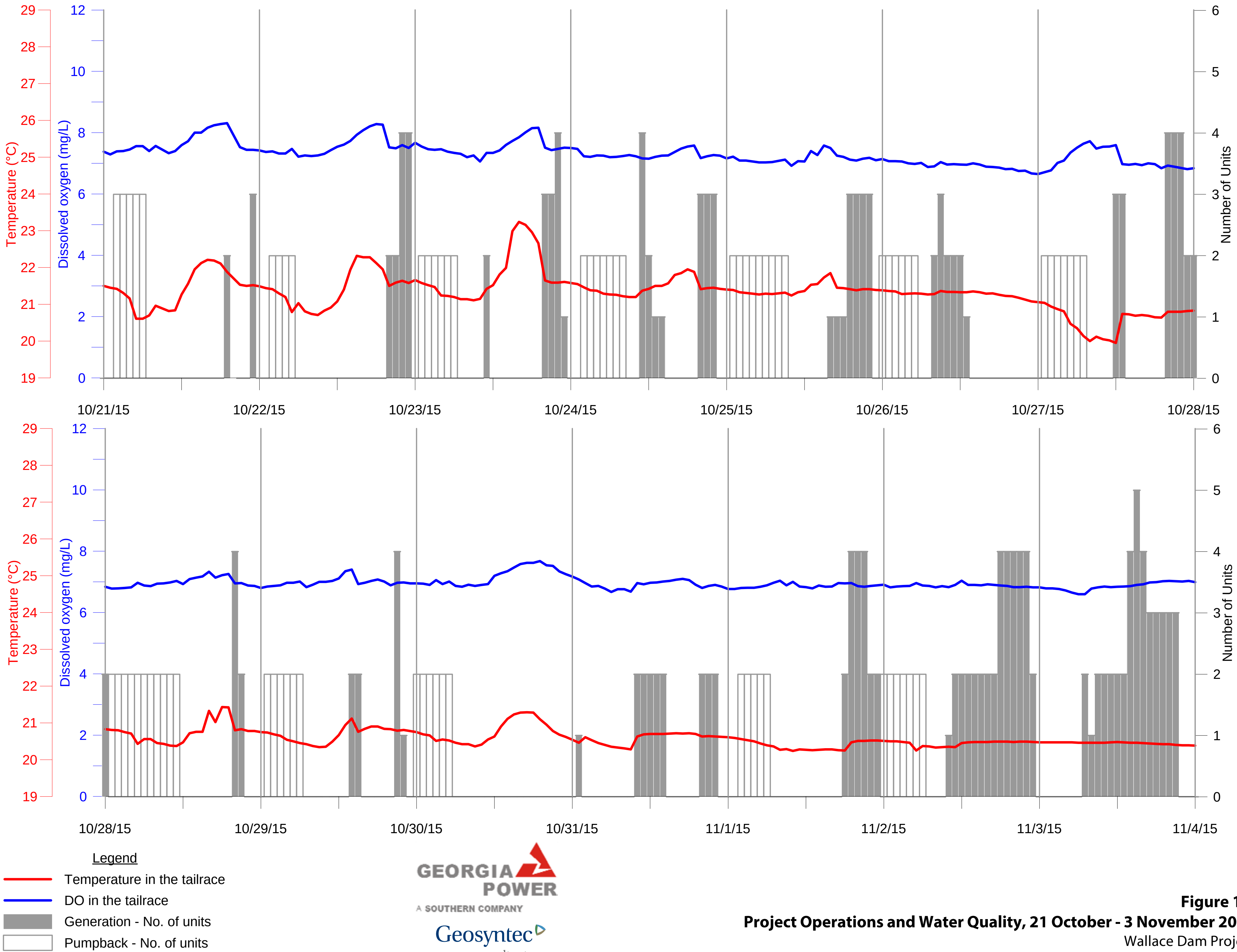
Figure 13h

Project Operations and Water Quality, 7 October - 20 October 2015

Wallace Dam Project

(FERC No. 2413)



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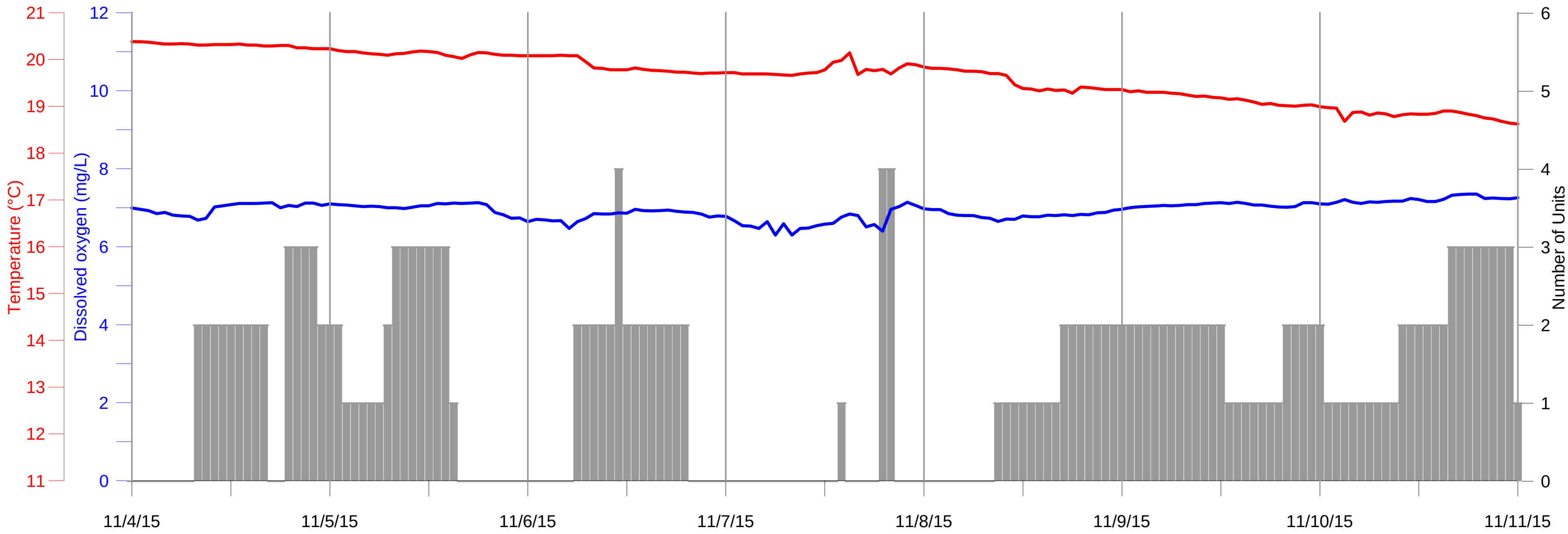
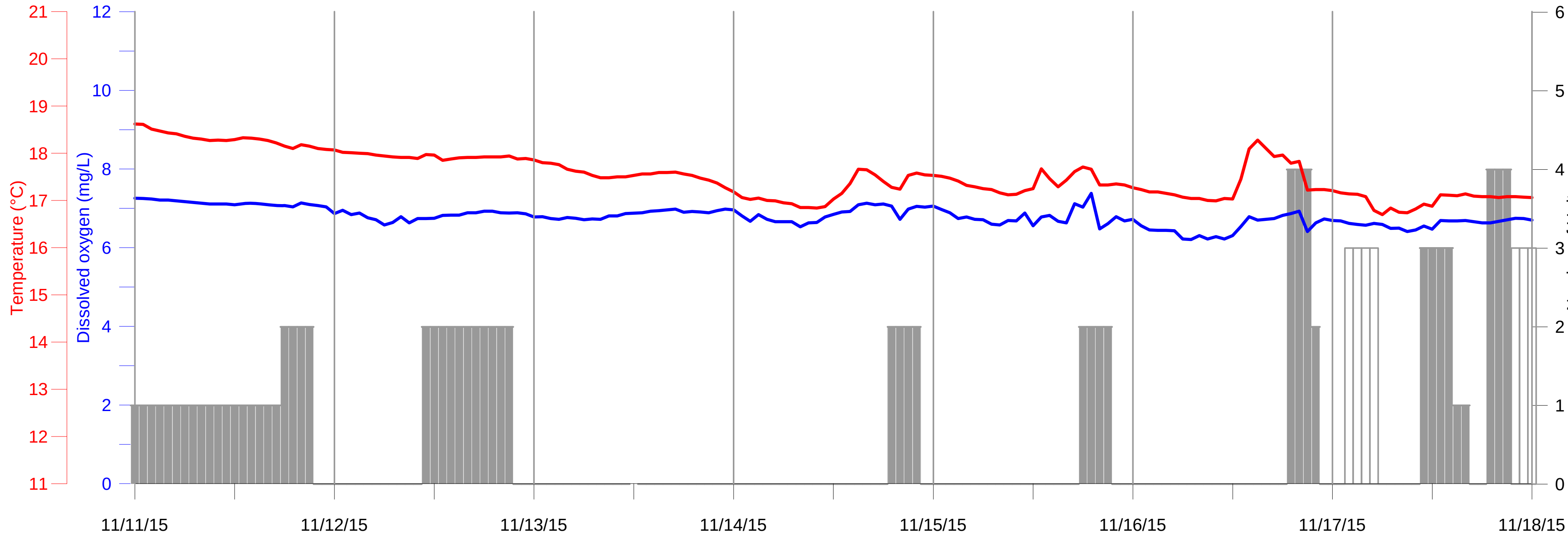
consultants

Figure 13i
Project Operations and Water Quality, 21 October - 3 November 2015
Wallace Dam Project
(FERC No. 2413)





Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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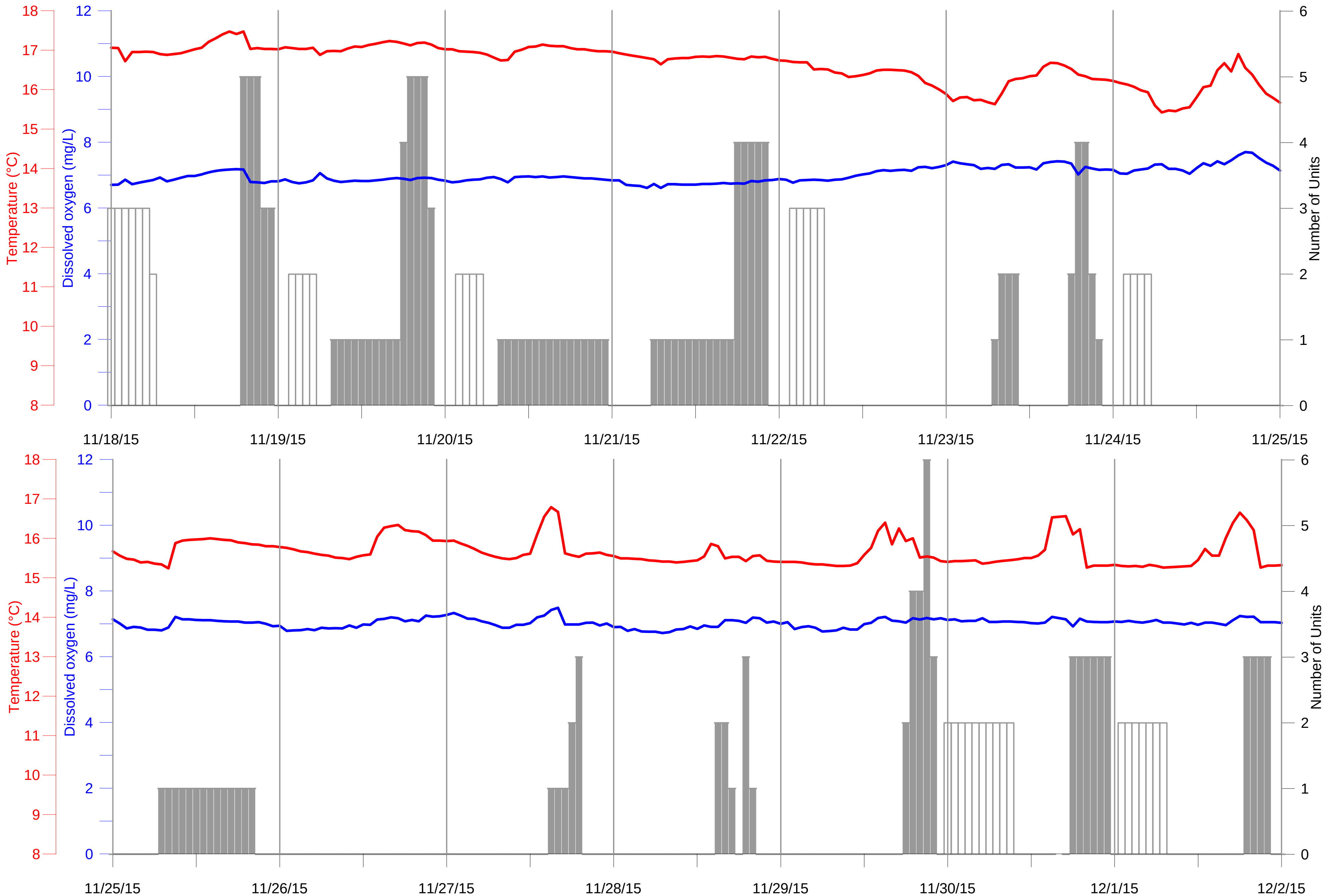
Figure 13j

Project Operations and Water Quality, 4 November - 17 November 2015

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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Geosyntec consultants

Figure 13k

Project Operations and Water Quality, 18 November - 1 December 2015

Wallace Dam Project

(FERC No. 2413)

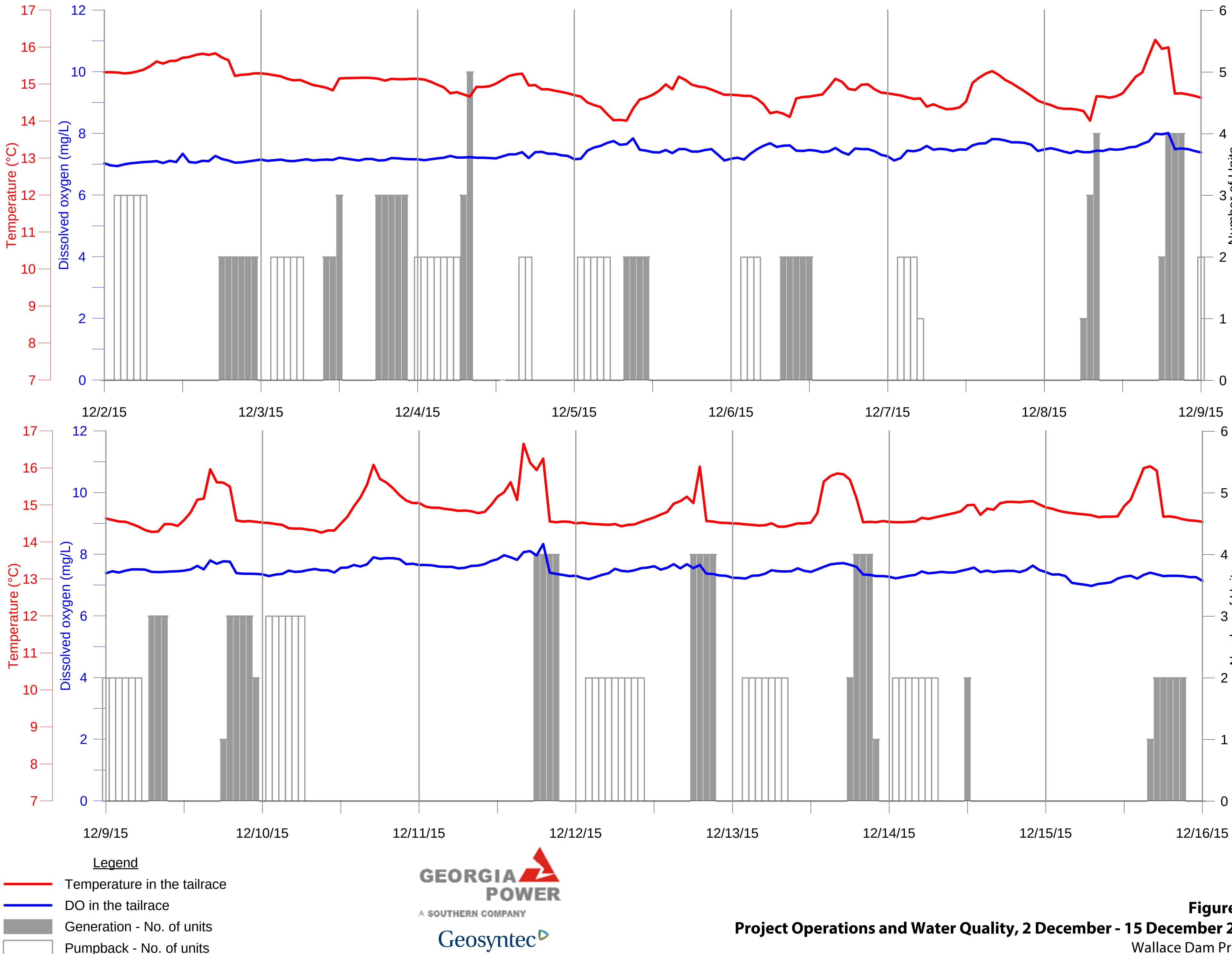

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Figure 13l

Project Operations and Water Quality, 2 December - 15 December 2015

Wallace Dam Project

(FERC No. 2413)

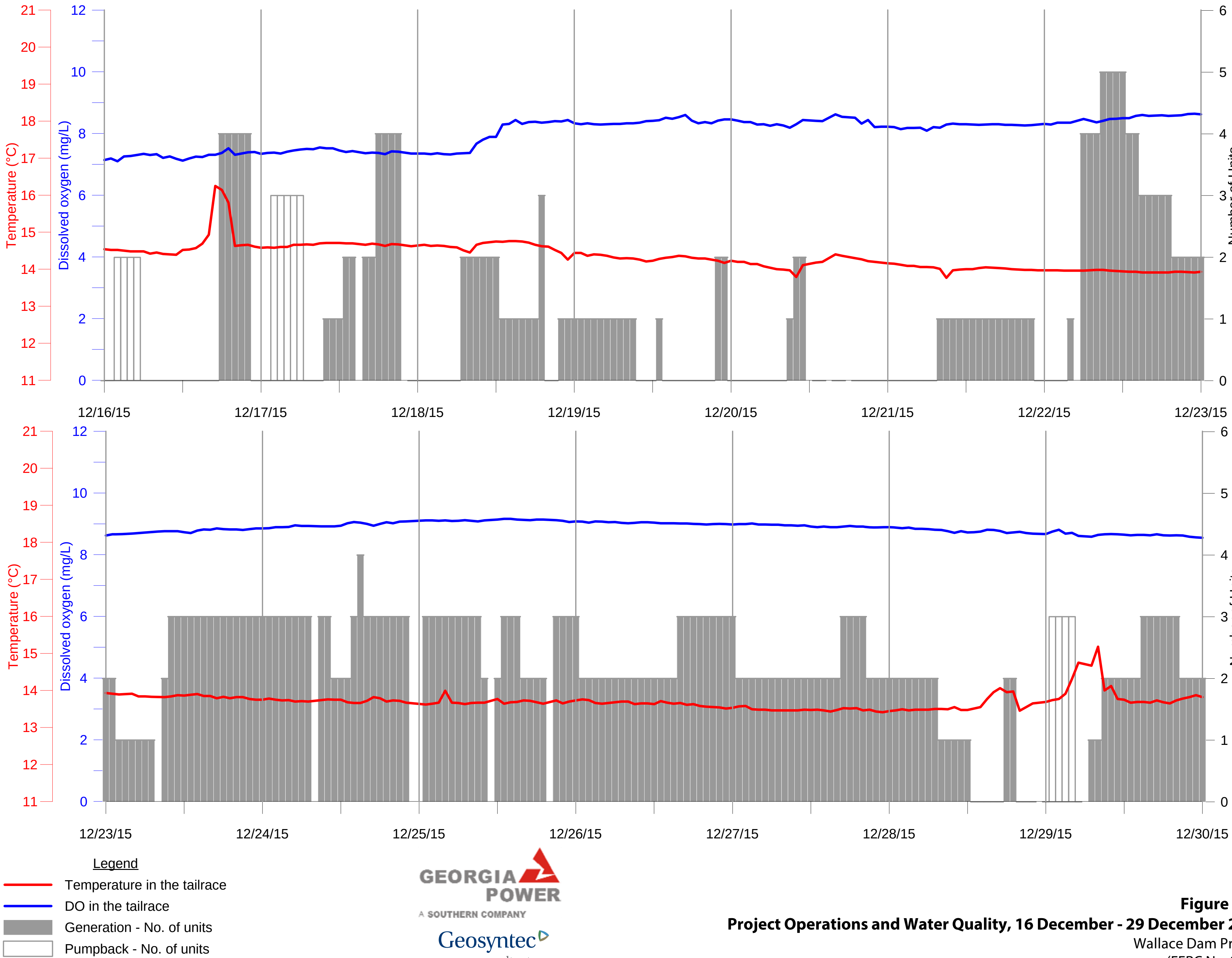

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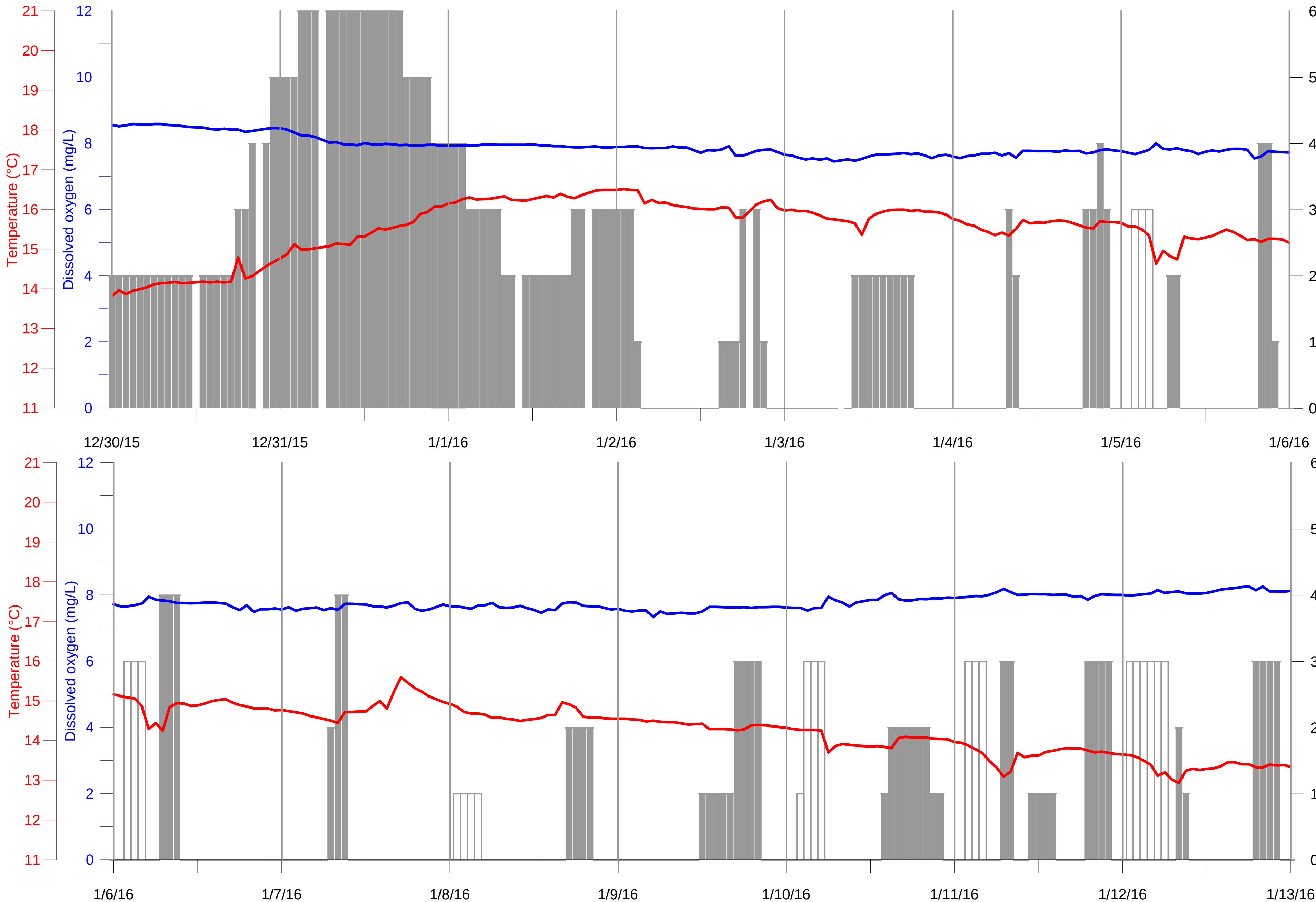
Figure 13m

Project Operations and Water Quality, 16 December - 29 December 2015

Wallace Dam Project

(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

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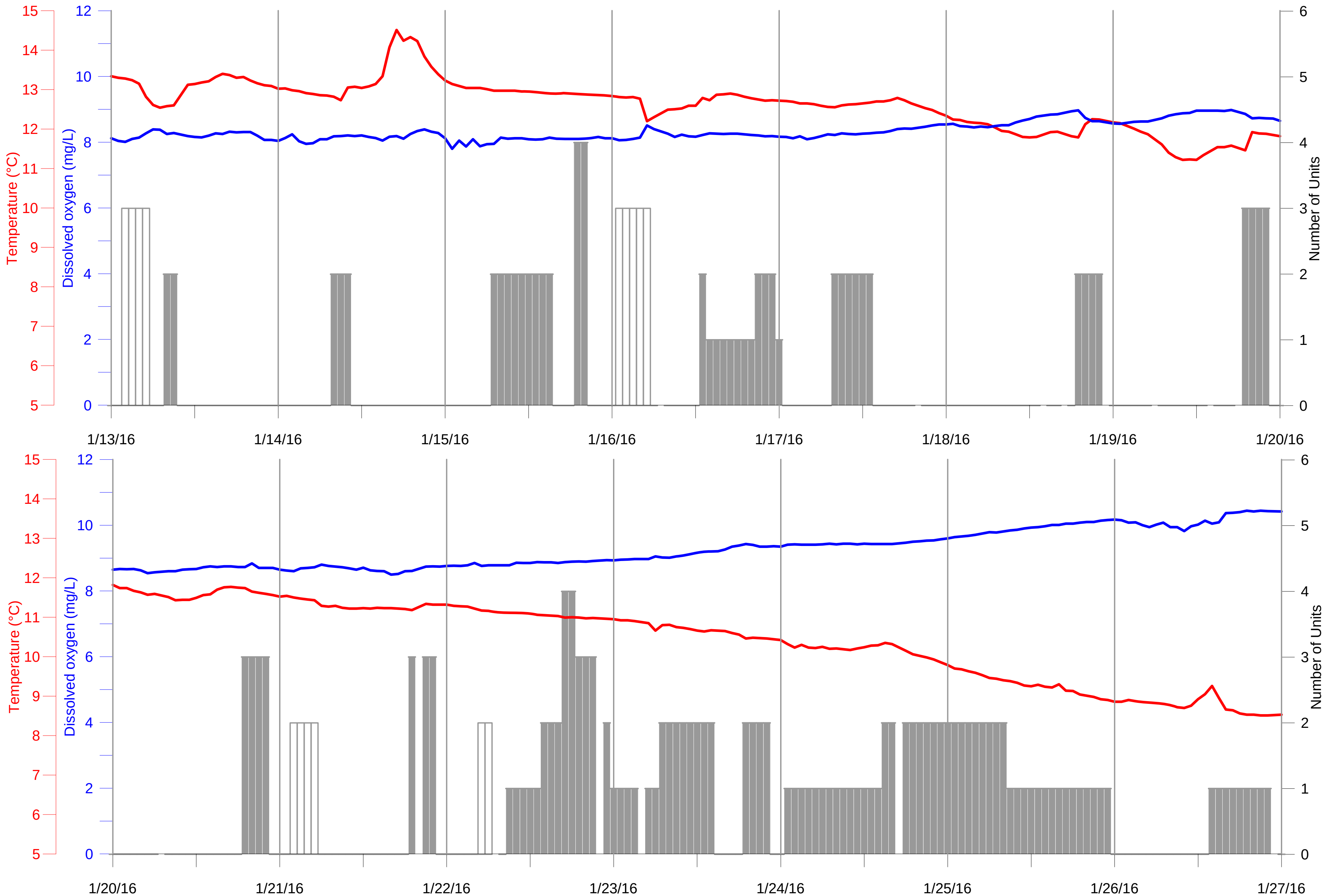
Figure 13n

Project Operations and Water Quality, 30 December 2015 - 12 January 2016

Wallace Dam Project

(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

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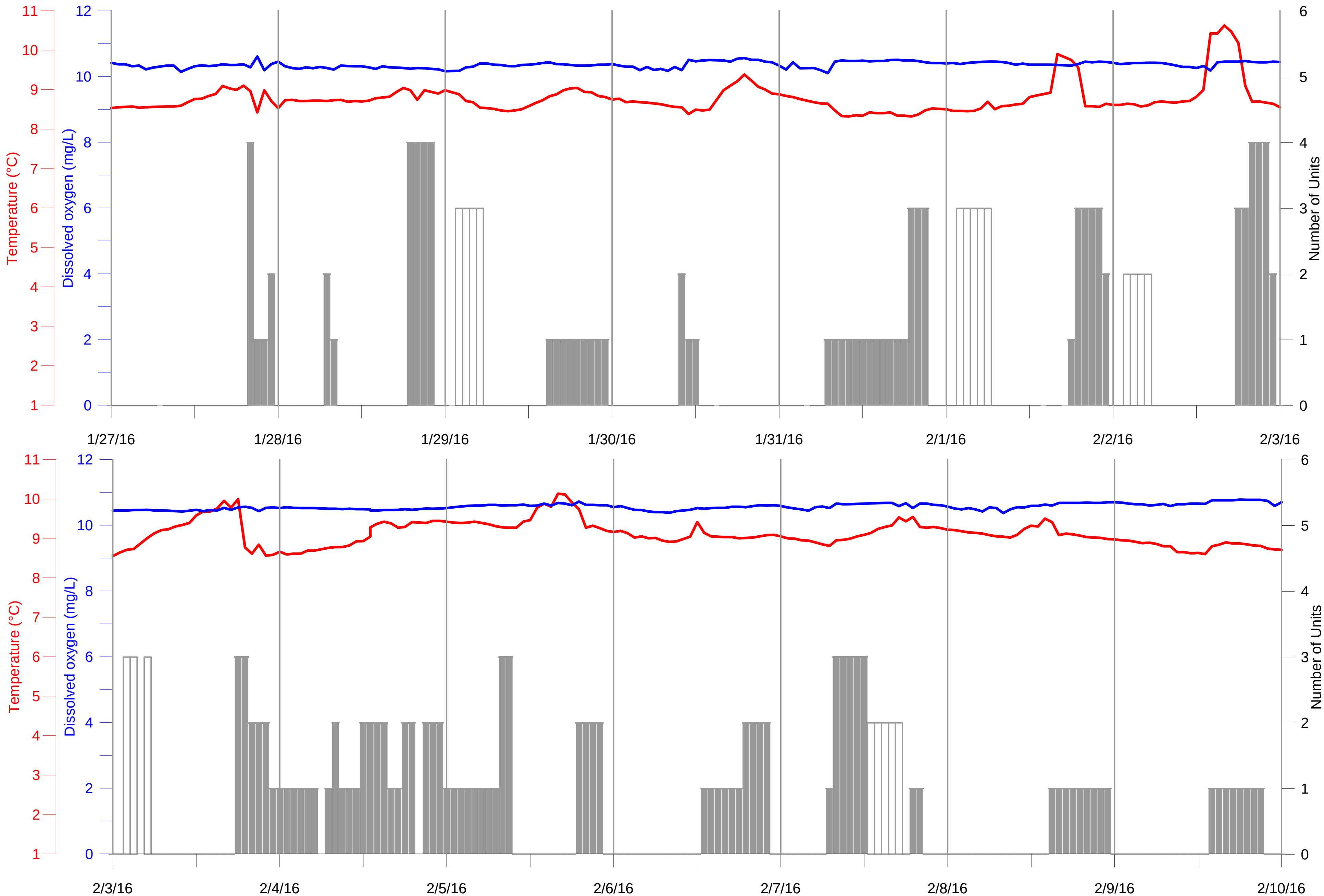
Figure 13o

Project Operations and Water Quality, 13 January - 26 January 2016

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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Figure 13p

Project Operations and Water Quality, 27 January - 9 February 2016

Wallace Dam Project

(FERC No. 2413)

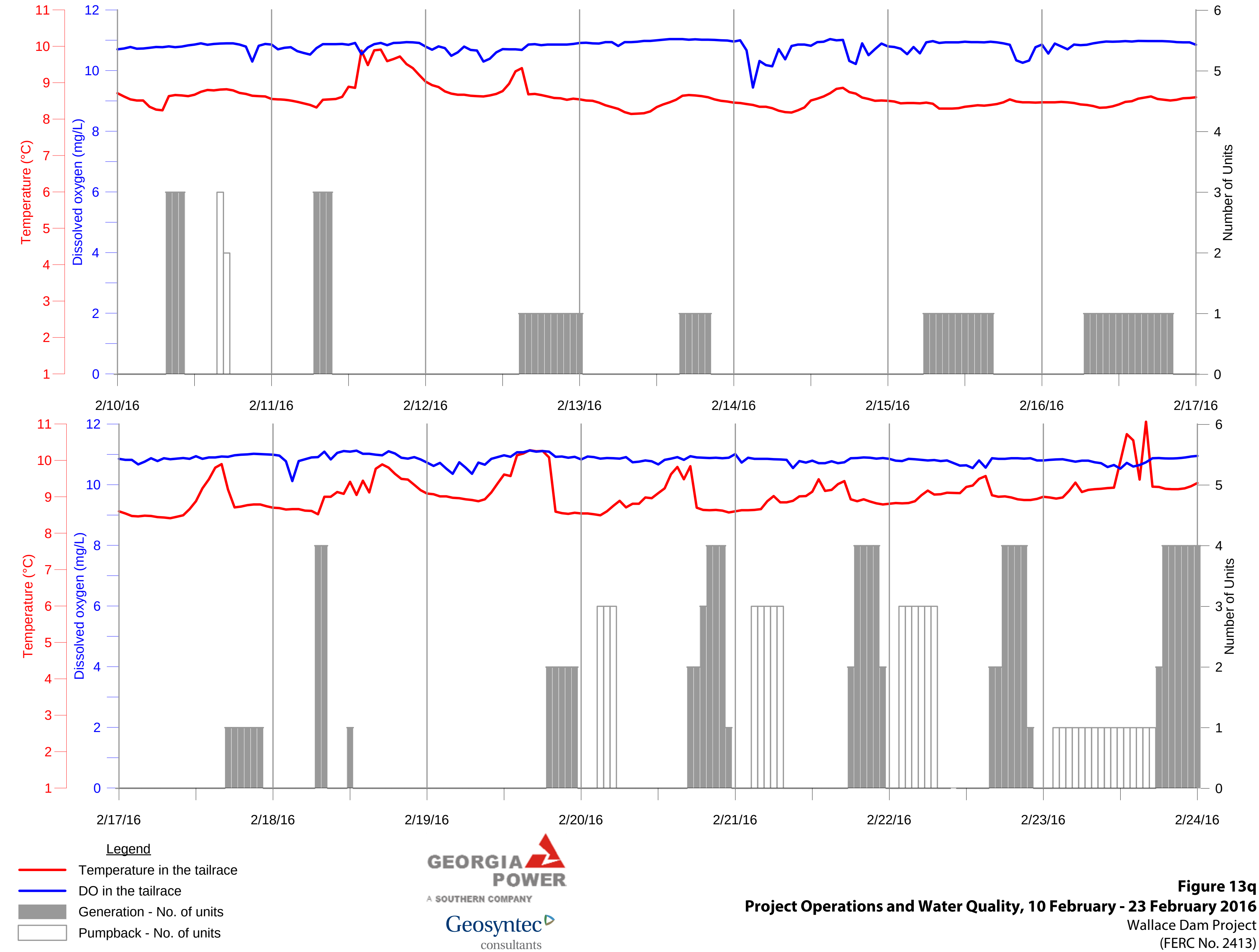

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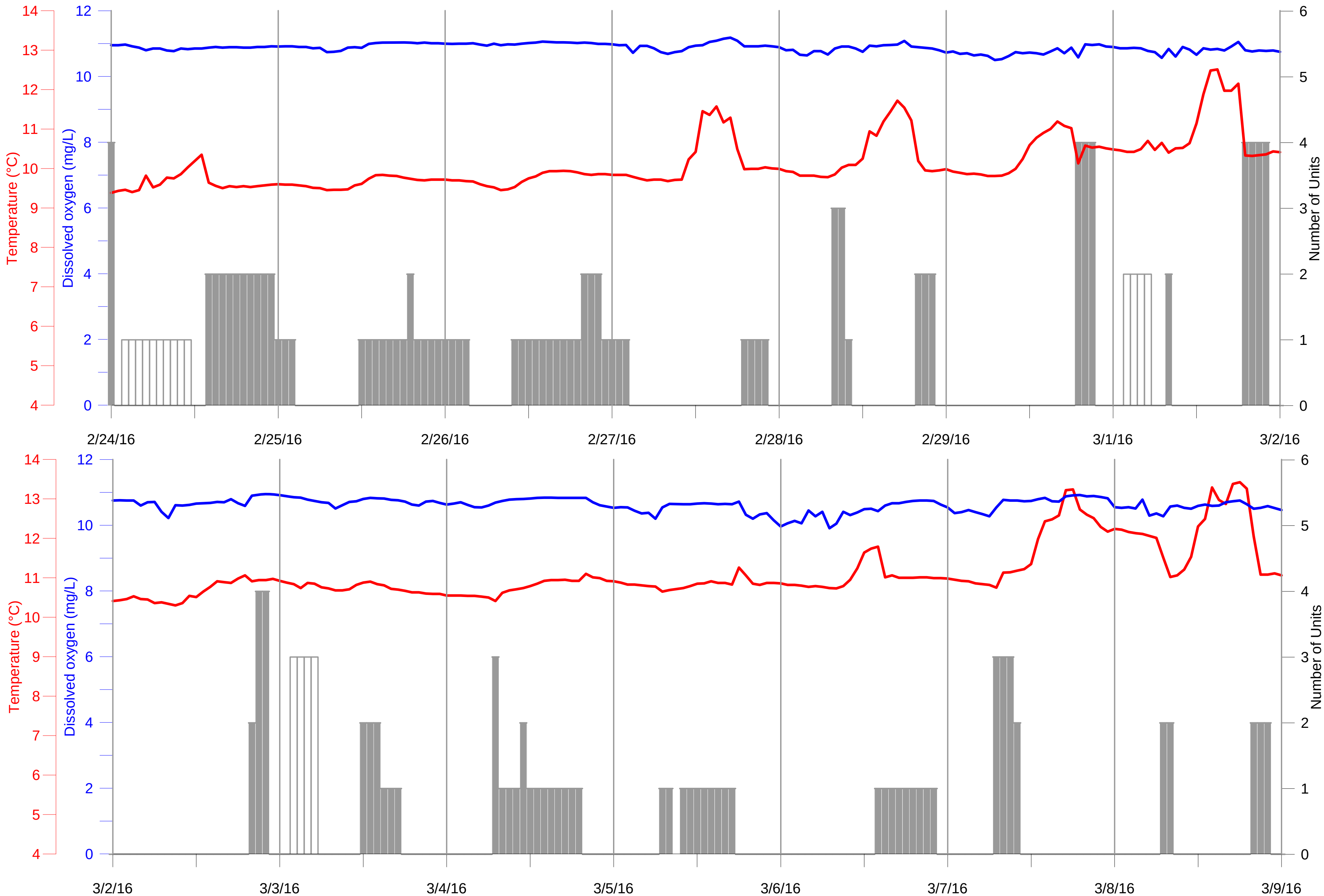
Figure 13q

Project Operations and Water Quality, 10 February - 23 February 2016

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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Figure 13r

Project Operations and Water Quality, 24 February - 8 March 2016

Wallace Dam Project

(FERC No. 2413)

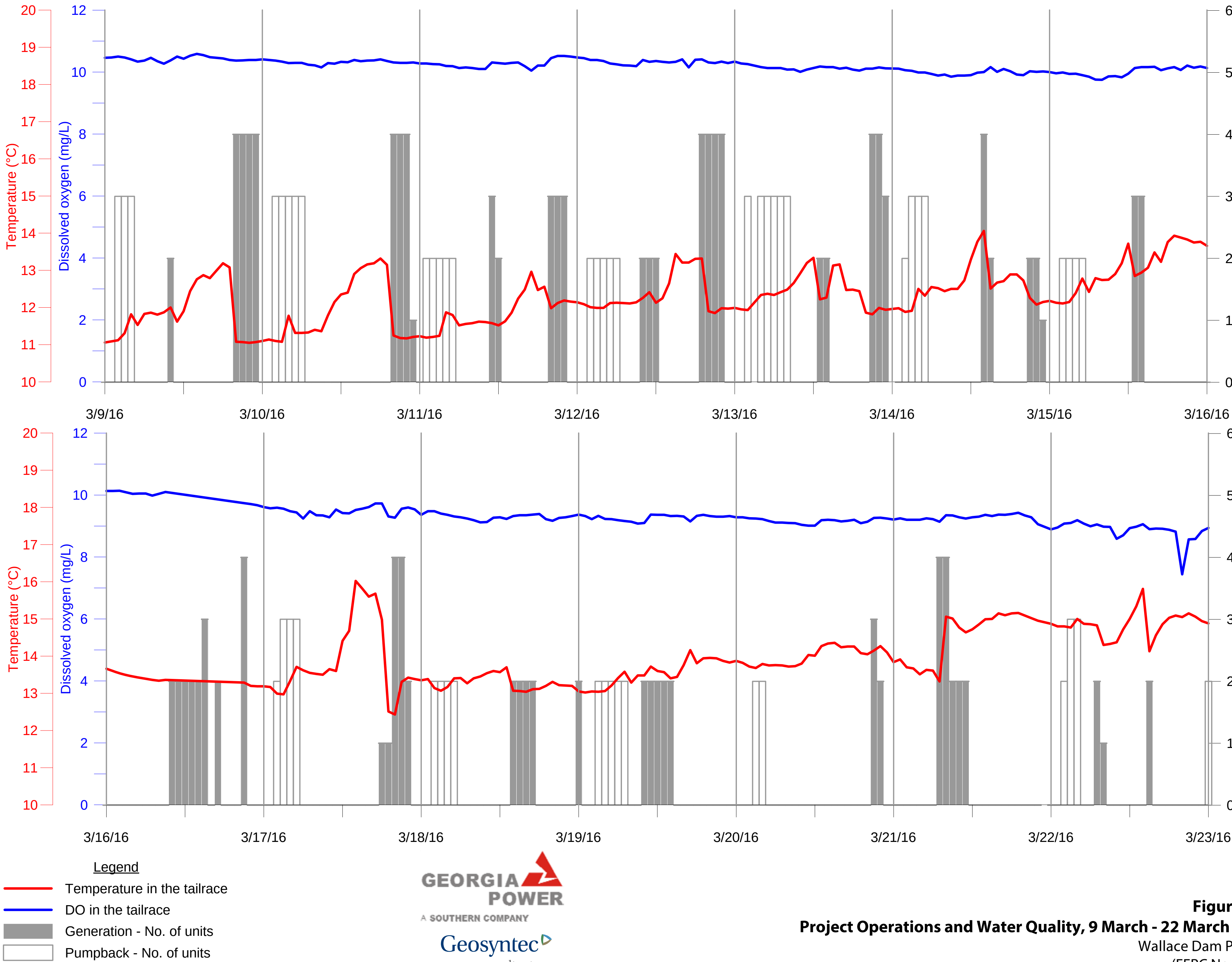

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Figure 13s
Project Operations and Water Quality, 9 March - 22 March 2016
Wallace Dam Project
(FERC No. 2413)

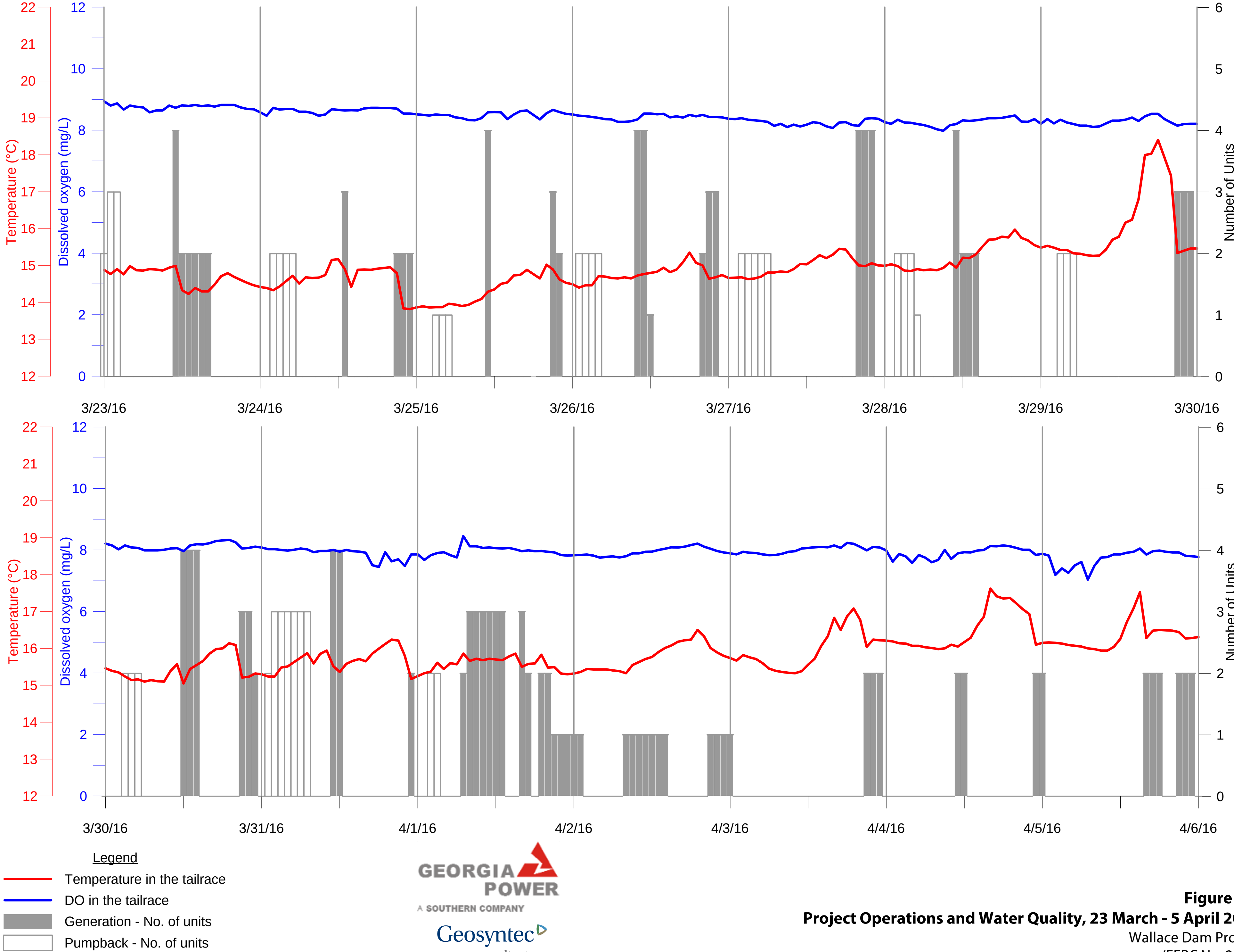

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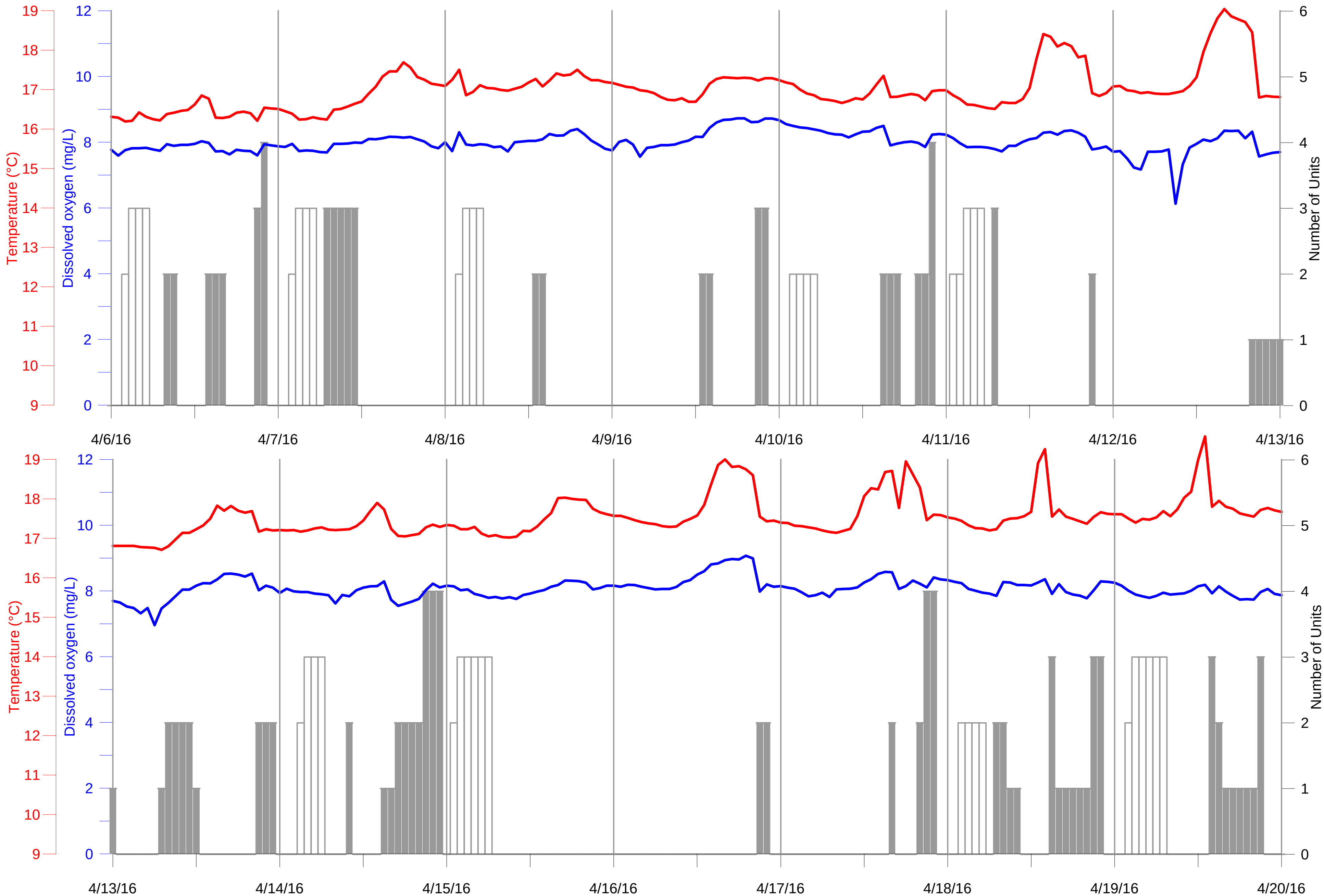
Figure 13t

Project Operations and Water Quality, 23 March - 5 April 2016

Wallace Dam Project

(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

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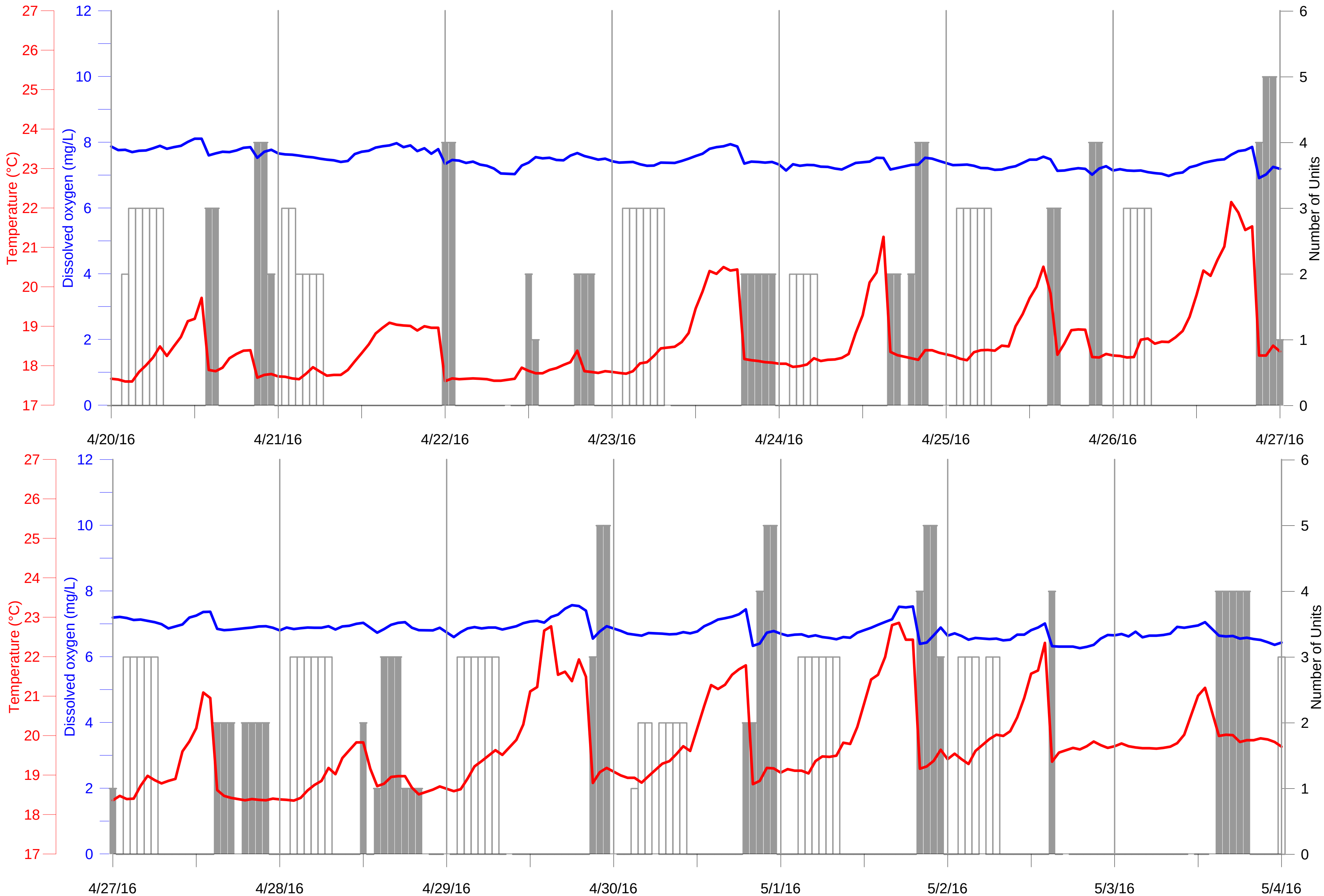
Figure 13u

Project Operations and Water Quality, 6 April - 19 April 2016

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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Figure 13v

Project Operations and Water Quality, 20 April - 3 May 2016

Wallace Dam Project

(FERC No. 2413)

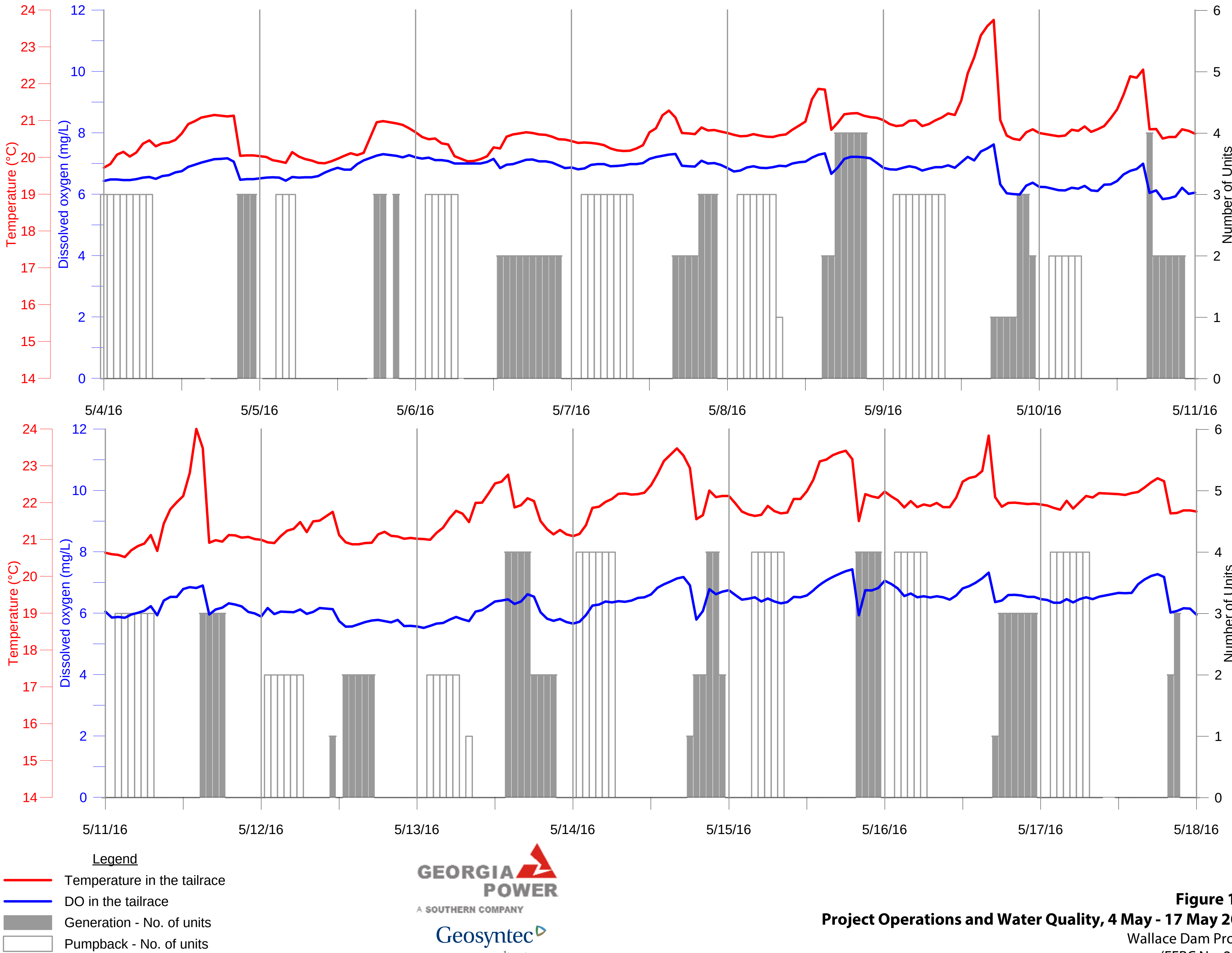
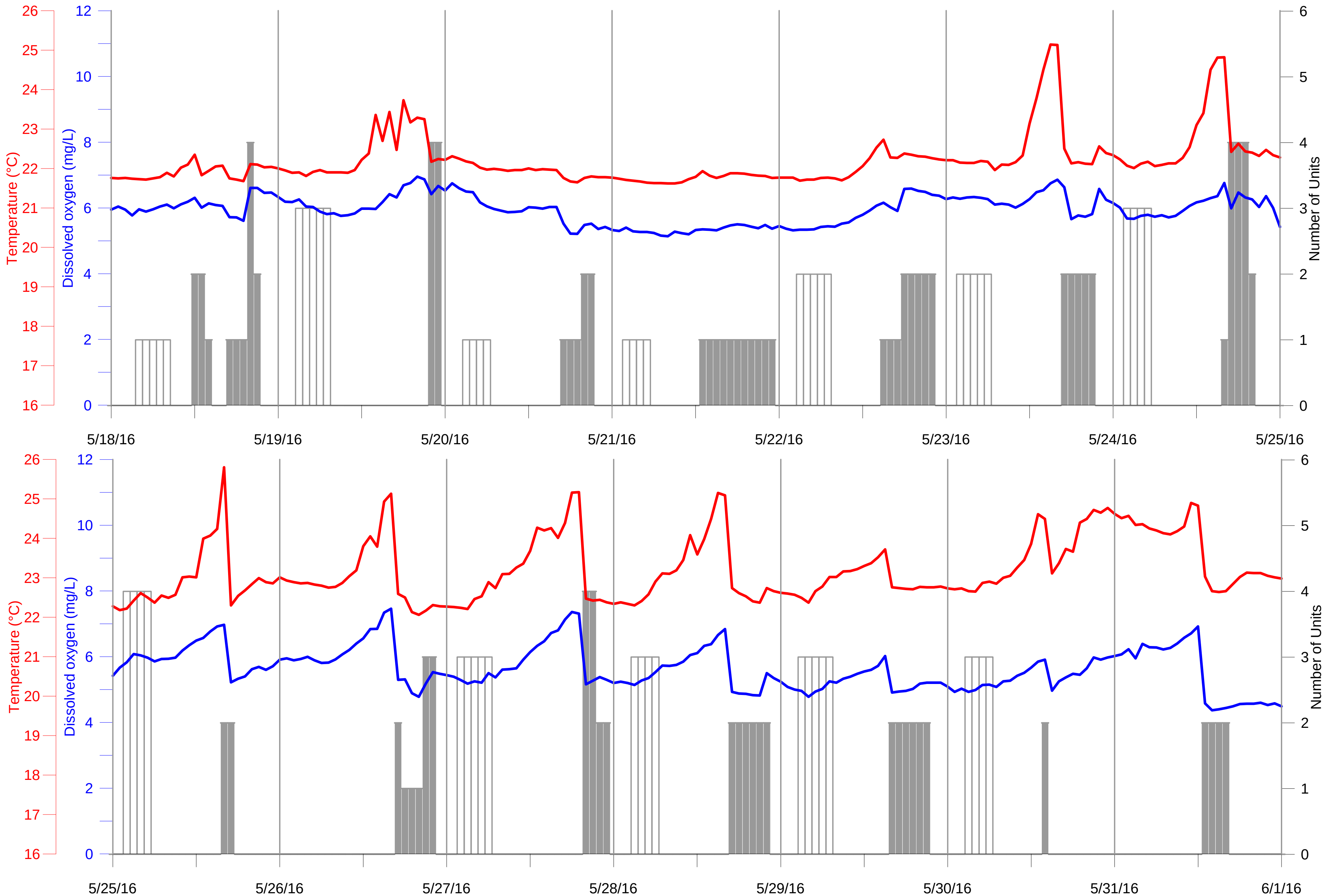


Figure 13w
Project Operations and Water Quality, 4 May - 17 May 2016
Wallace Dam Project
(FERC No. 2413)



Legend

Temperature in the tailrace

DO in the tailrace

Generation - No. of units

Pumpback - No. of units

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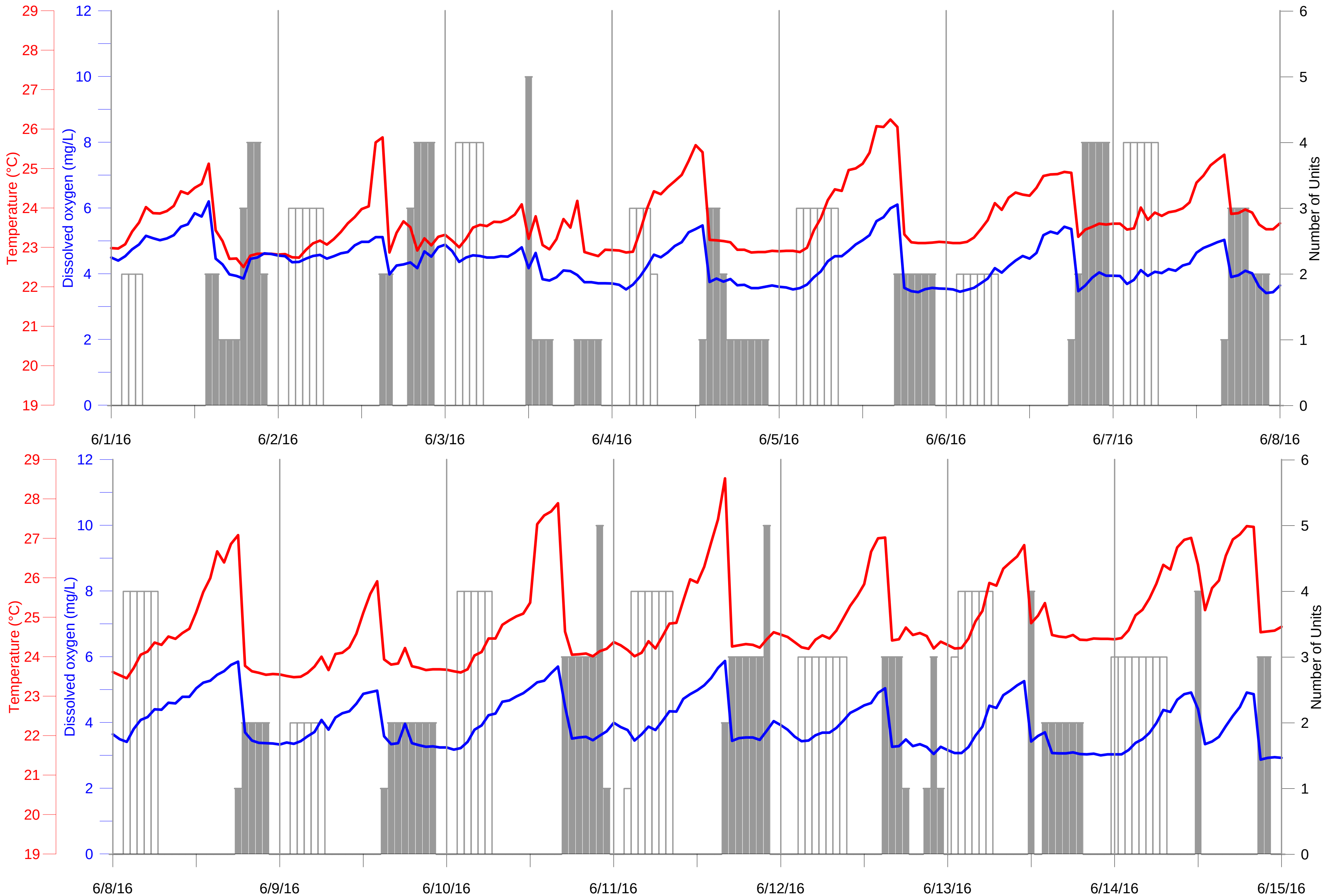
Figure 13x

Project Operations and Water Quality, 18 May - 31 May 2016

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

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Figure 13y
Project Operations and Water Quality, 1 June - 14 June 2016
Wallace Dam Project
(FERC No. 2413)

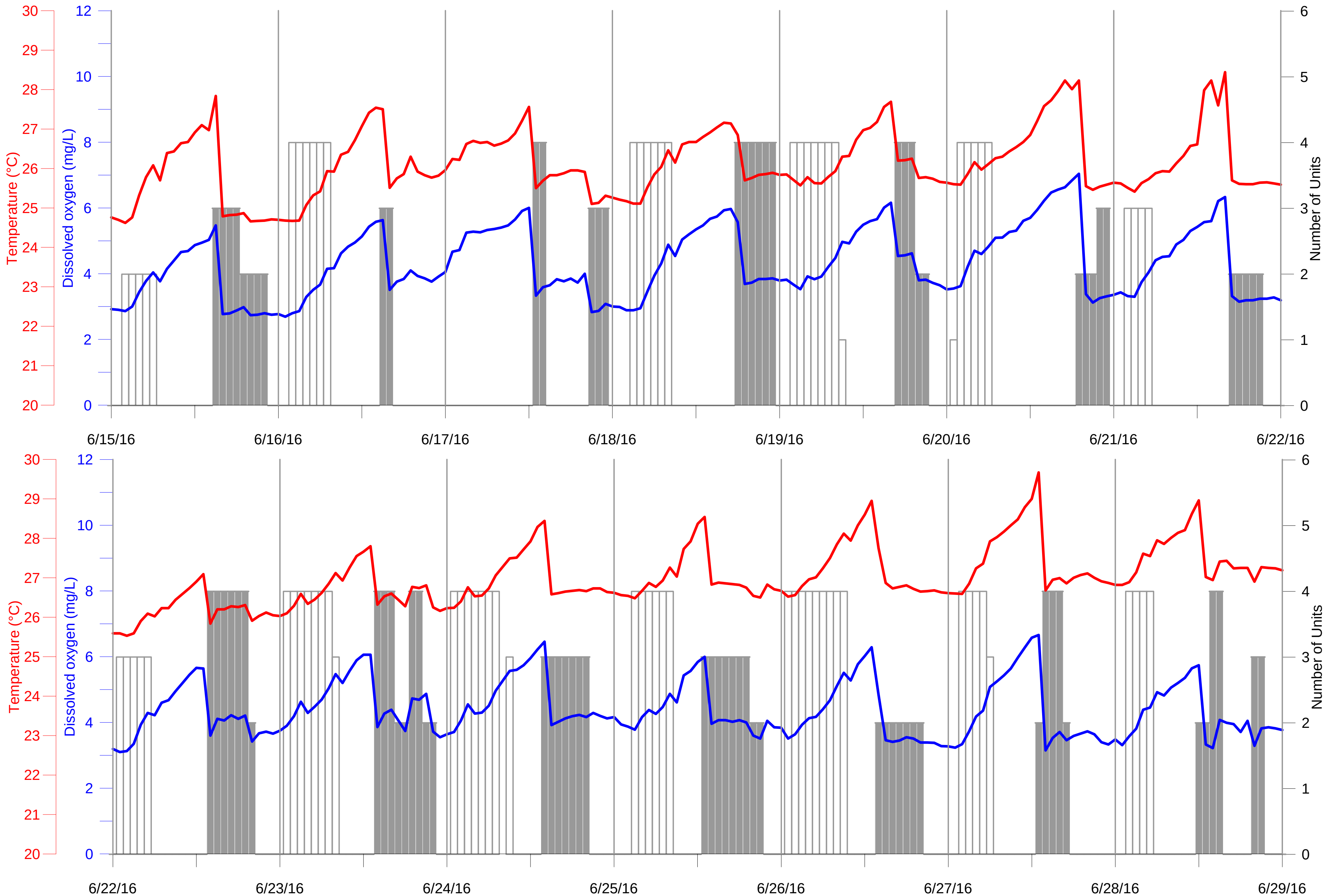

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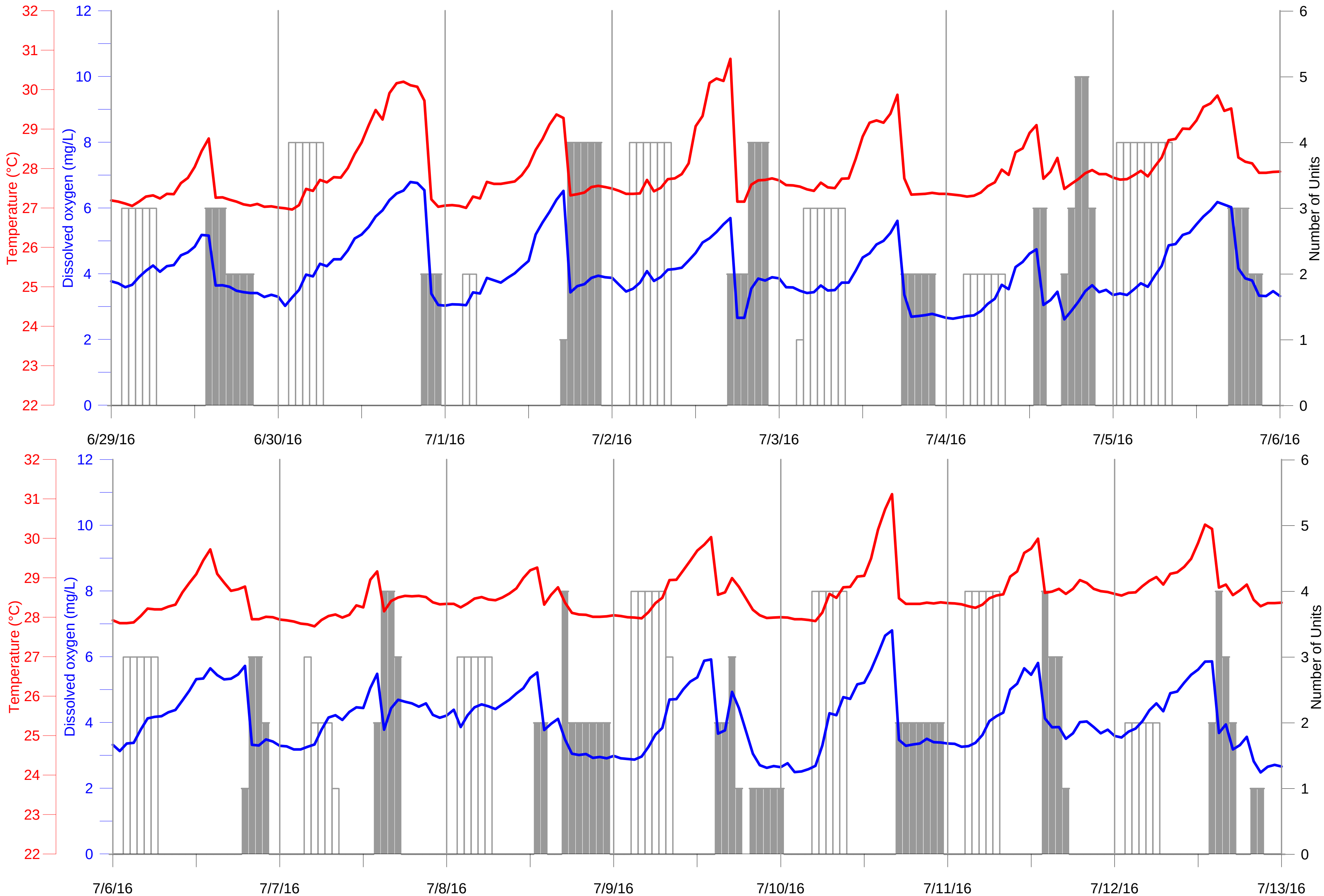
Figure 13z

Project Operations and Water Quality, 15 June - 28 June 2016

Wallace Dam Project

(FERC No. 2413)



Legend

- Temperature in the tailrace
- DO in the tailrace
- Generation - No. of units
- Pumpback - No. of units

GEORGIA POWER
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Figure 13aa

Project Operations and Water Quality, 29 June - 12 July 2016

Wallace Dam Project

(FERC No. 2413)

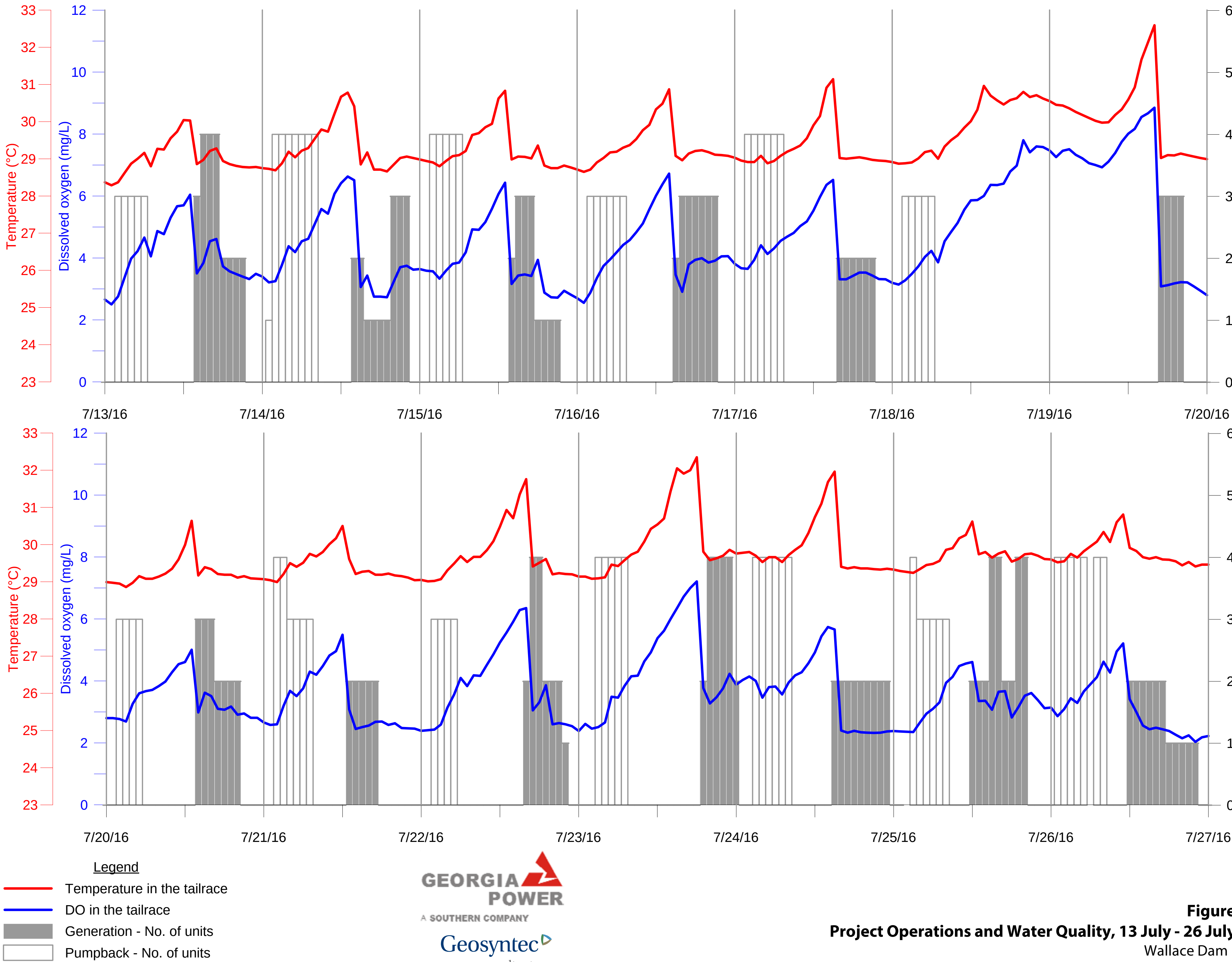

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Figure 13ab
Project Operations and Water Quality, 13 July - 26 July 2016
Wallace Dam Project
(FERC No. 2413)

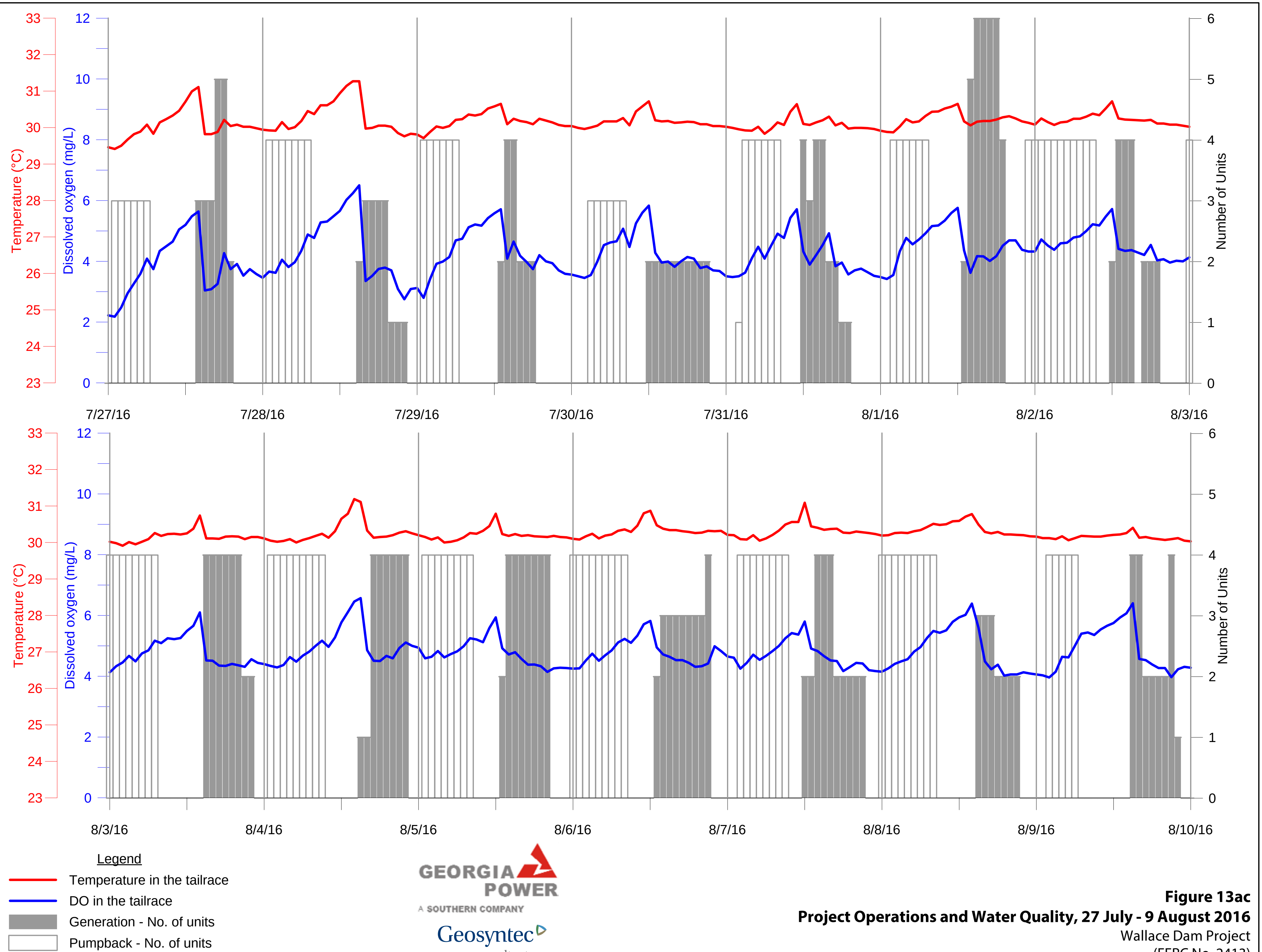

Figure 13ac

Project Operations and Water Quality, 27 July - 9 August 2016

Wallace Dam Project

(FERC No. 2413)

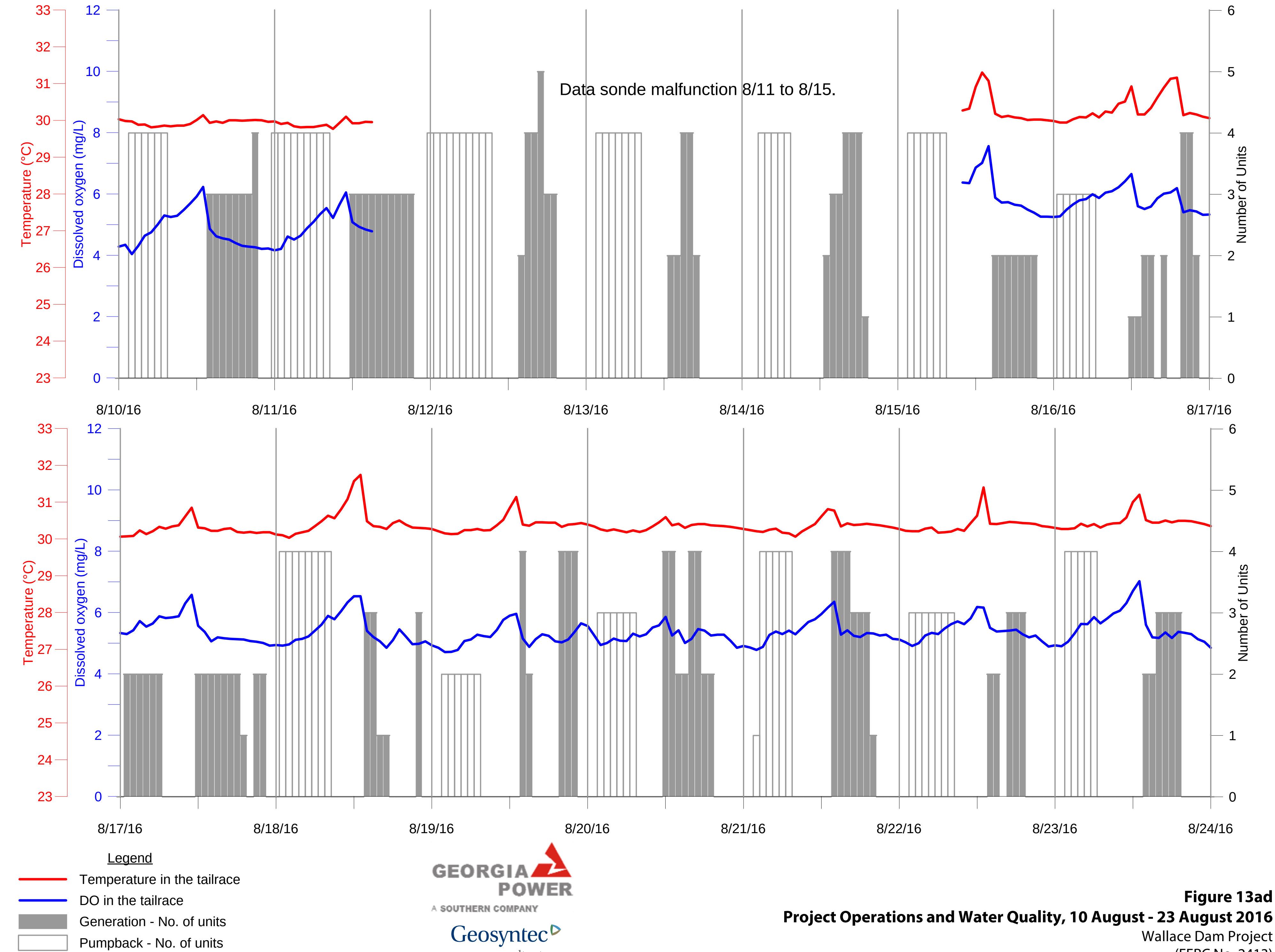

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Figure 13ad
Project Operations and Water Quality, 10 August - 23 August 2016
Wallace Dam Project
(FERC No. 2413)

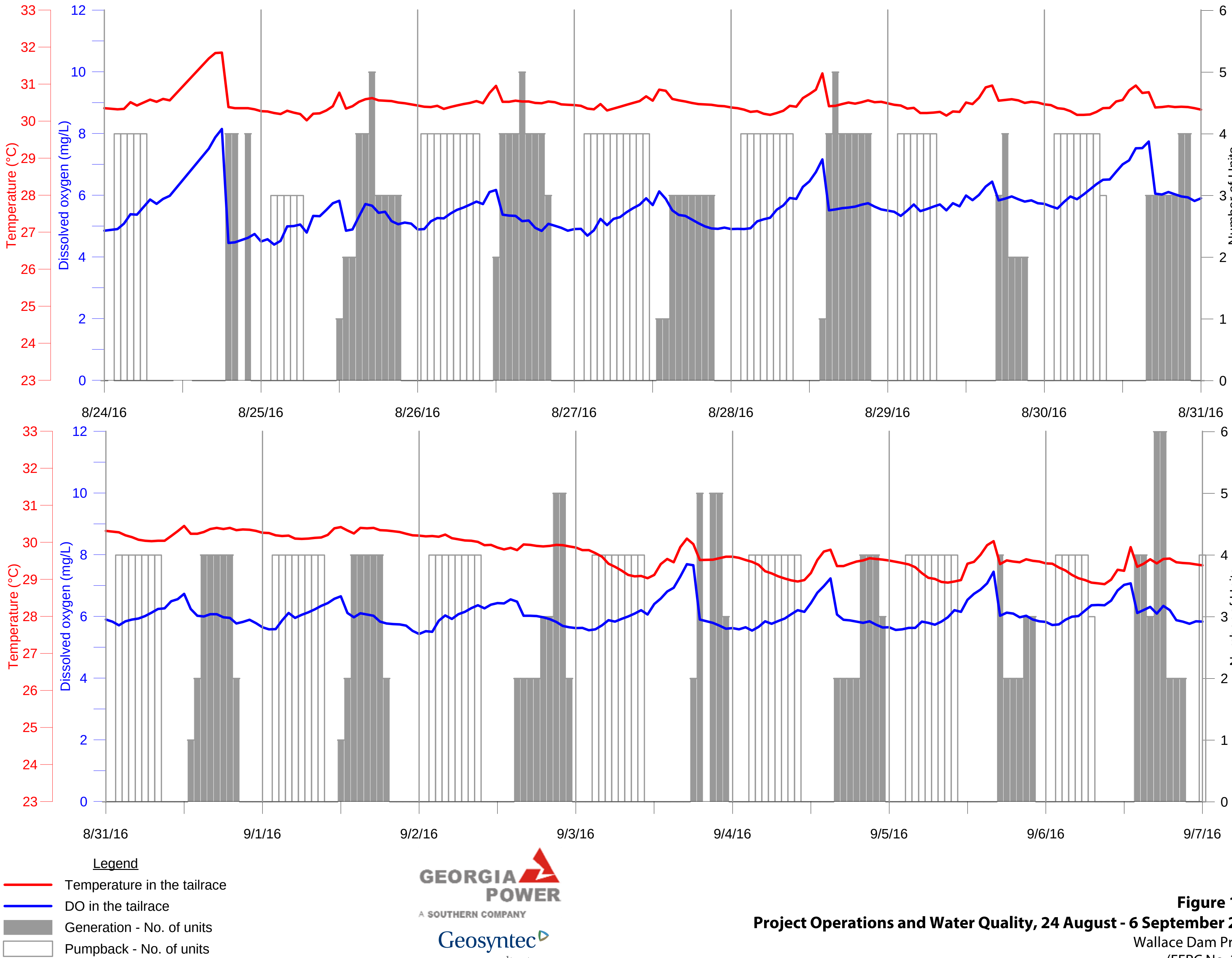

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Figure 13ae
Project Operations and Water Quality, 24 August - 6 September 2016
Wallace Dam Project
(FERC No. 2413)

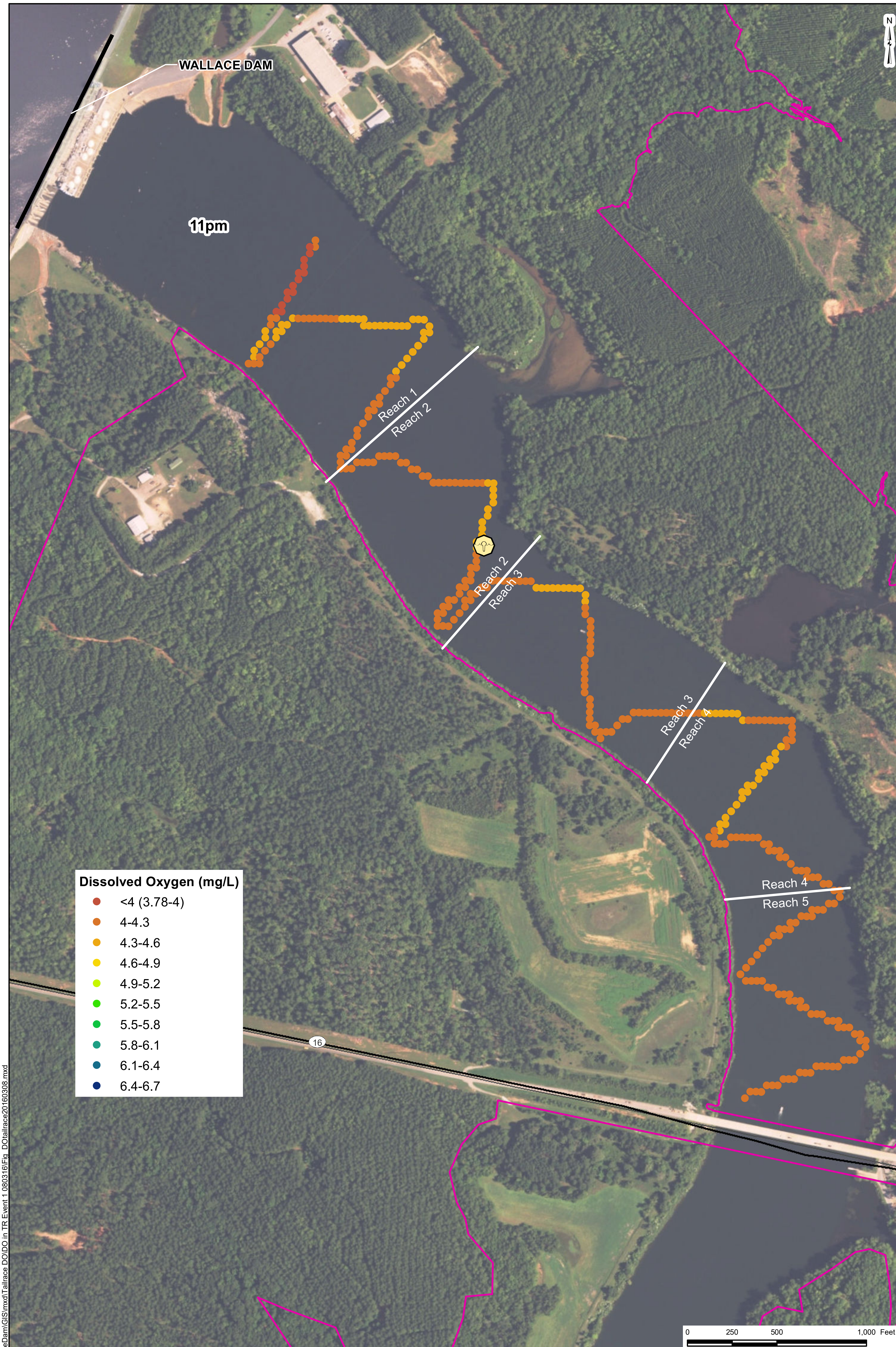
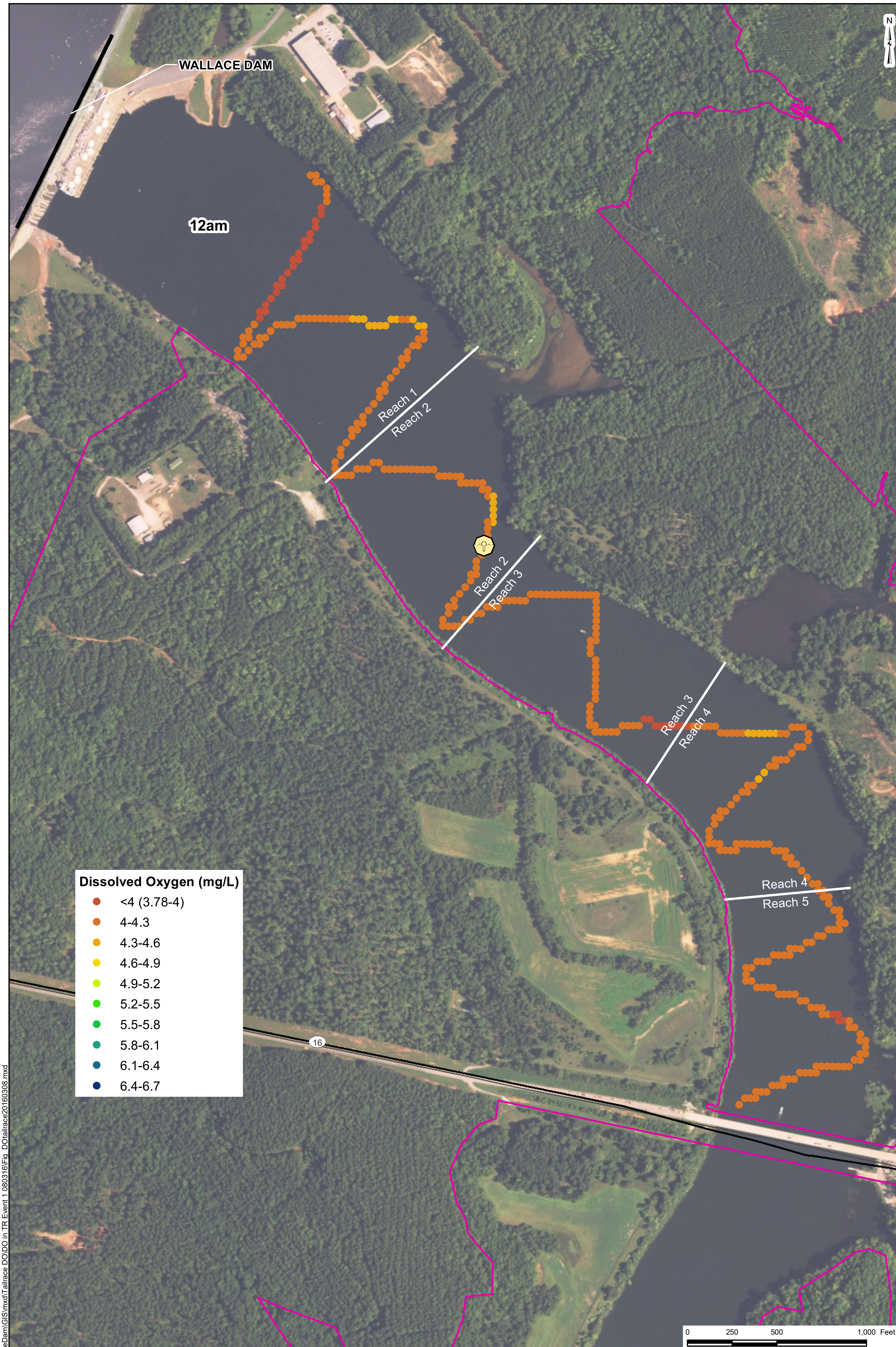


Figure 14a
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)



Tailrace Buoy
State Highway
Project_Boundary

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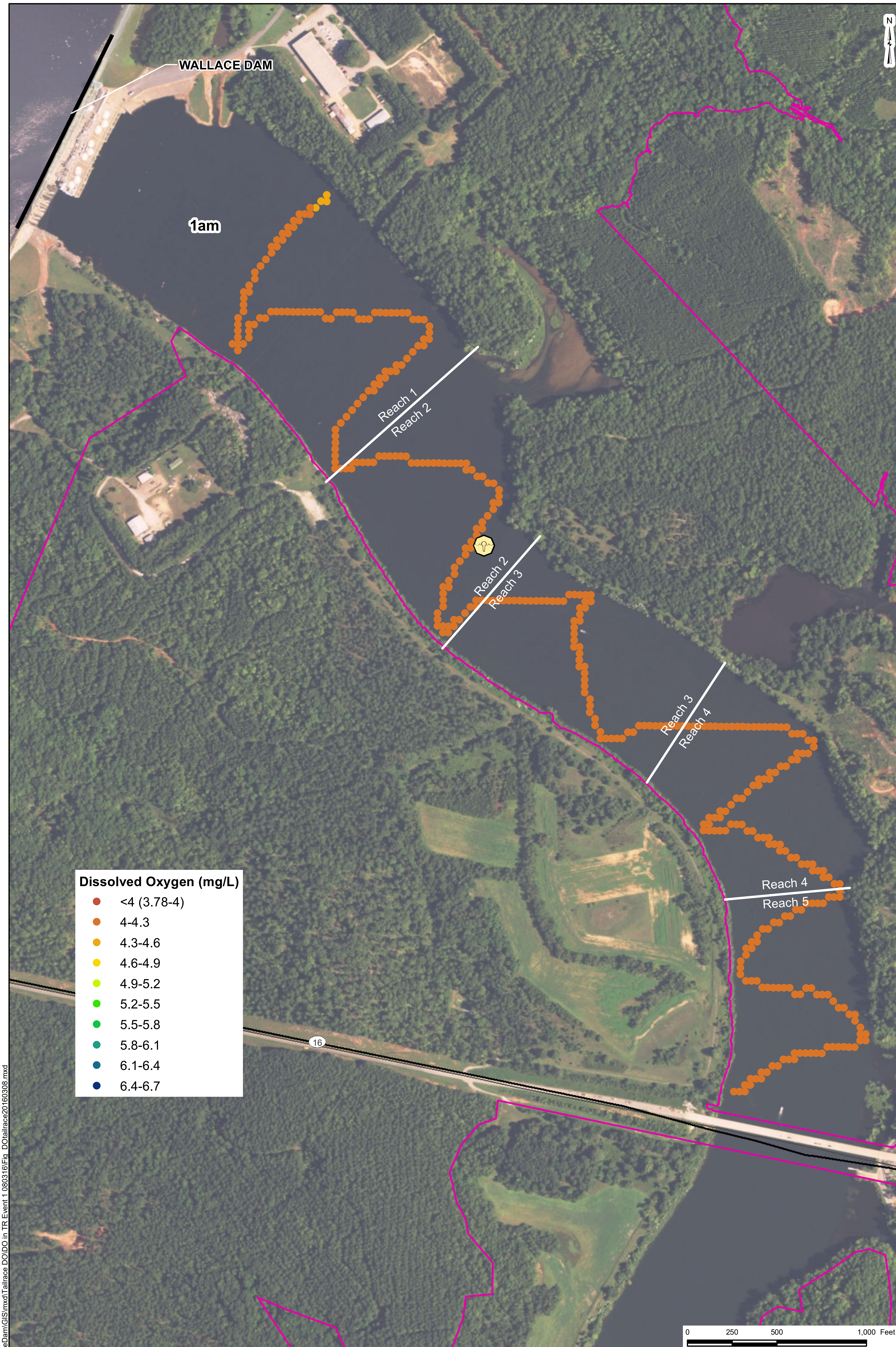
Figure 14b
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
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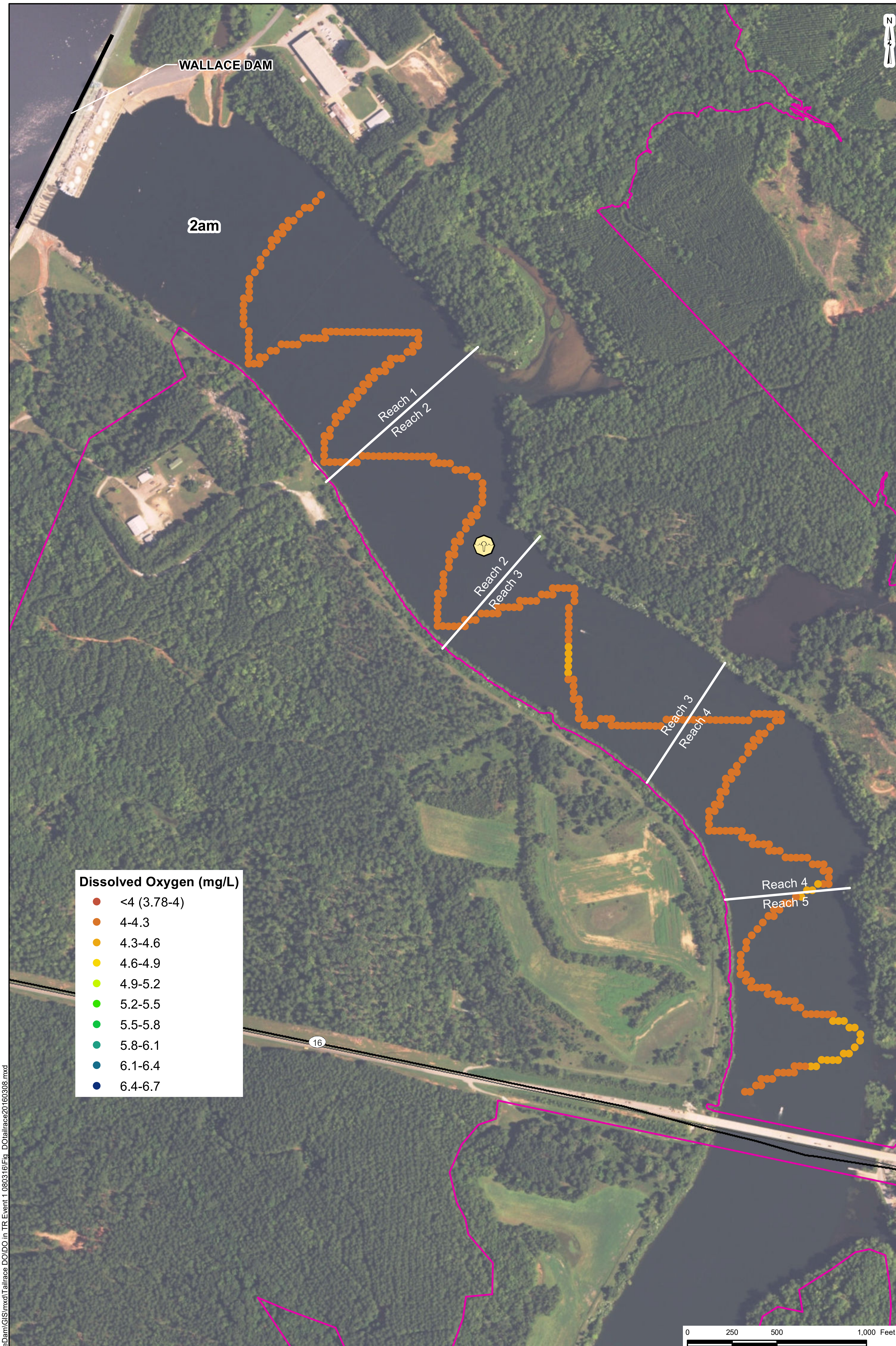
Geosyntec consultants

Figure 14c
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



Tailrace Buoy

State Highway

Project_Boundary

GEORGIA POWER
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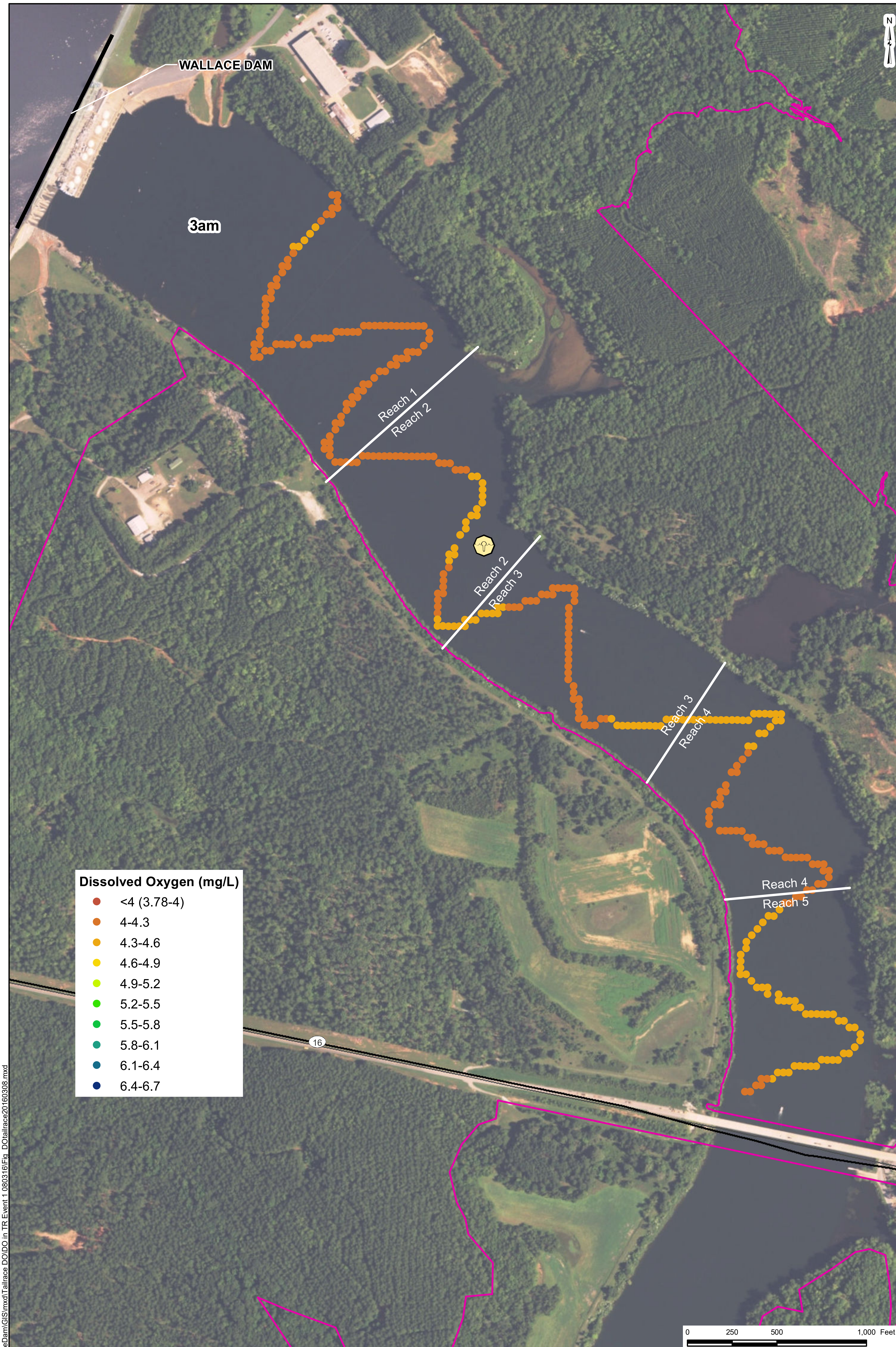
Figure 14d
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



Tailrace Buoy

State Highway

Project_Boundary

GEORGIA POWER
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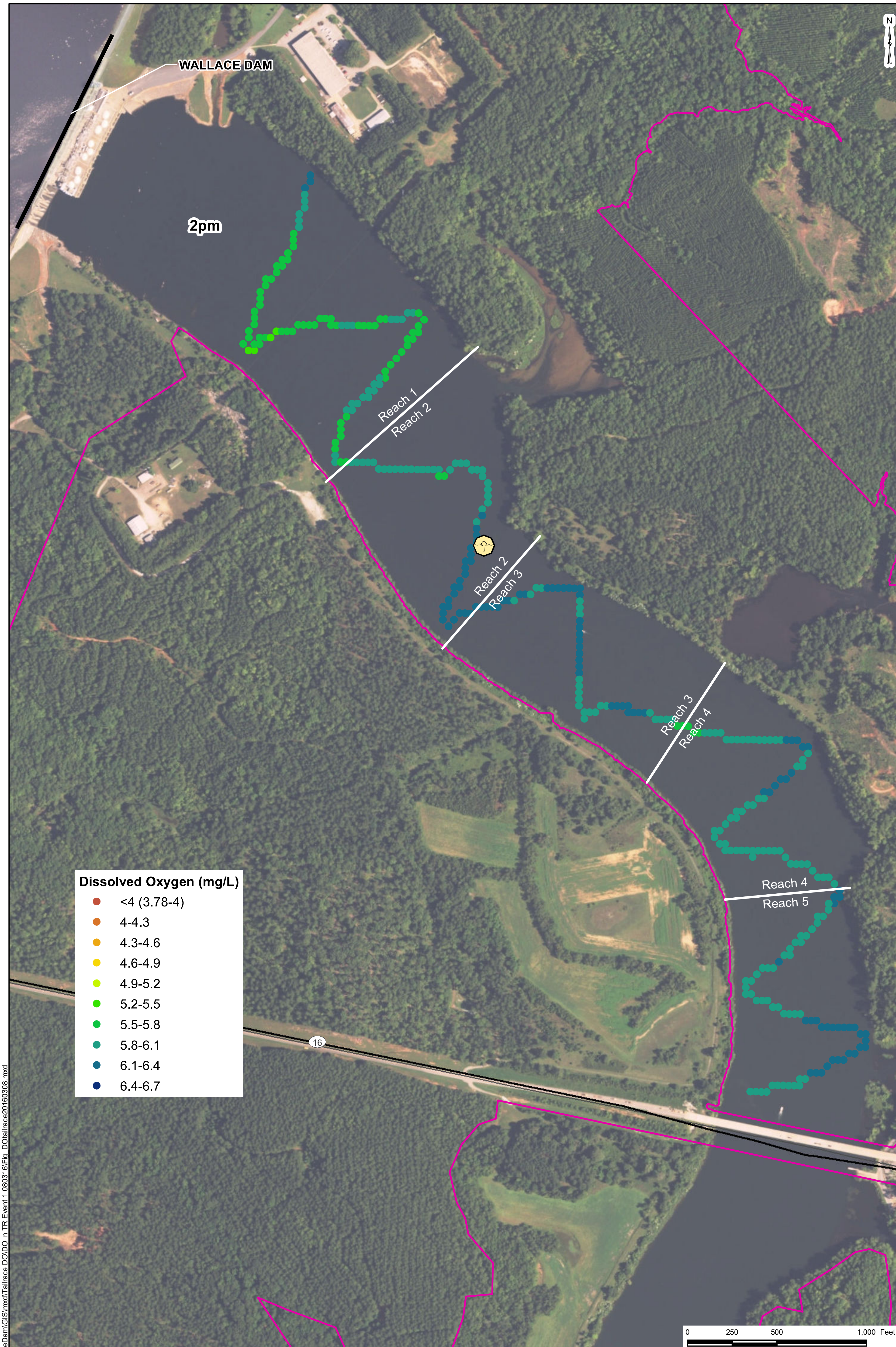
Figure 14e

Hourly Tailrace Monitoring: 8/3/16 - 8/4/16

Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



Tailrace Buoy
State Highway
Project_Boundary

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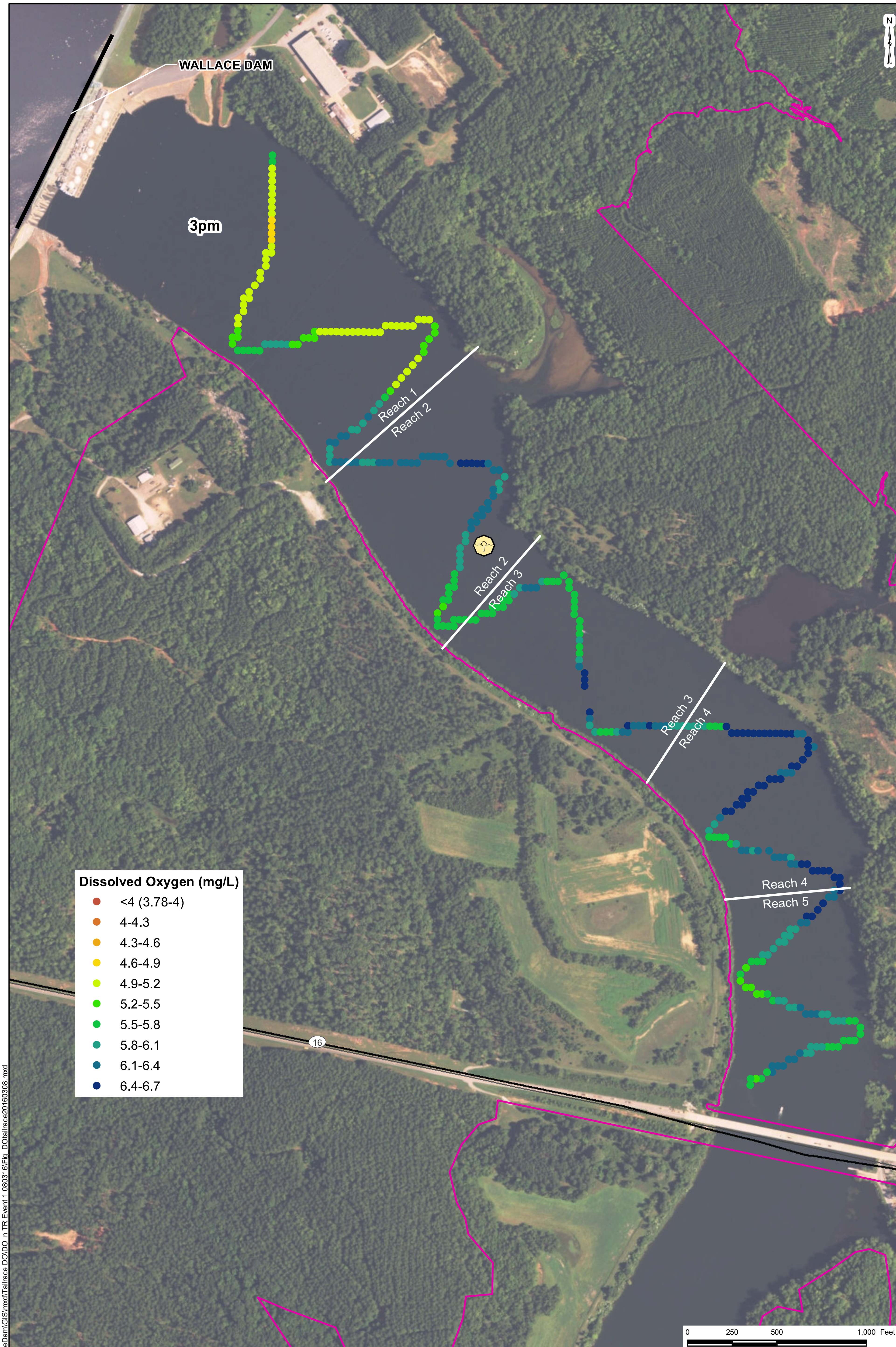
Figure 14f
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd

Tailrace Buoy

State Highway

Project_Boundary

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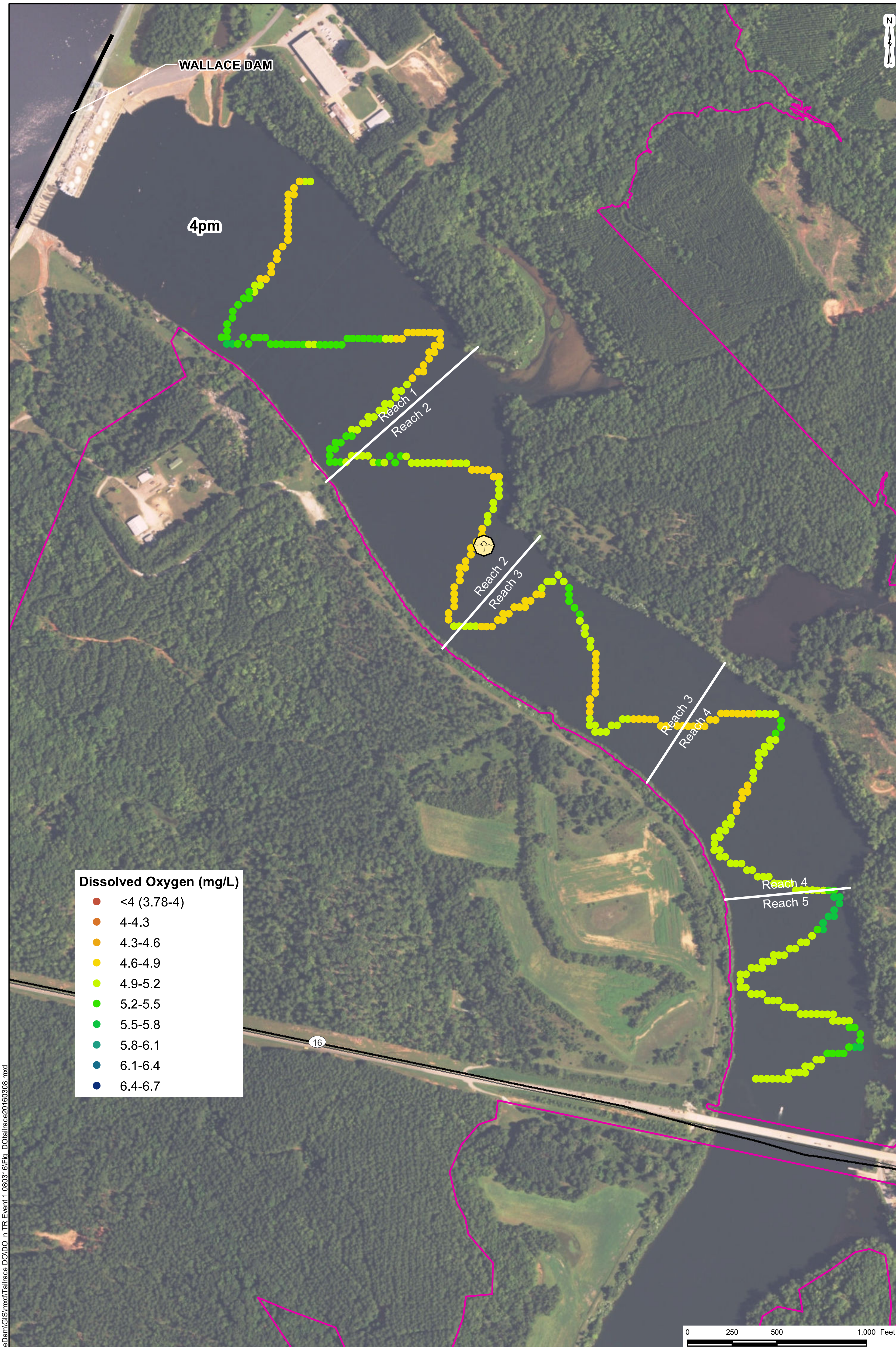
A SOUTHERN COMPANY
Geosyntec consultants

Figure 14g
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd

Tailrace Buoy

State Highway

Project_Boundary

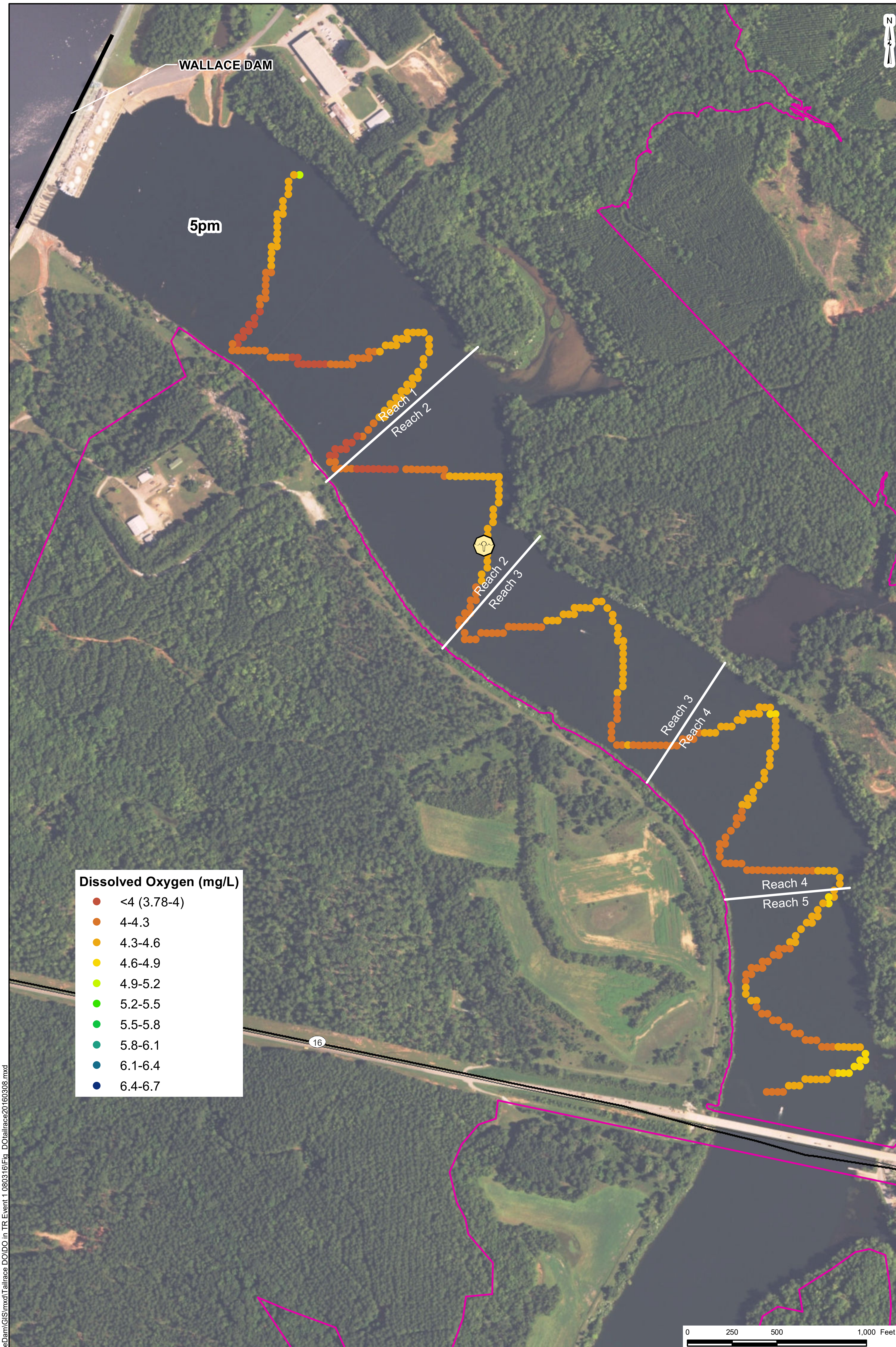
GEORGIA POWER
A SOUTHERN COMPANY

Geosyntec consultants

Figure 14h

Hourly Tailrace Monitoring: 8/3/16 - 8/4/16

Wallace Dam Project
(FERC No. 2413)

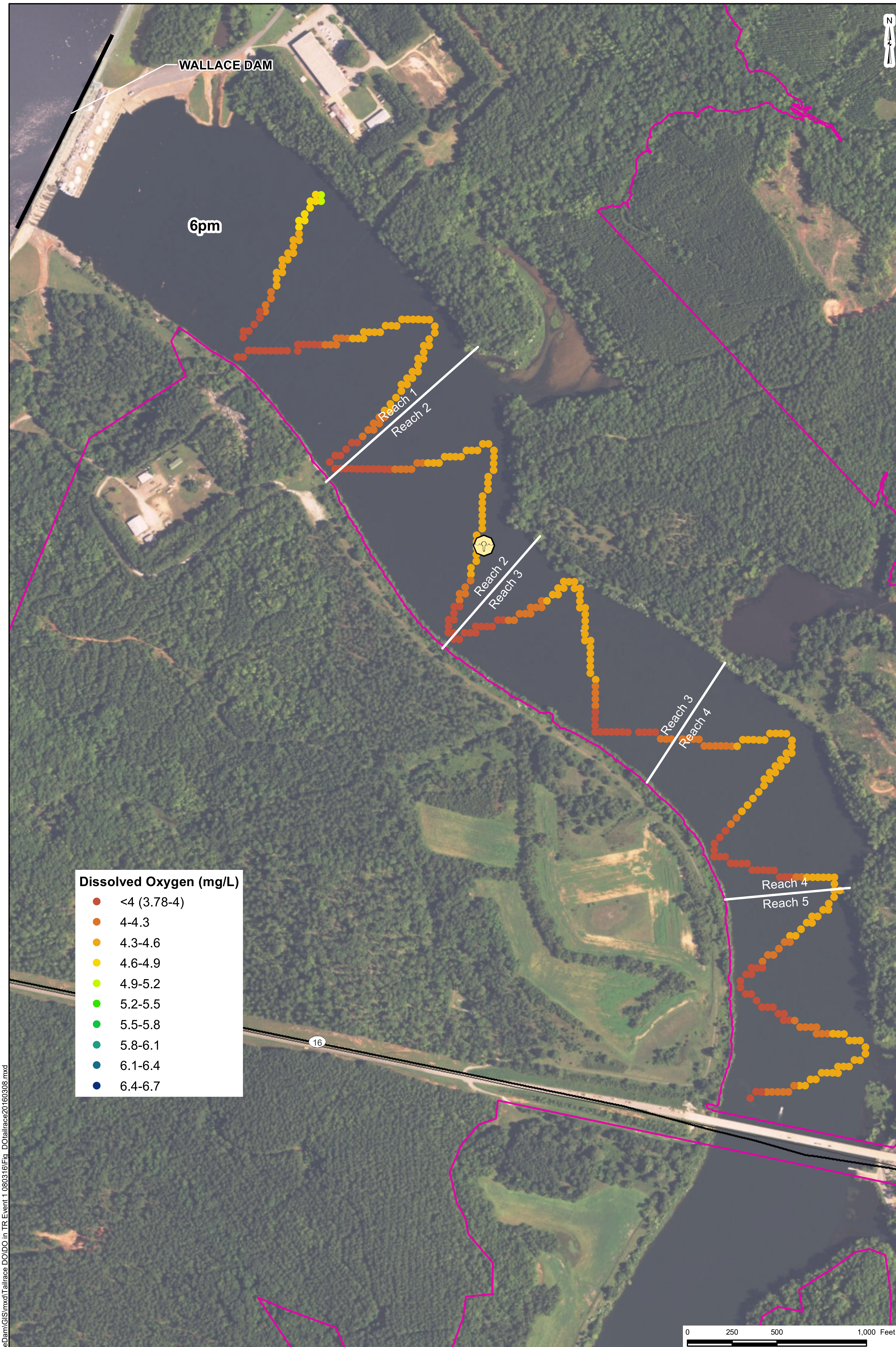


Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
A SOUTHERN COMPANY
Geosyntec consultants

Figure 14i
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd

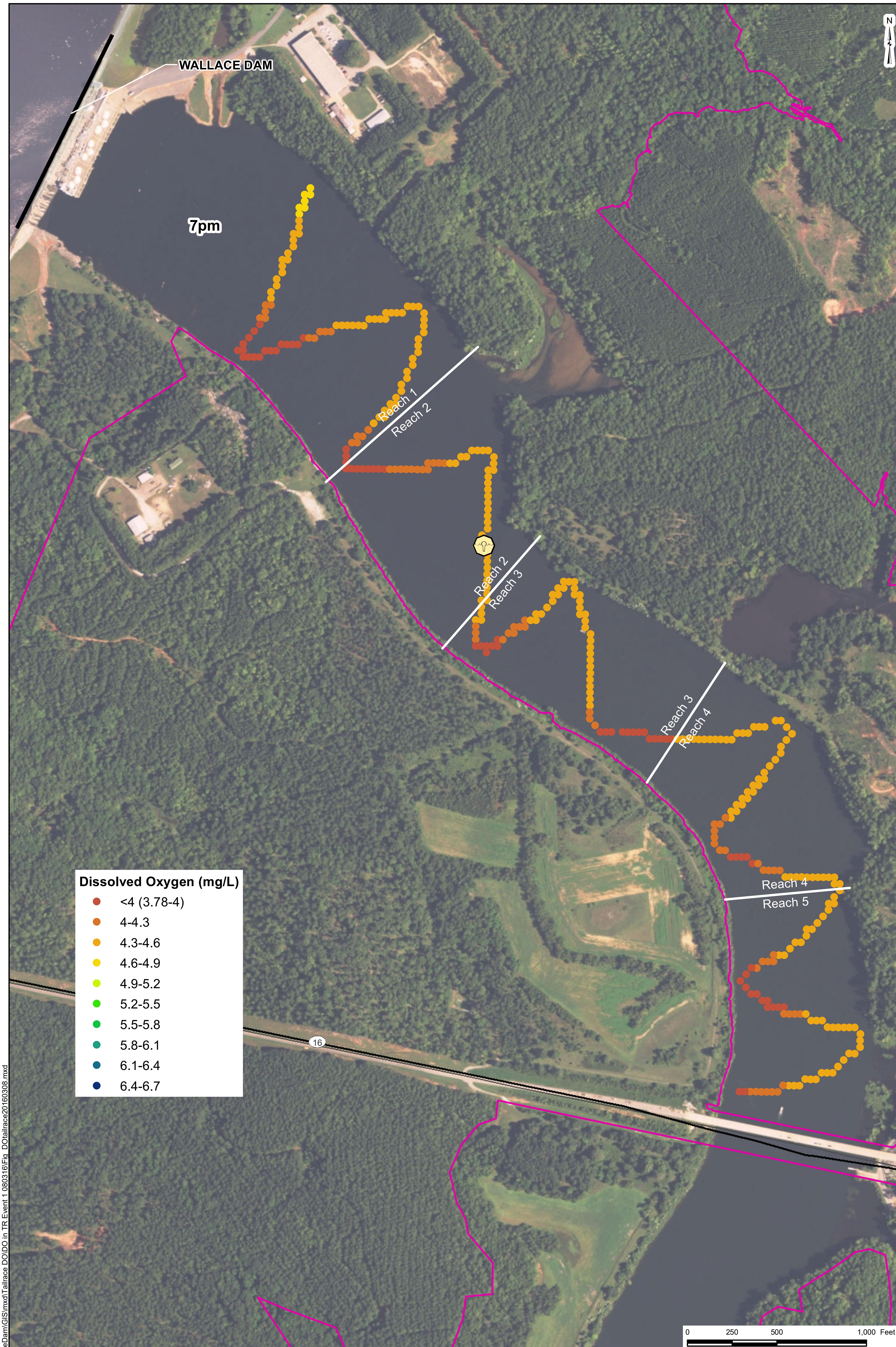


Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
A SOUTHERN COMPANY
Geosyntec consultants

Figure 14j
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 1 080316\Fig_DOtailrace20160308.mxd

Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
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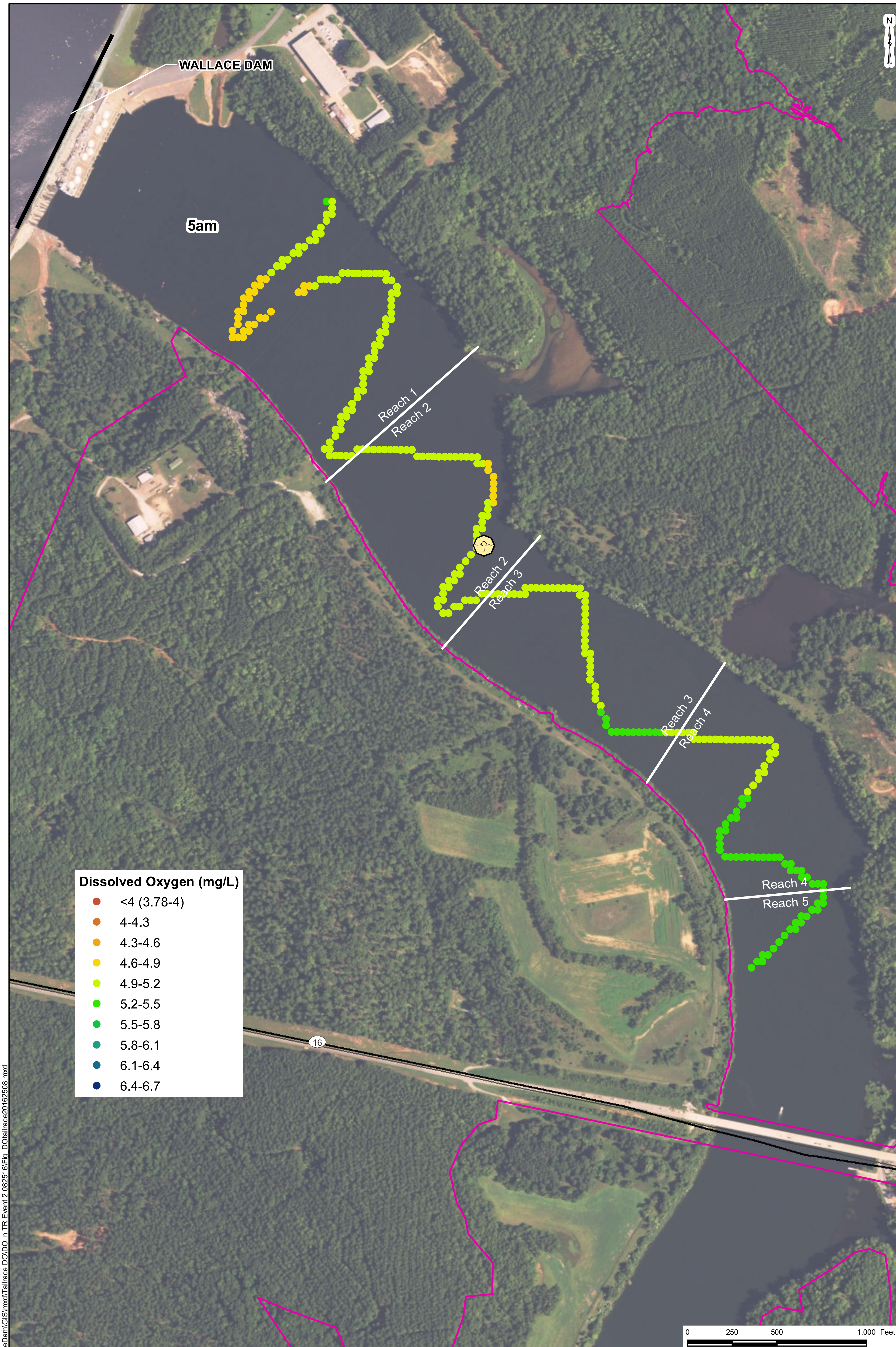
Geosyntec consultants

Figure 14k
Hourly Tailrace Monitoring: 8/3/16 - 8/4/16
Wallace Dam Project
(FERC No. 2413)



Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
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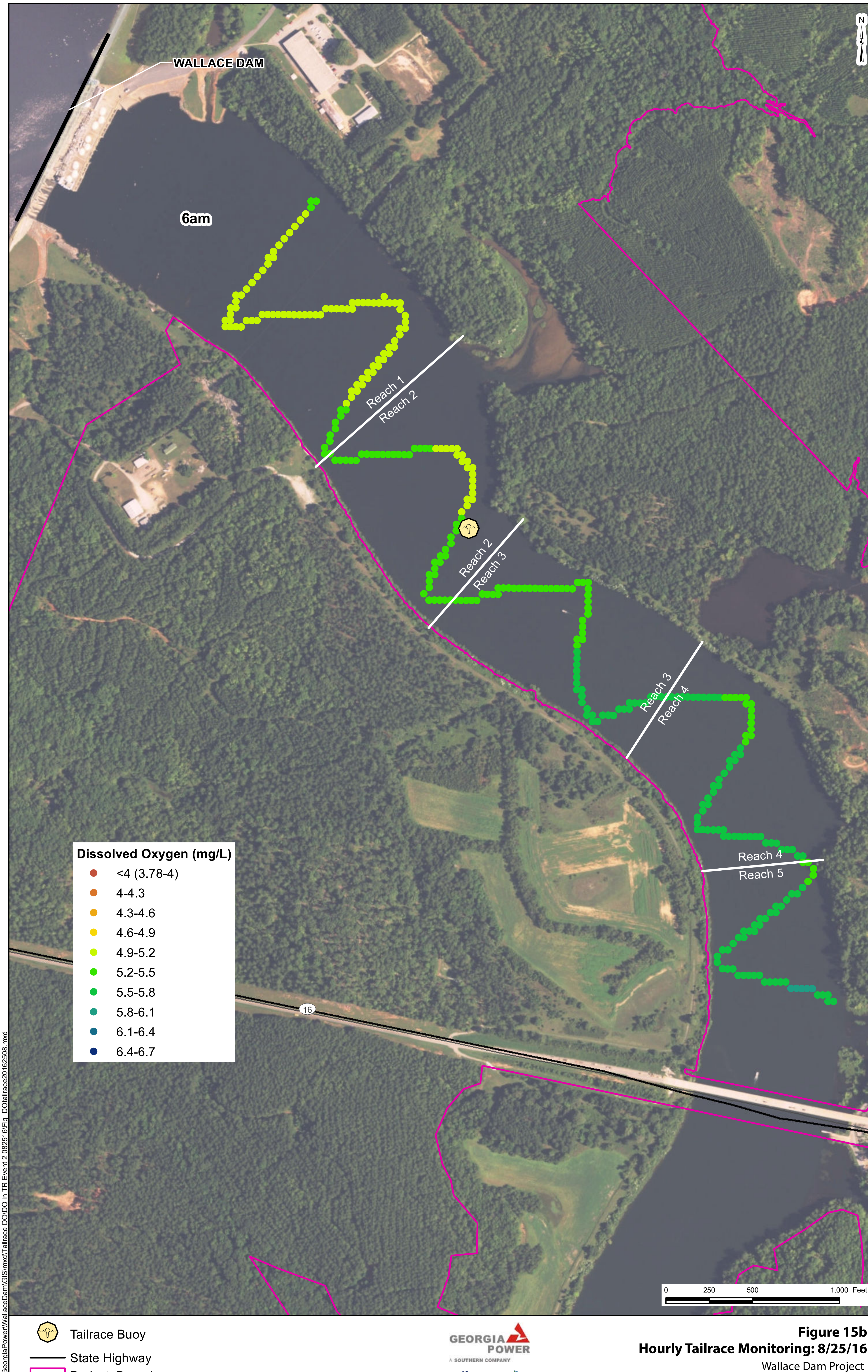
Geosyntec consultants

Figure 15a
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd



GEORGIA POWER
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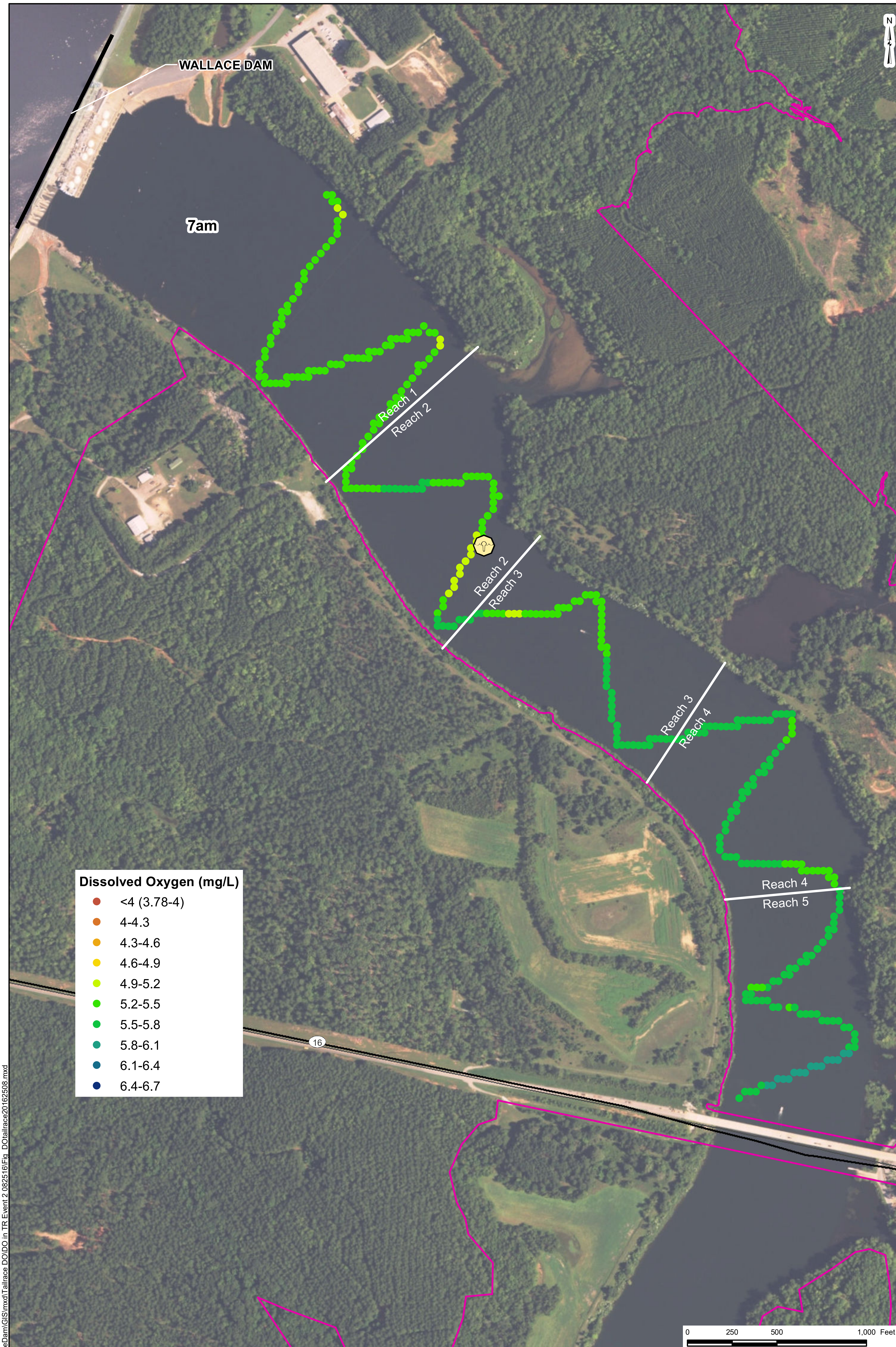
Geosyntec consultants

Figure 15b
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd



Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
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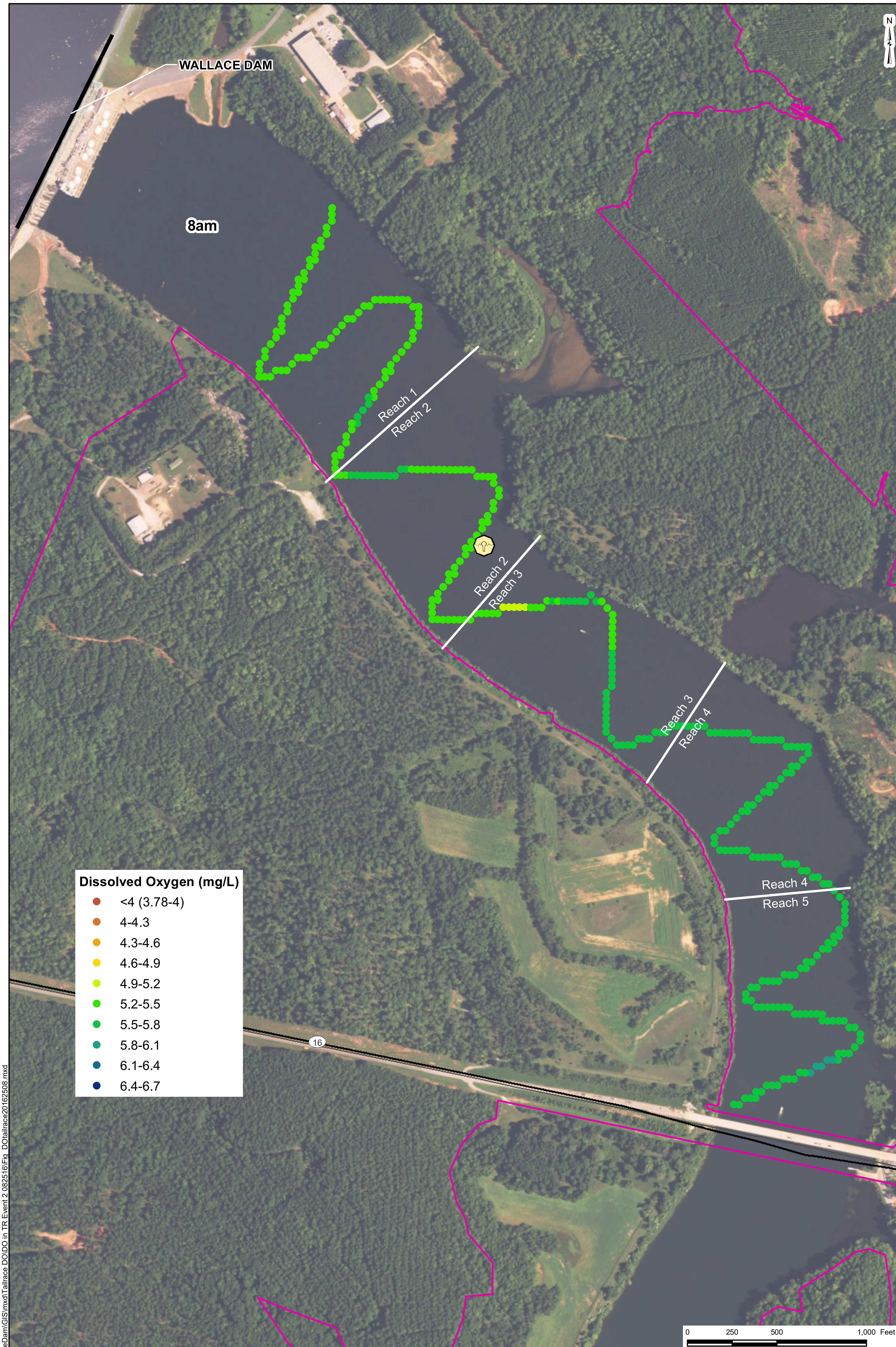
Geosyntec consultants

Figure 15c
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd

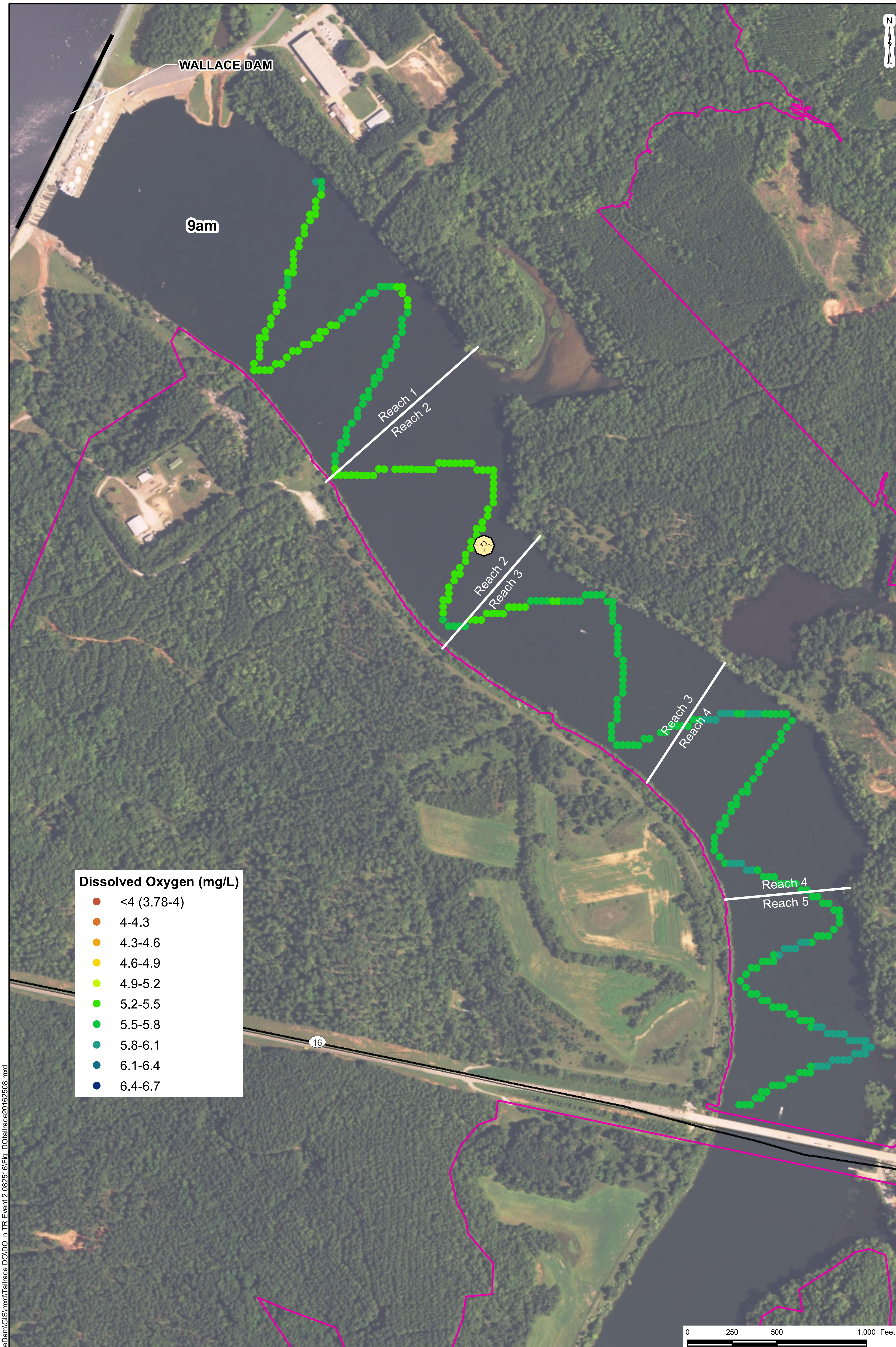


Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
A SOUTHERN COMPANY
Geosyntec consultants

Figure 15d
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd



Tailrace Buoy
State Highway
Project_Boundary

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Figure 15e
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd

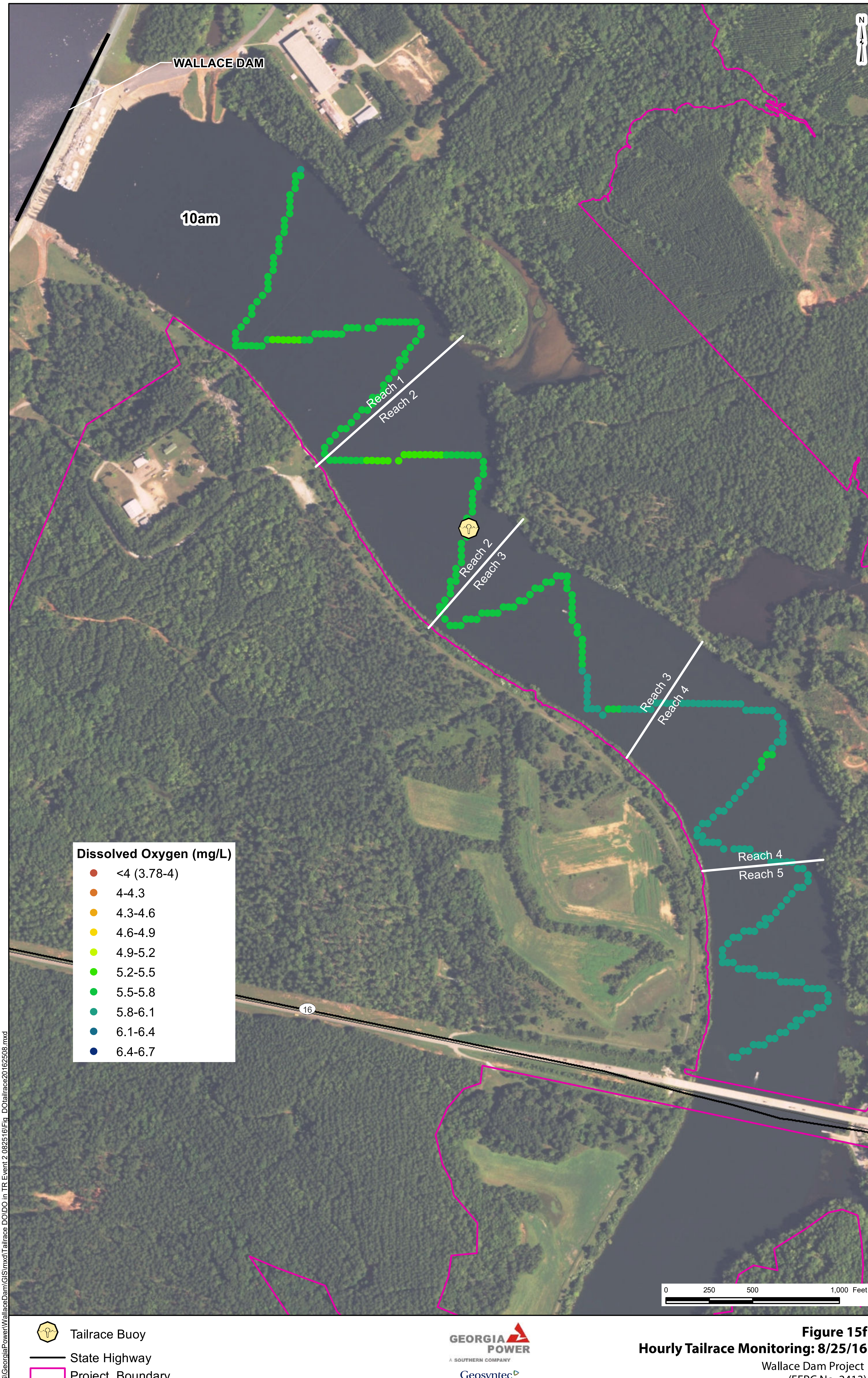
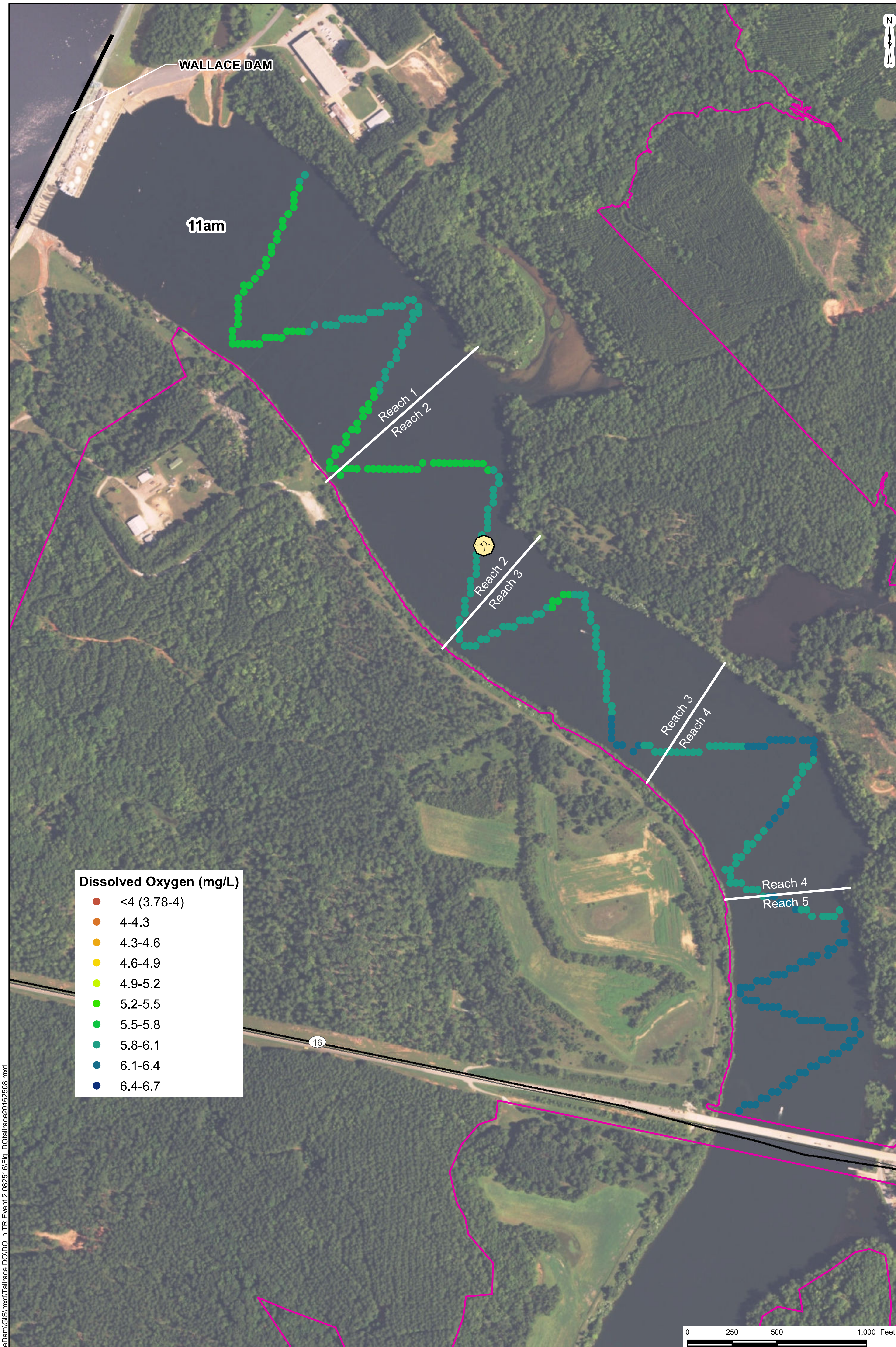


Figure 15f
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)



Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
A SOUTHERN COMPANY
Geosyntec consultants

Figure 15g
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd

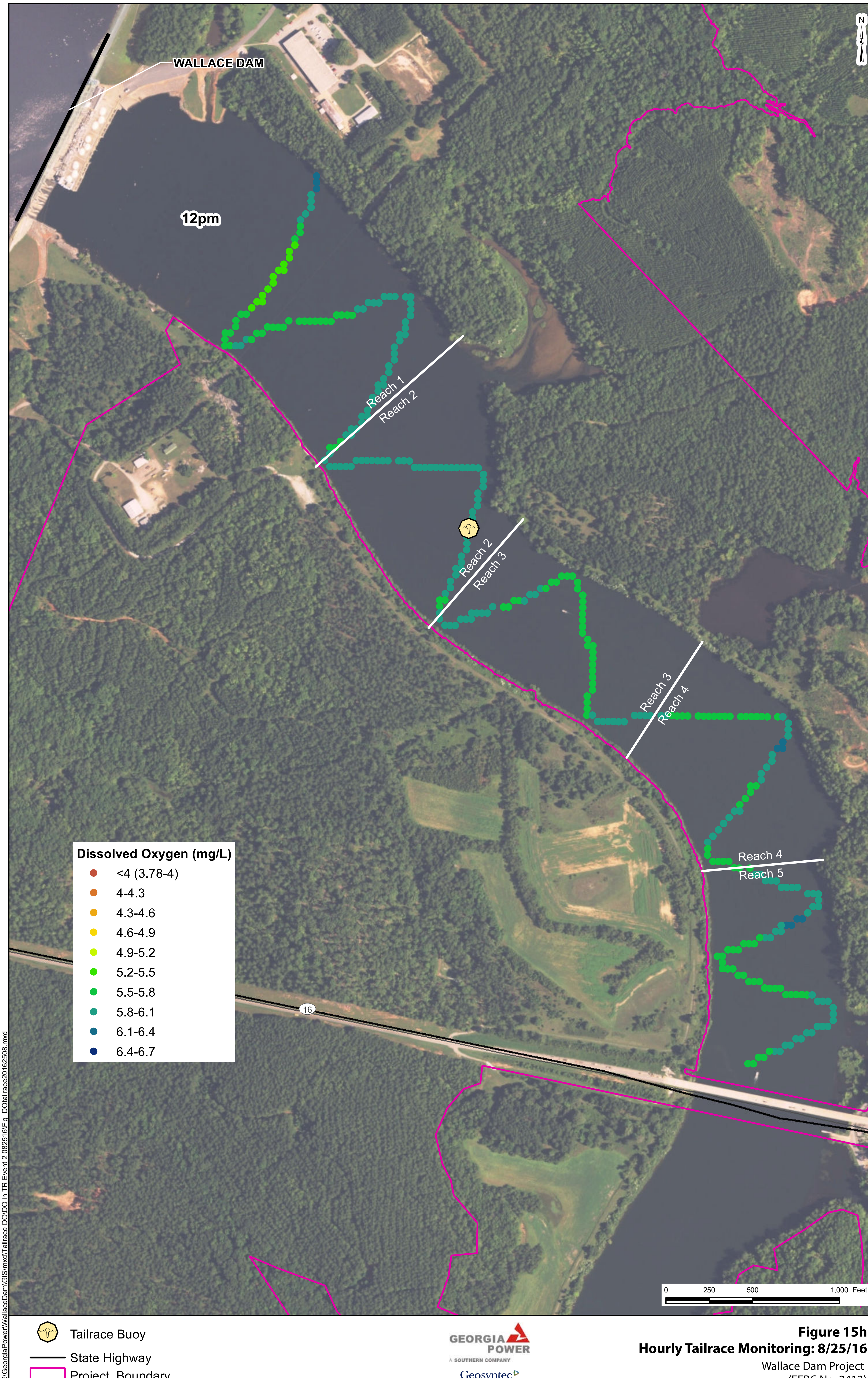
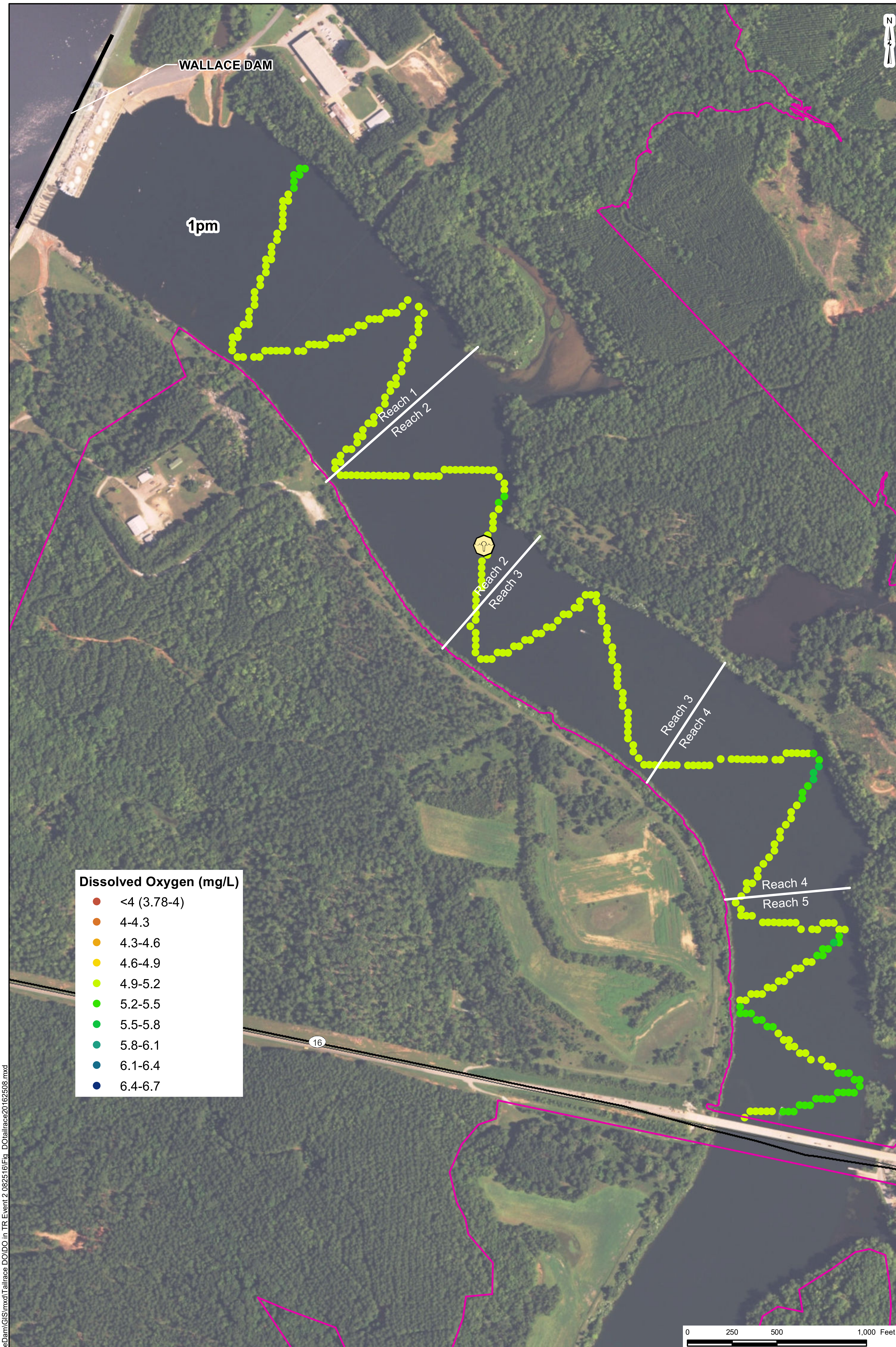


Figure 15h
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd

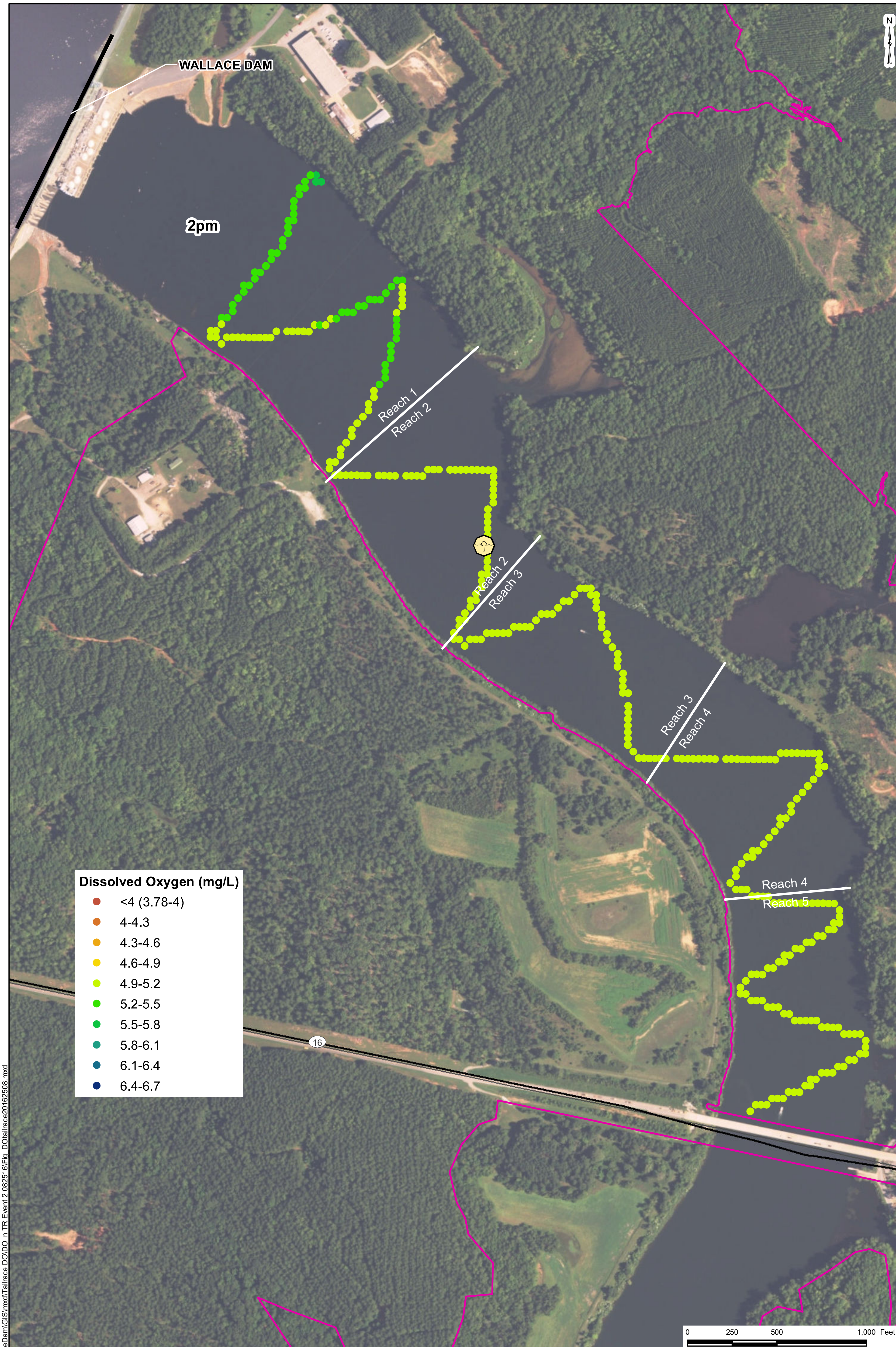


Tailrace Buoy
State Highway
Project_Boundary

GEORGIA POWER
A SOUTHERN COMPANY
Geosyntec consultants

Figure 15i
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\Tailrace DO\DO in TR Event 2 082516\Fig_DOtailrace20162508.mxd

Tailrace Buoy
State Highway
Project_Boundary

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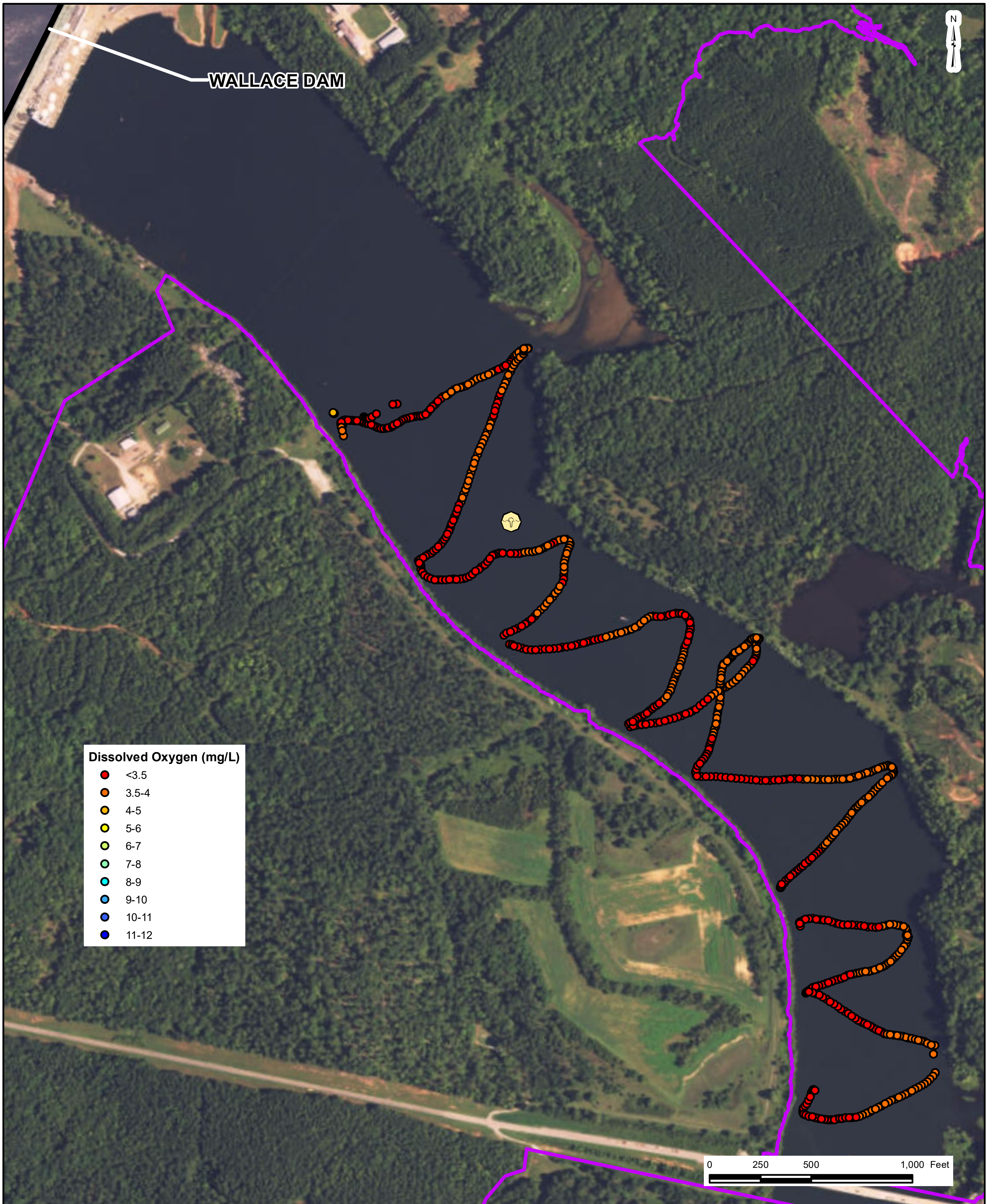
Figure 15j
Hourly Tailrace Monitoring: 8/25/16
Wallace Dam Project
(FERC No. 2413)

APPENDIX A

Dissolved Oxygen in the Tailrace



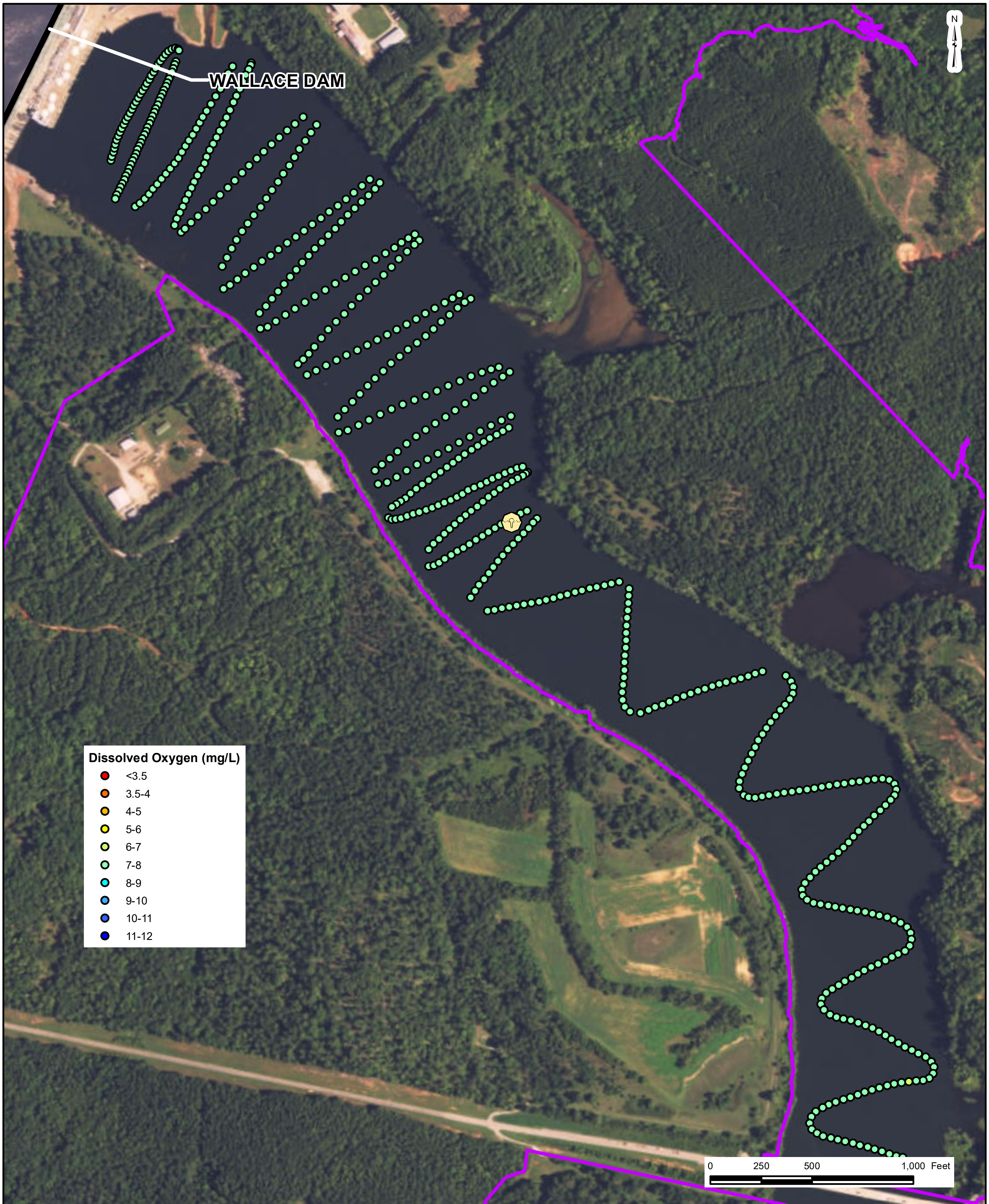
Tailrace Buoy
Dam
Project Boundary

GEORGIA POWER
Geosyntec consultants

Figure A-1
Dissolved Oxygen in the Tailrace, 7/22/2015

Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\Appendix\B1_DO in the tailrace_20150722.mxd



Tailrace Buoy
Dam
Project Boundary

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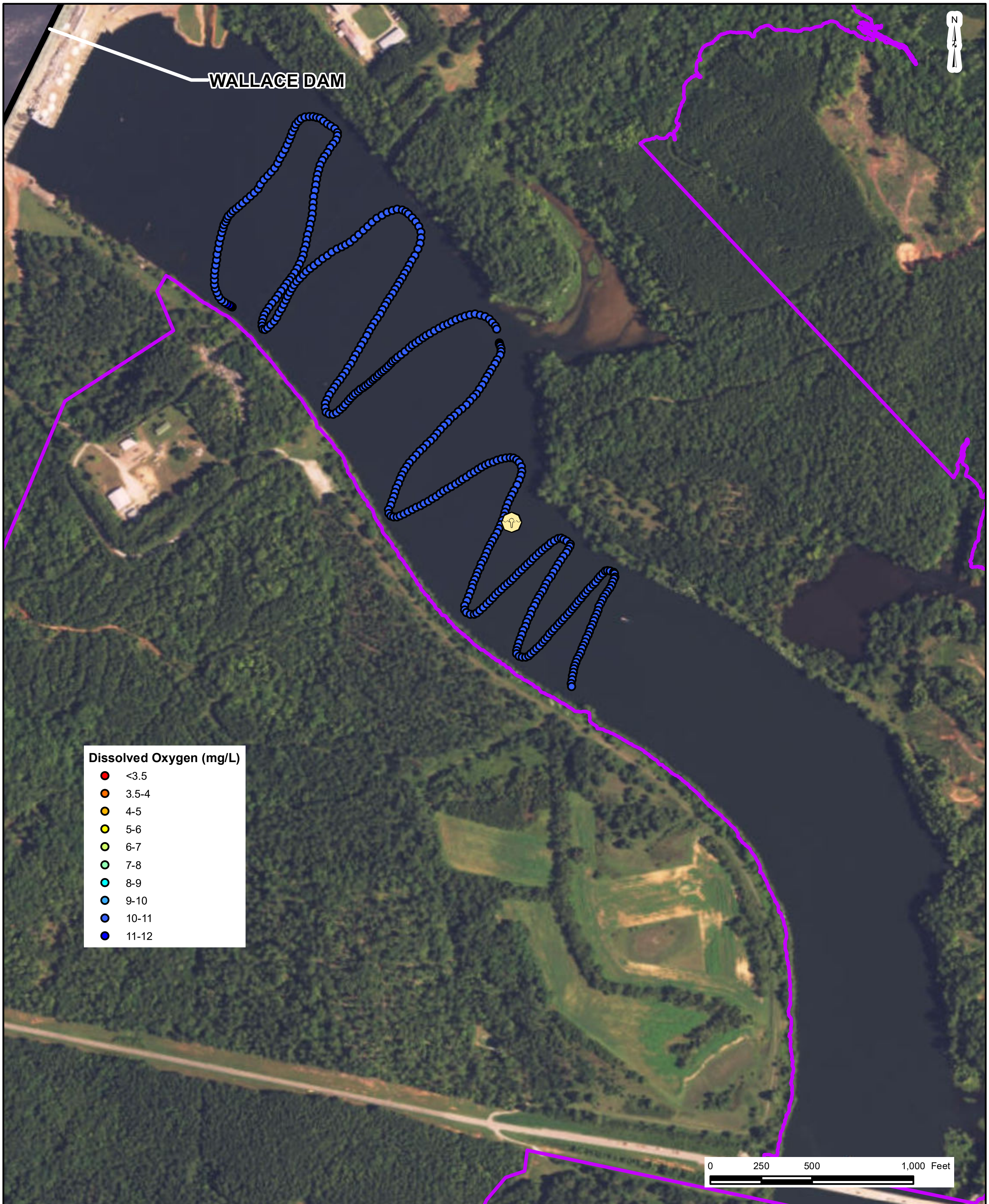
Figure A-2
Dissolved Oxygen in the Tailrace, 11/16/2015

Wallace Dam Project
(FERC No. 2413)

N:\G\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\Appendix\B2_DO in the tailrace_20151116.mxd



N:\G\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\Appendix\B3_DO in the tailrace_20160218.mxd

Tailrace Buoy
Dam
Project Boundary

GEORGIA POWER
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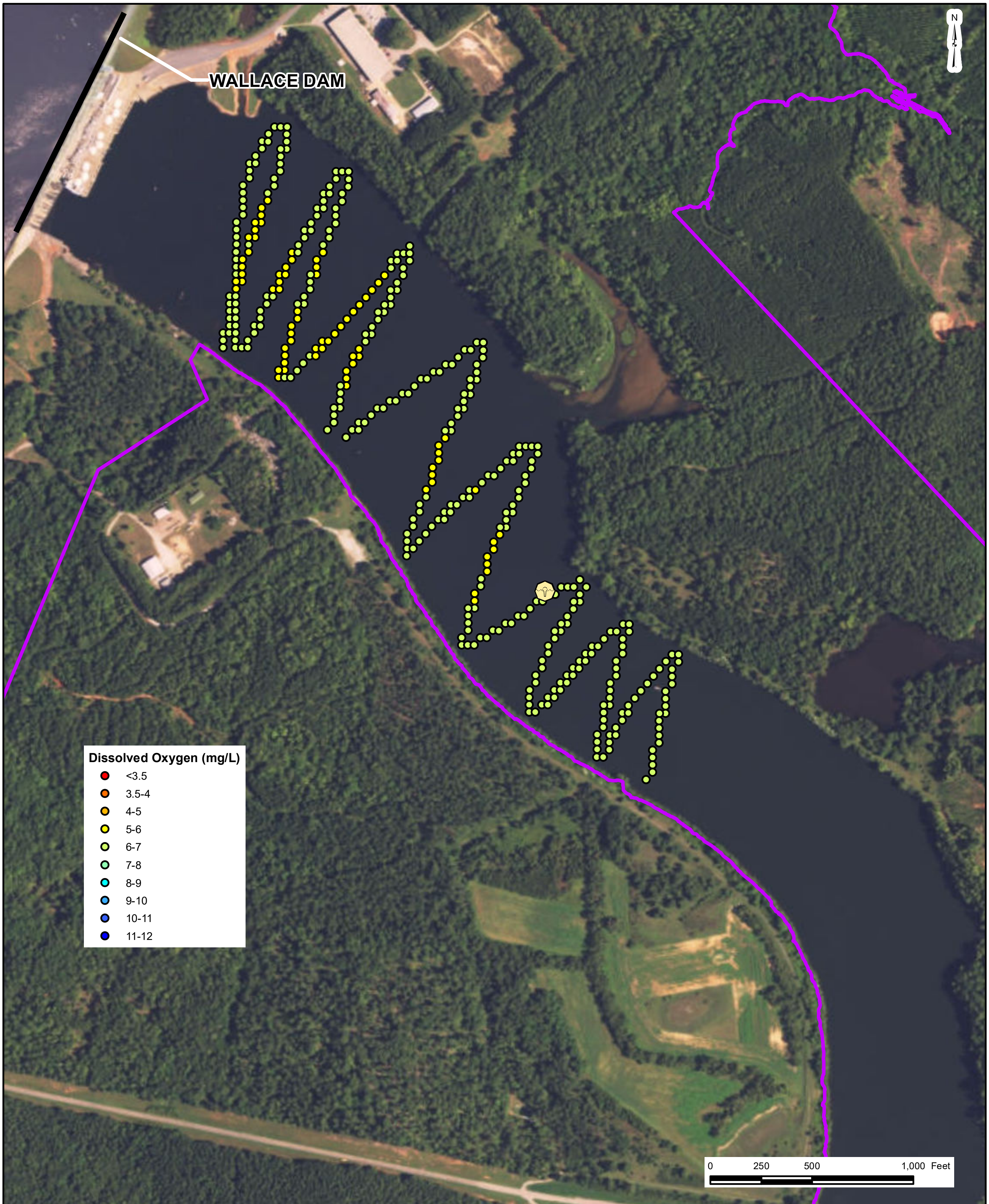
Figure A-3
Dissolved Oxygen in the Tailrace, 2/18/2016

Wallace Dam Project
(FERC No. 2413)



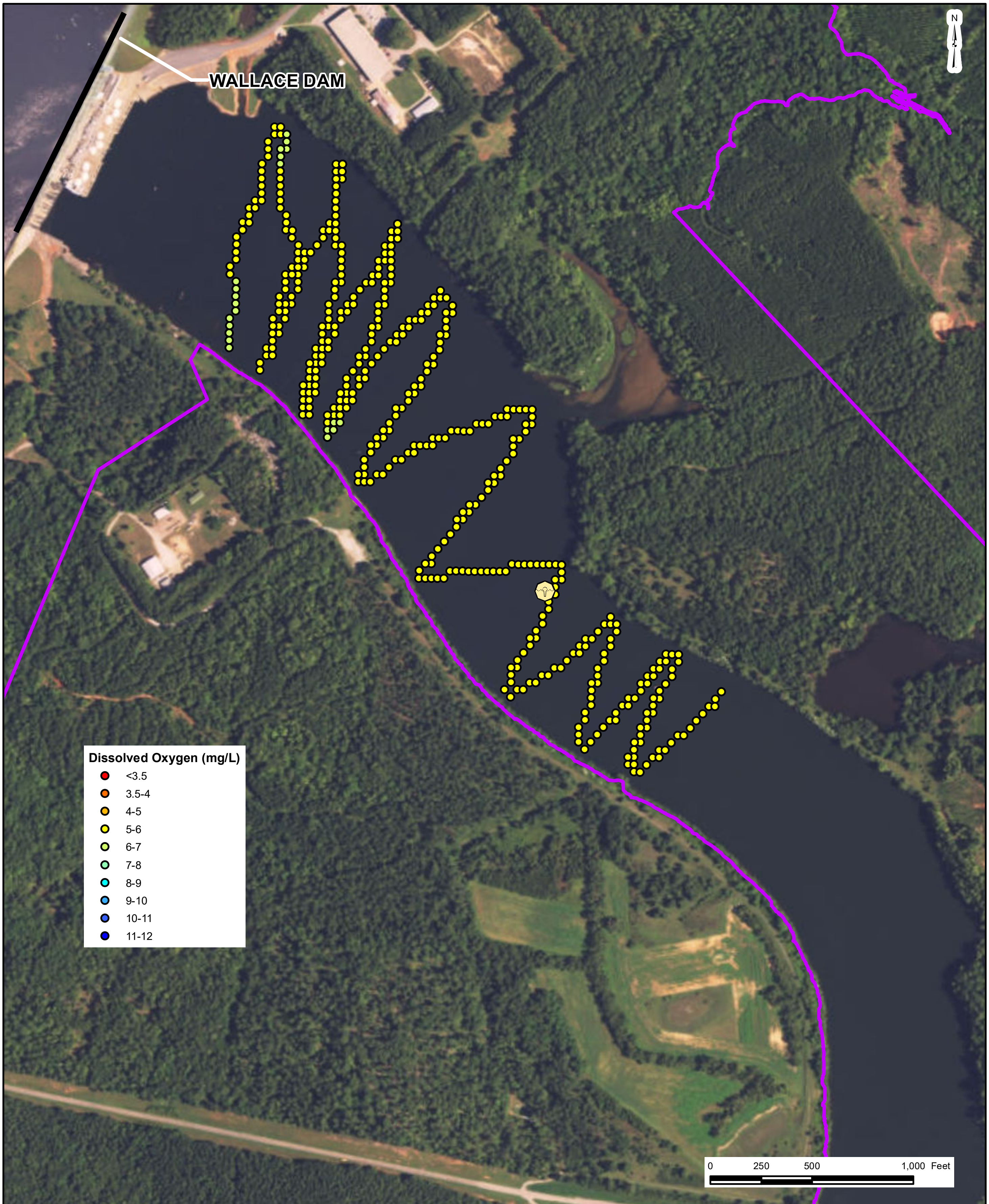
Tailrace Buoy
Dam
Project Boundary

GEORGIA POWER
Geosyntec consultants

Figure A-4
Dissolved Oxygen in the Tailrace, 5/16/2016; Non-generation

Wallace Dam Project
(FERC No. 2413)

N:\GIS\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\Appendix\B4_DO in the tailrace_20160516.mxd



Tailrace Buoy
Dam
Project Boundary

GEORGIA POWER
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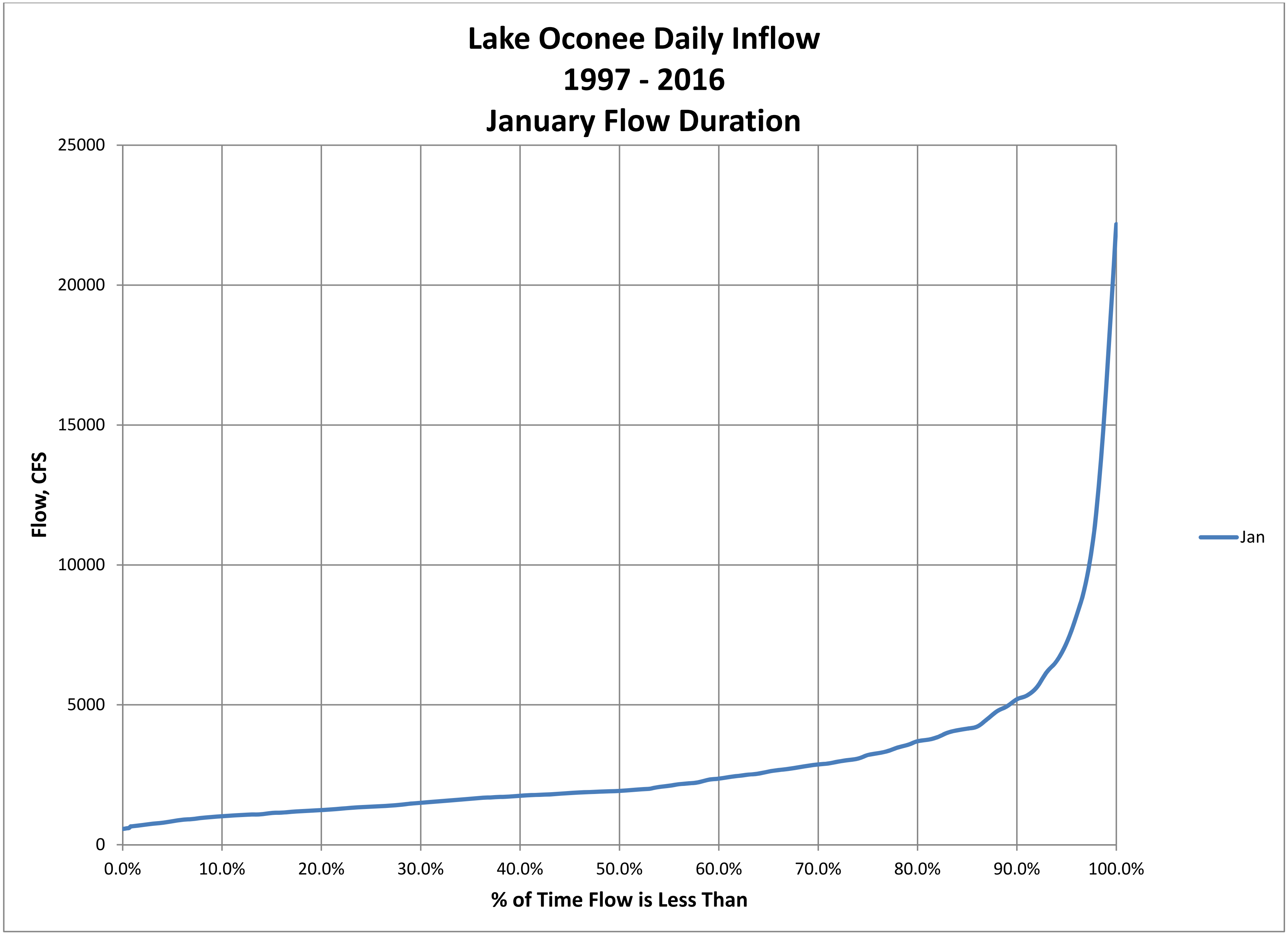
Figure A-5
Dissolved Oxygen in the Tailrace, 5/16/2016; During Generation

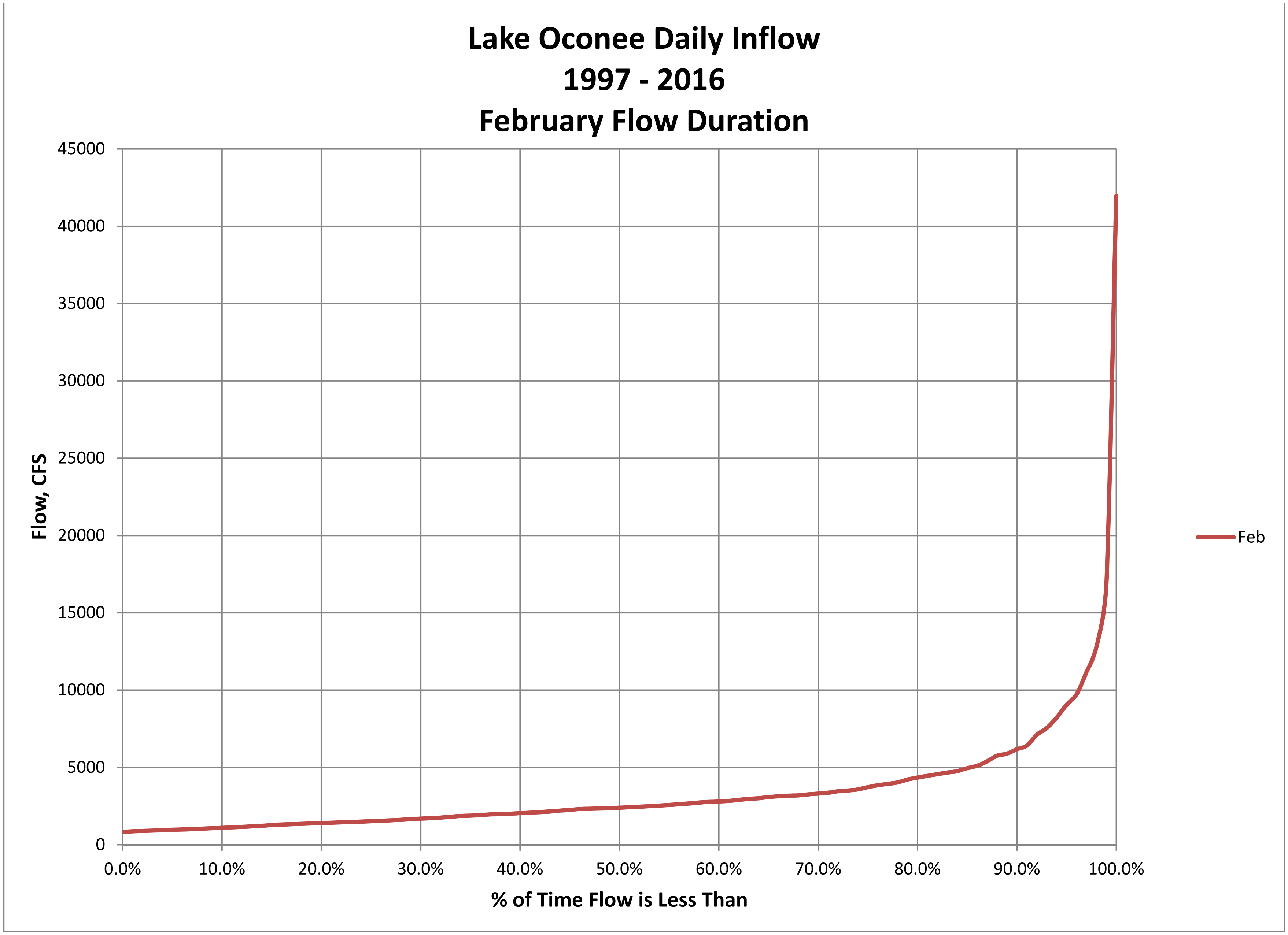
Wallace Dam Project
(FERC No. 2413)

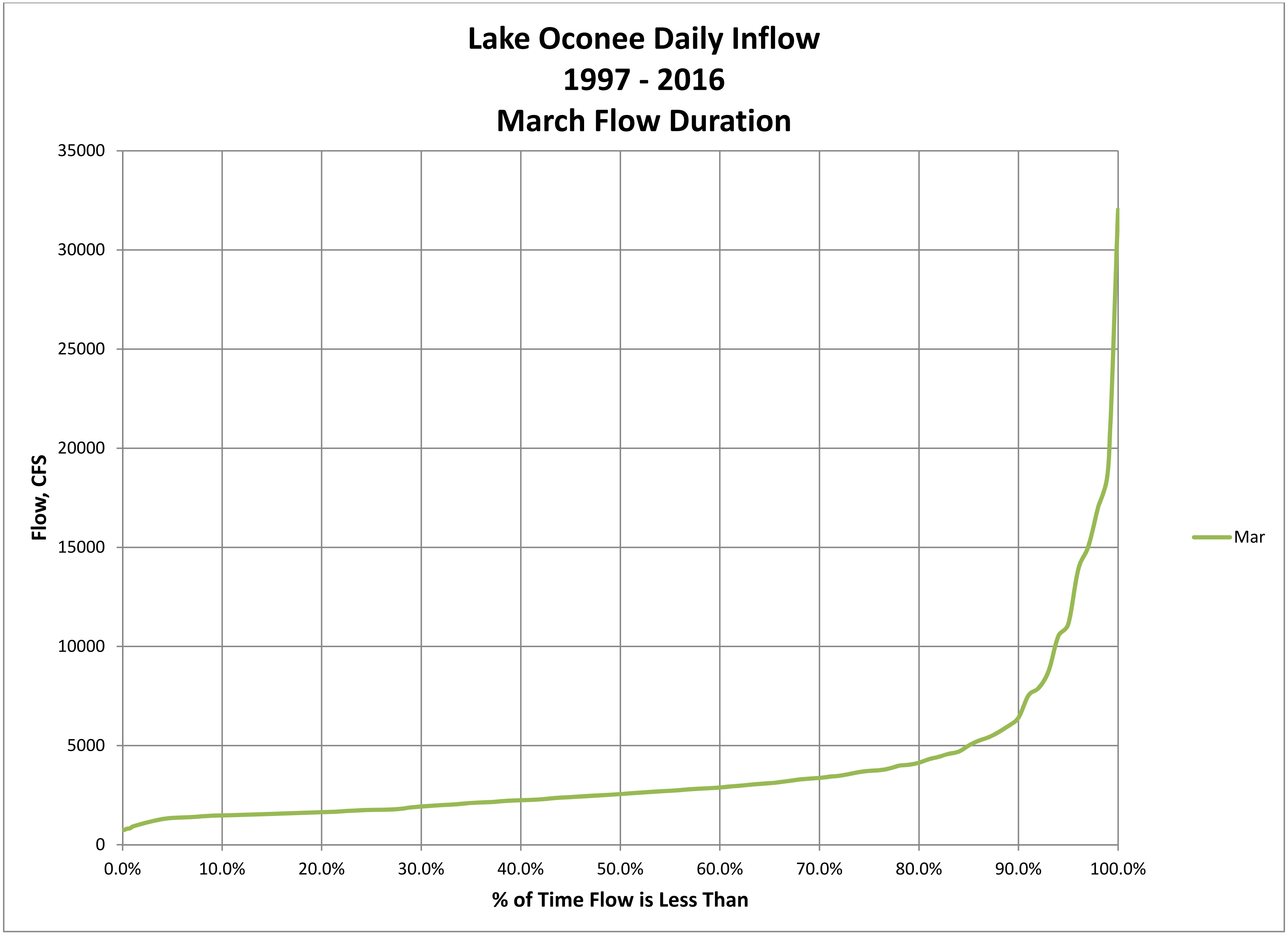
N:\G\GeorgiaPower\WallaceDam\GIS\mxd\WaterResourcesFigures\Appendix\B5_DO in the tailrace_20160516.mxd

APPENDIX B

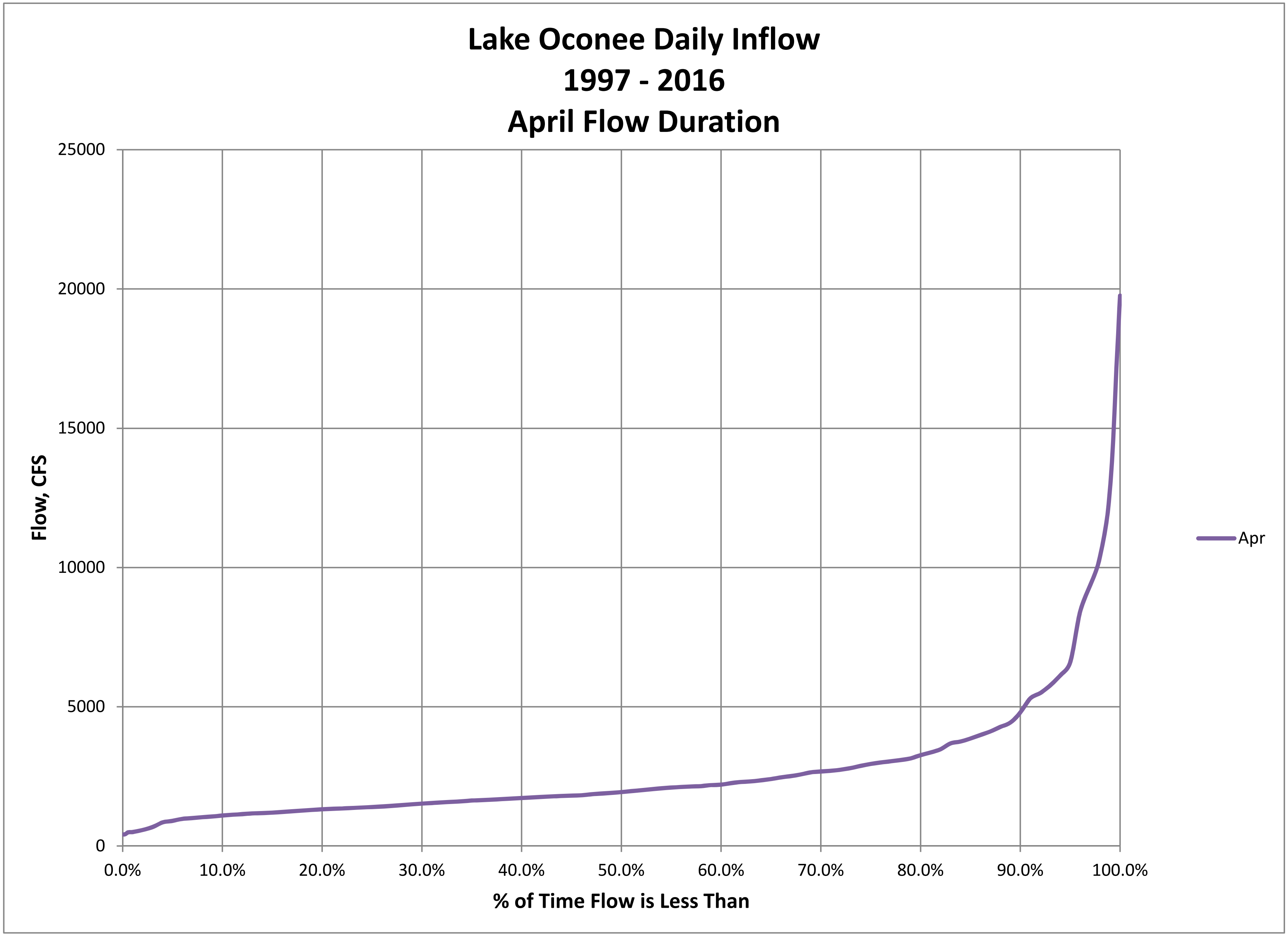
Flow Duration Curves for Wallace Dam, 1997-2016


Lake Oconee Daily Inflow
1997 - 2016
January Flow Duration
25000
20000
15000
10000
5000
0
Flow, CFS
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Jan

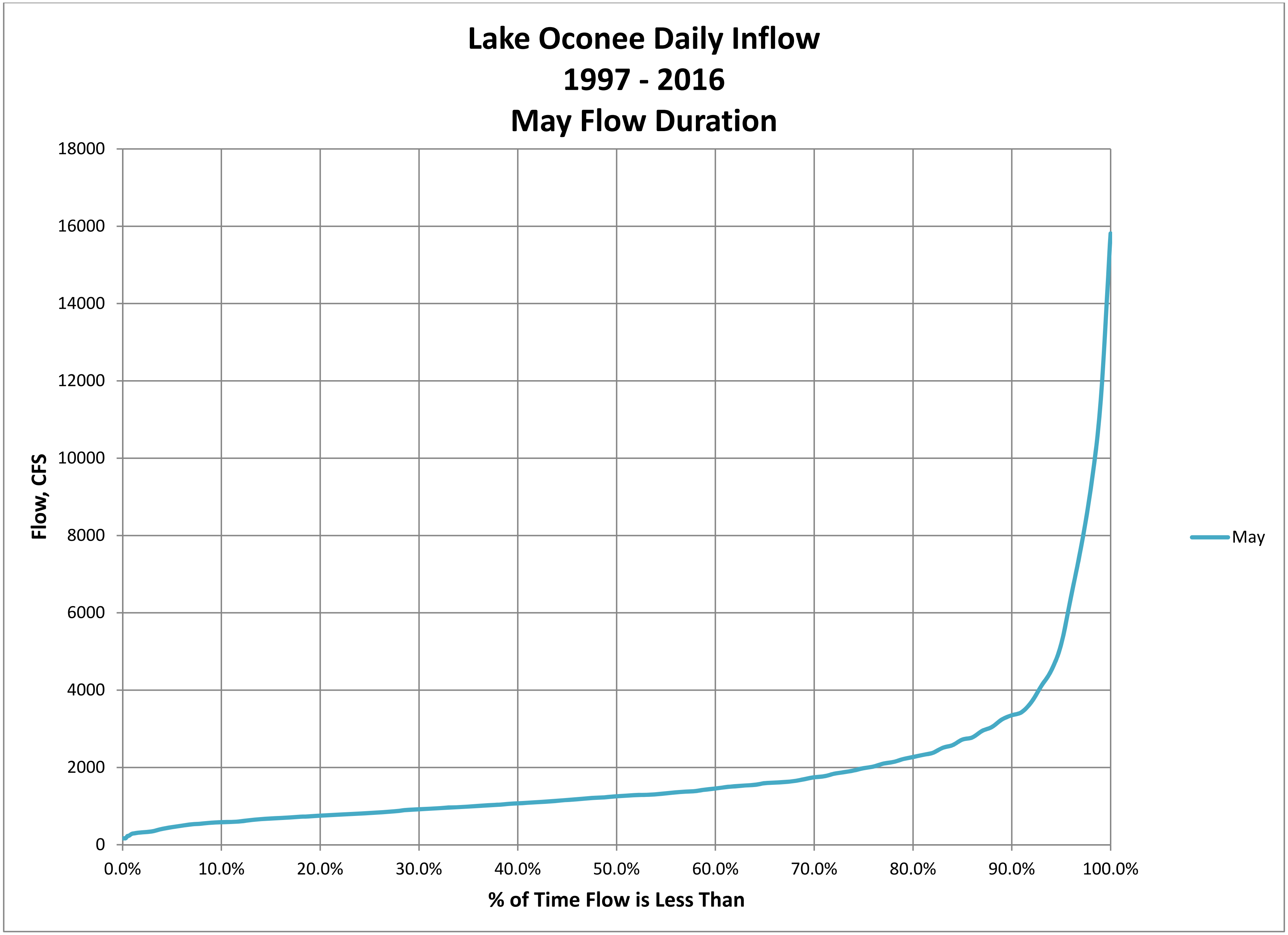

Lake Oconee Daily Inflow
1997 - 2016
February Flow Duration
Flow, CFS
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Feb



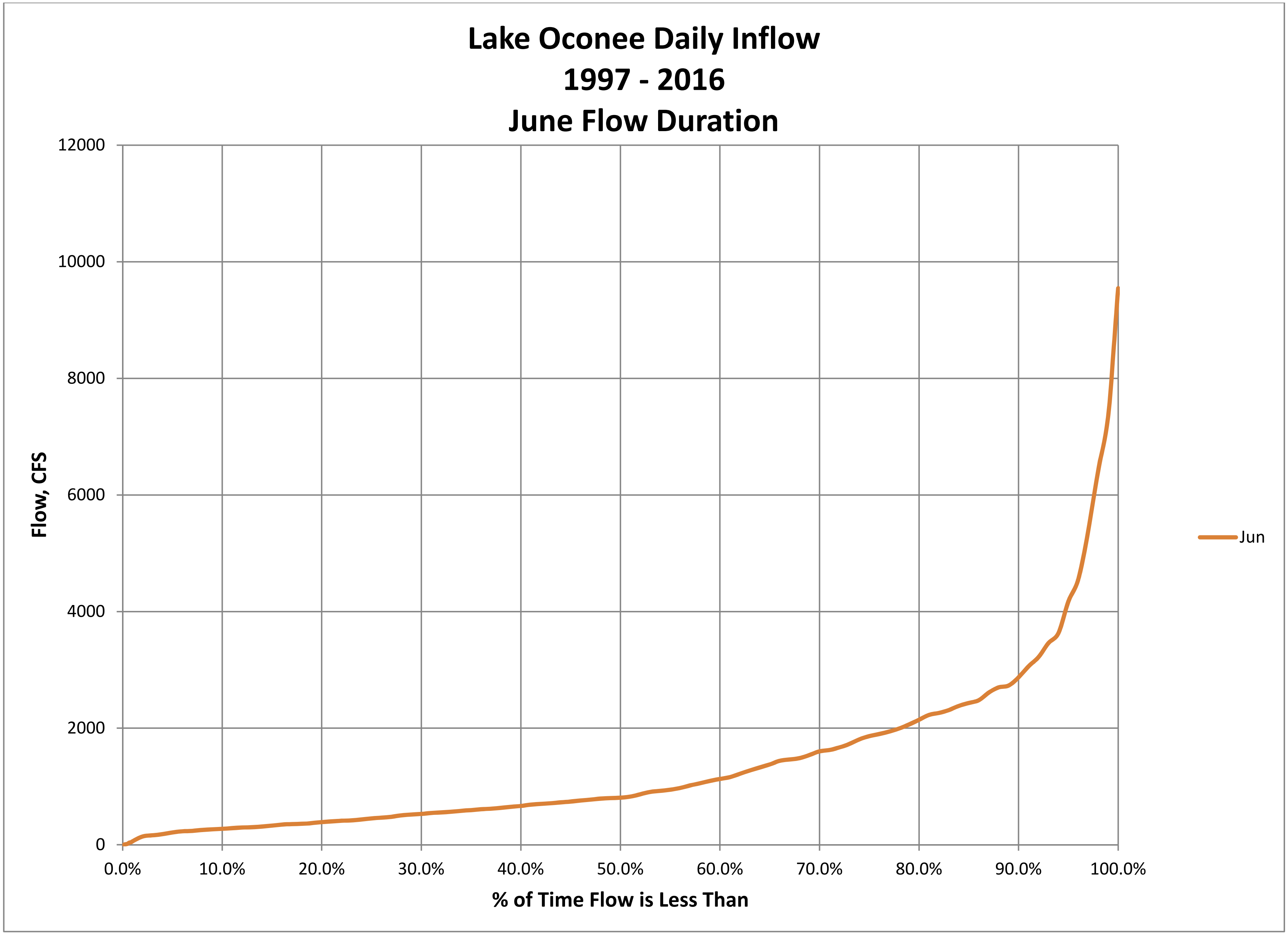
Lake Oconee Daily Inflow
1997 - 2016
March Flow Duration
Flow, CFS
35000
30000
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Mar

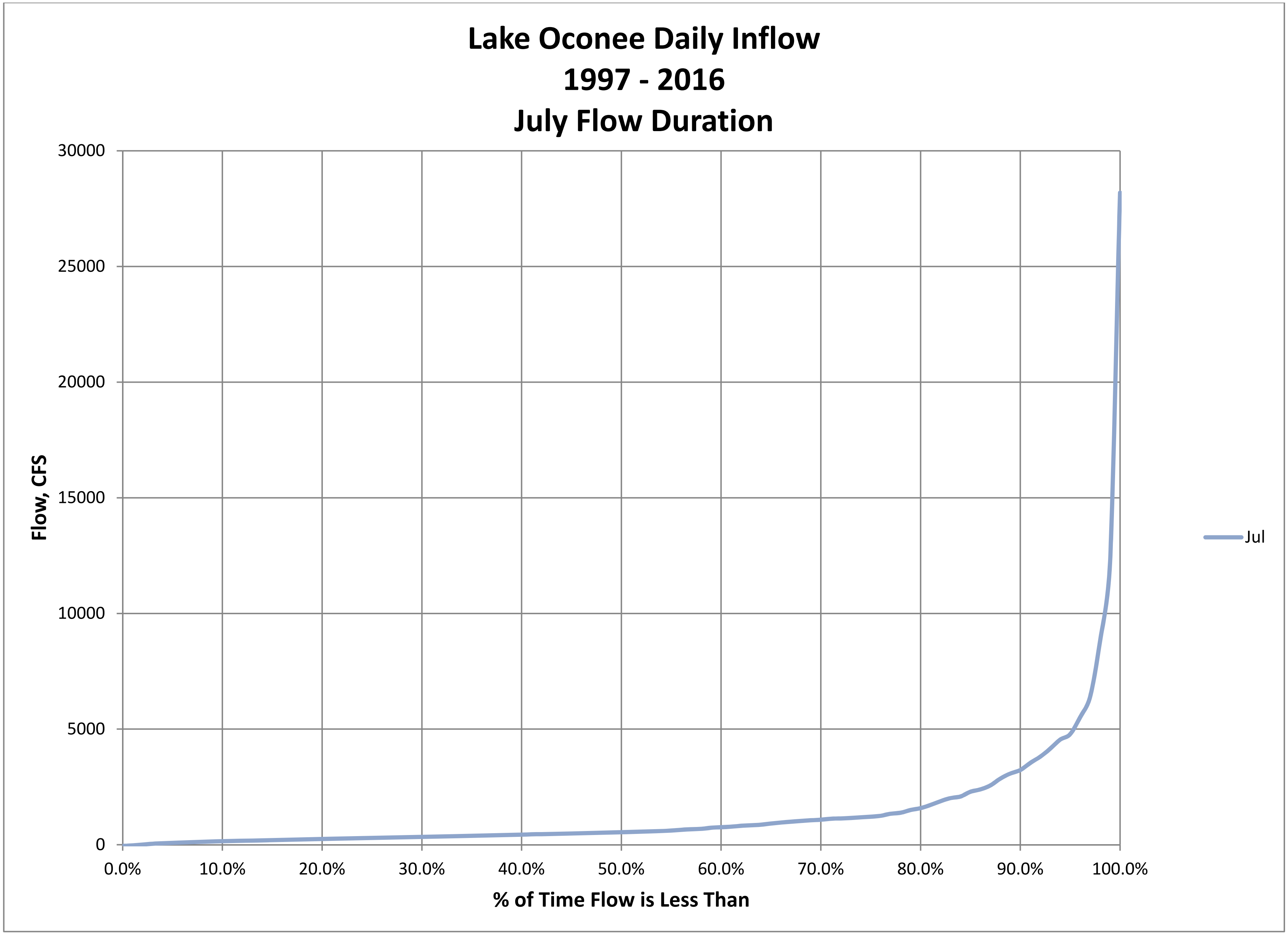


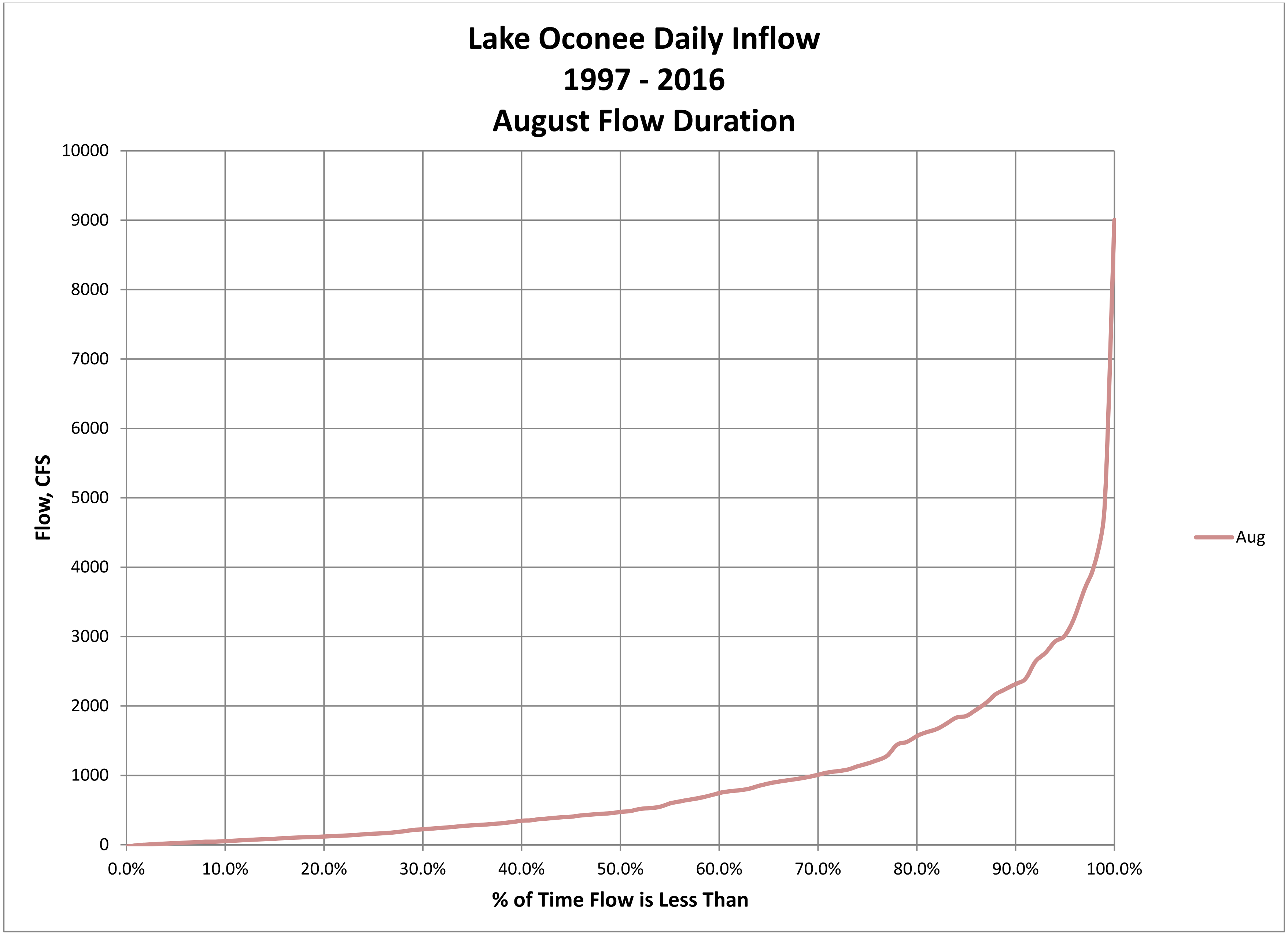
Lake Oconee Daily Inflow
1997 - 2016
April Flow Duration
Flow, CFS
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Apr



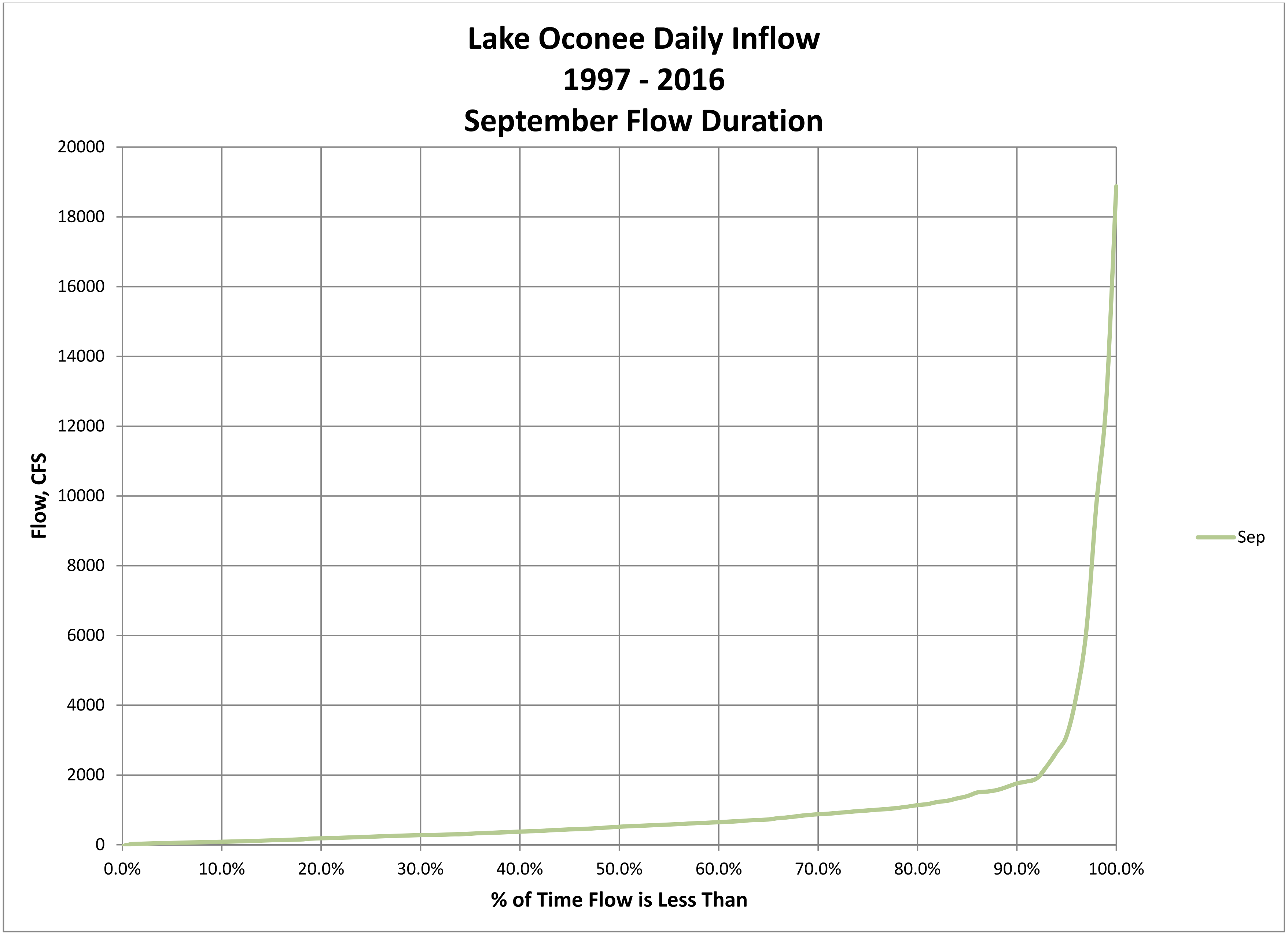
Lake Oconee Daily Inflow
1997 - 2016
May Flow Duration
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Flow, CFS
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
May


Lake Oconee Daily Inflow
1997 - 2016
June Flow Duration
Flow, CFS
12000
10000
8000
6000
4000
2000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Jun

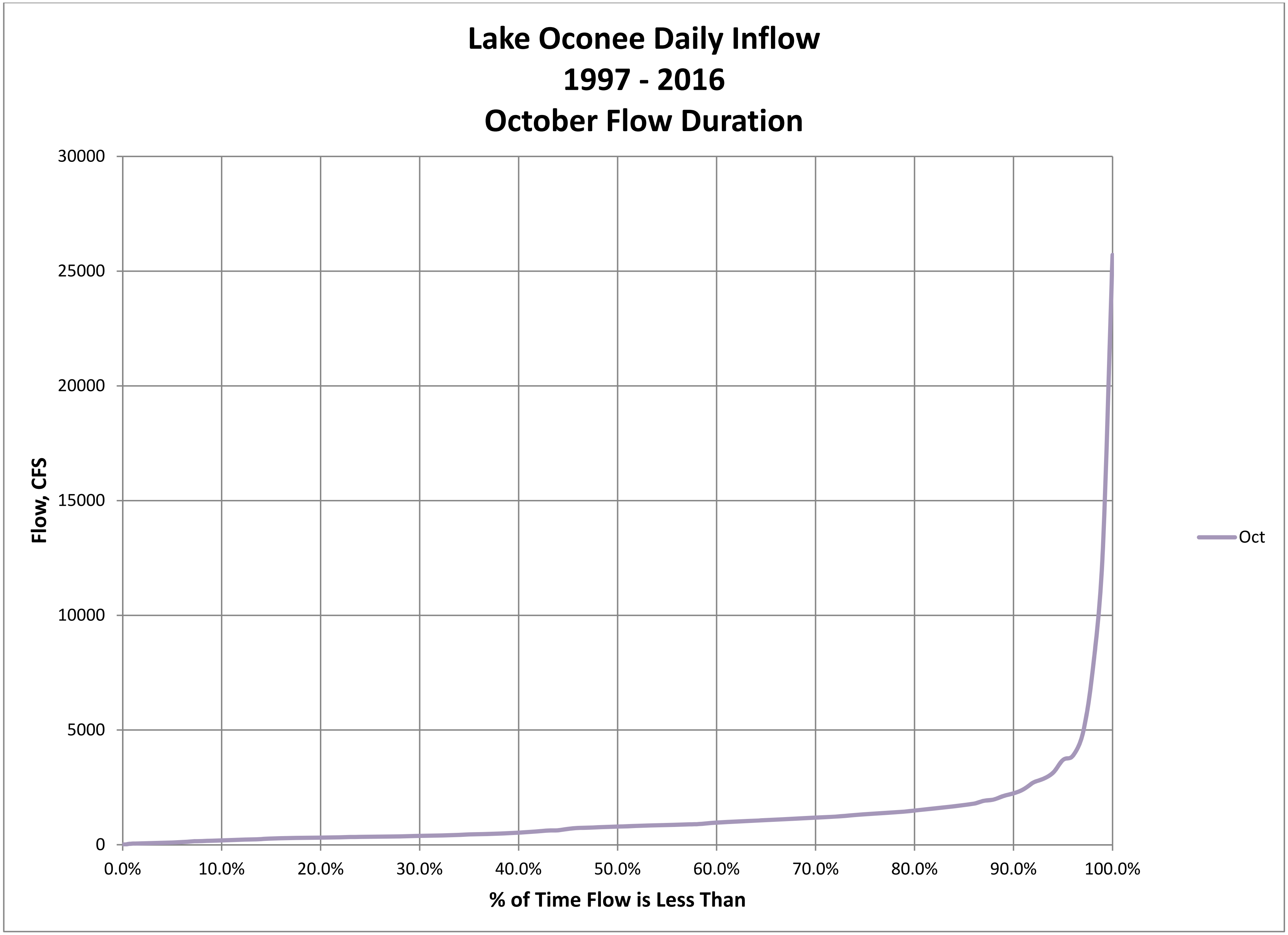

Lake Oconee Daily Inflow
1997 - 2016
July Flow Duration
Flow, CFS
30000
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Jul



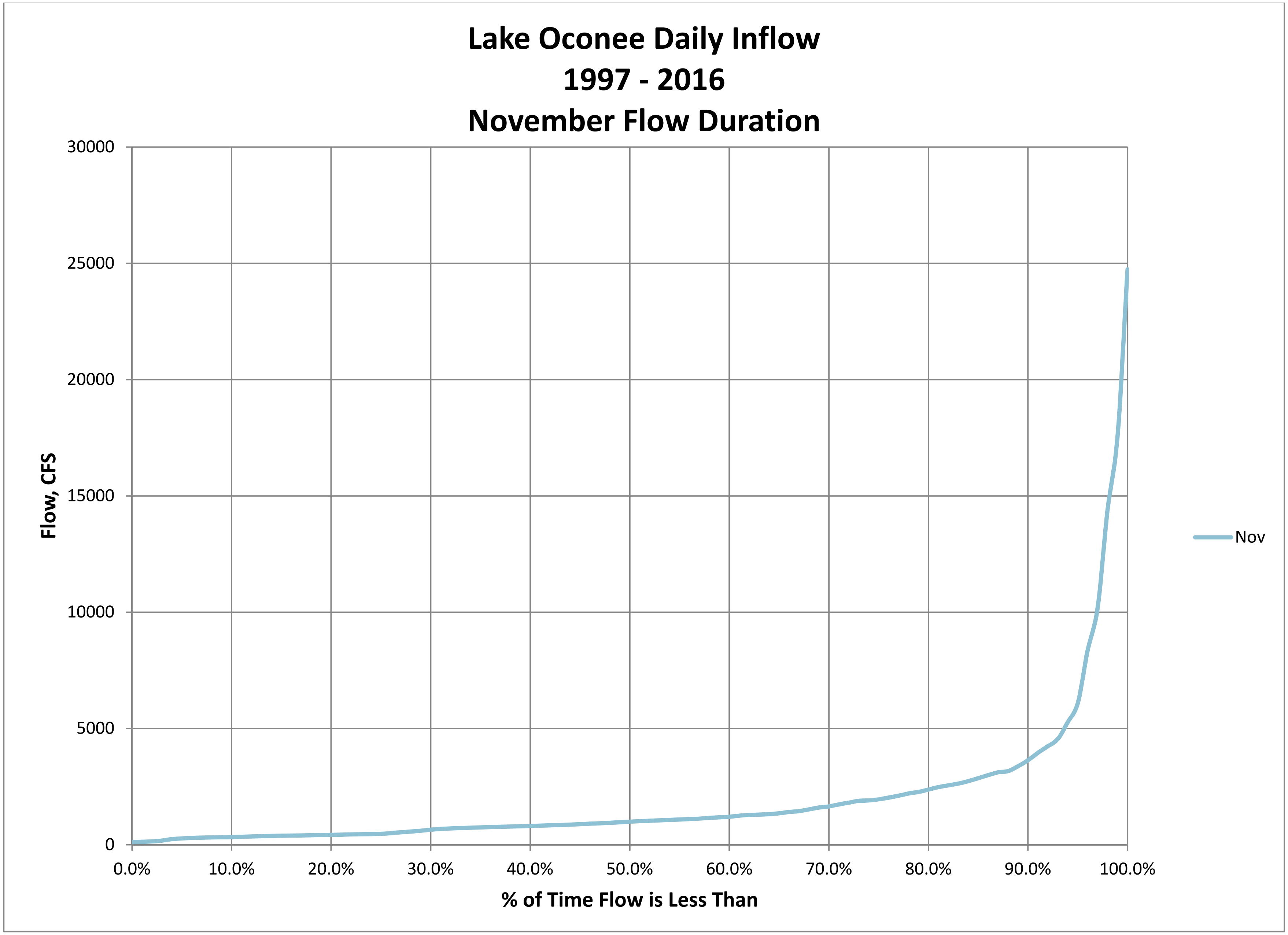
Lake Oconee Daily Inflow
1997 - 2016
August Flow Duration
Flow, CFS
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Aug



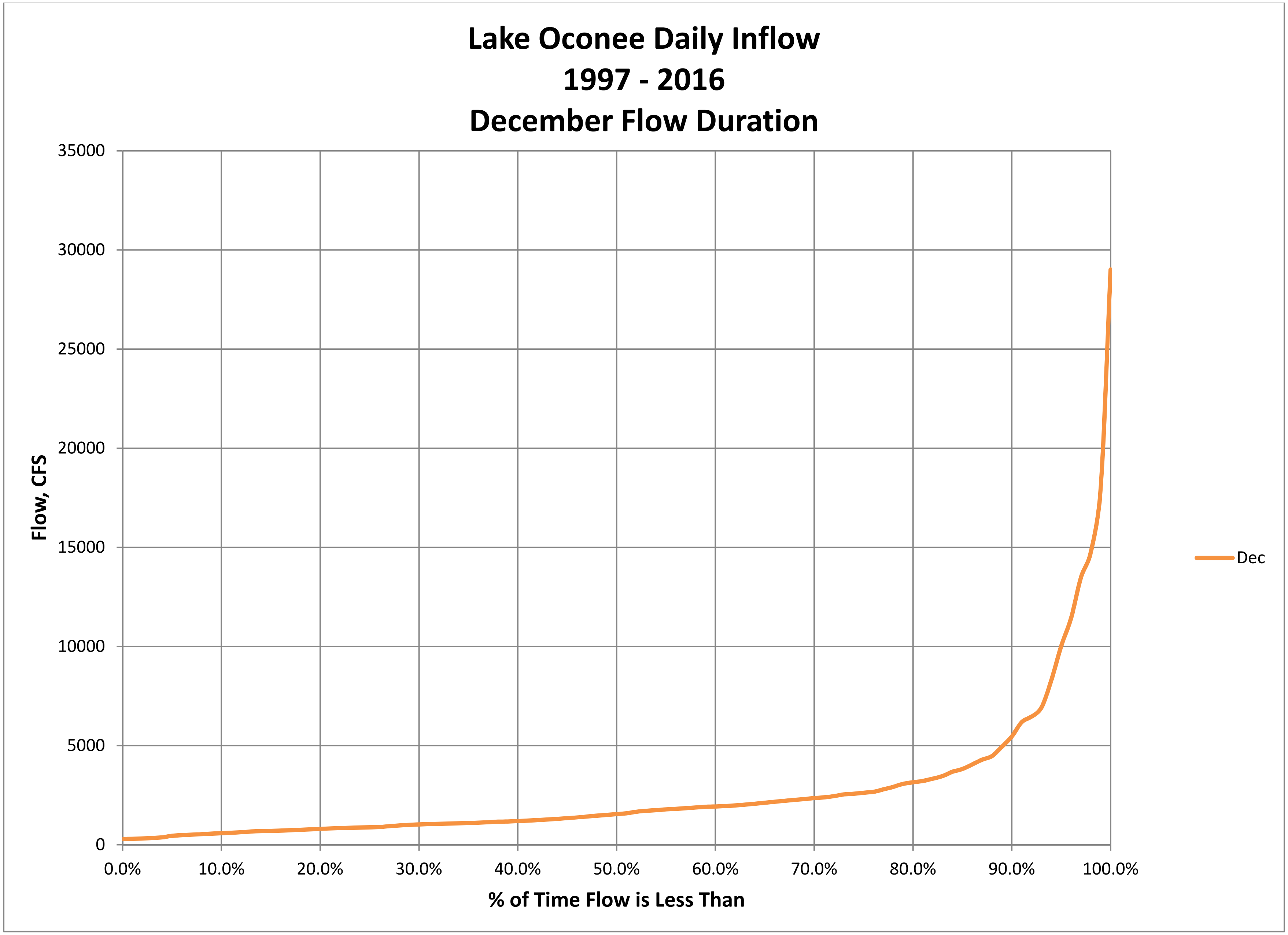
Lake Oconee Daily Inflow
1997 - 2016
September Flow Duration
Flow, CFS
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Sep



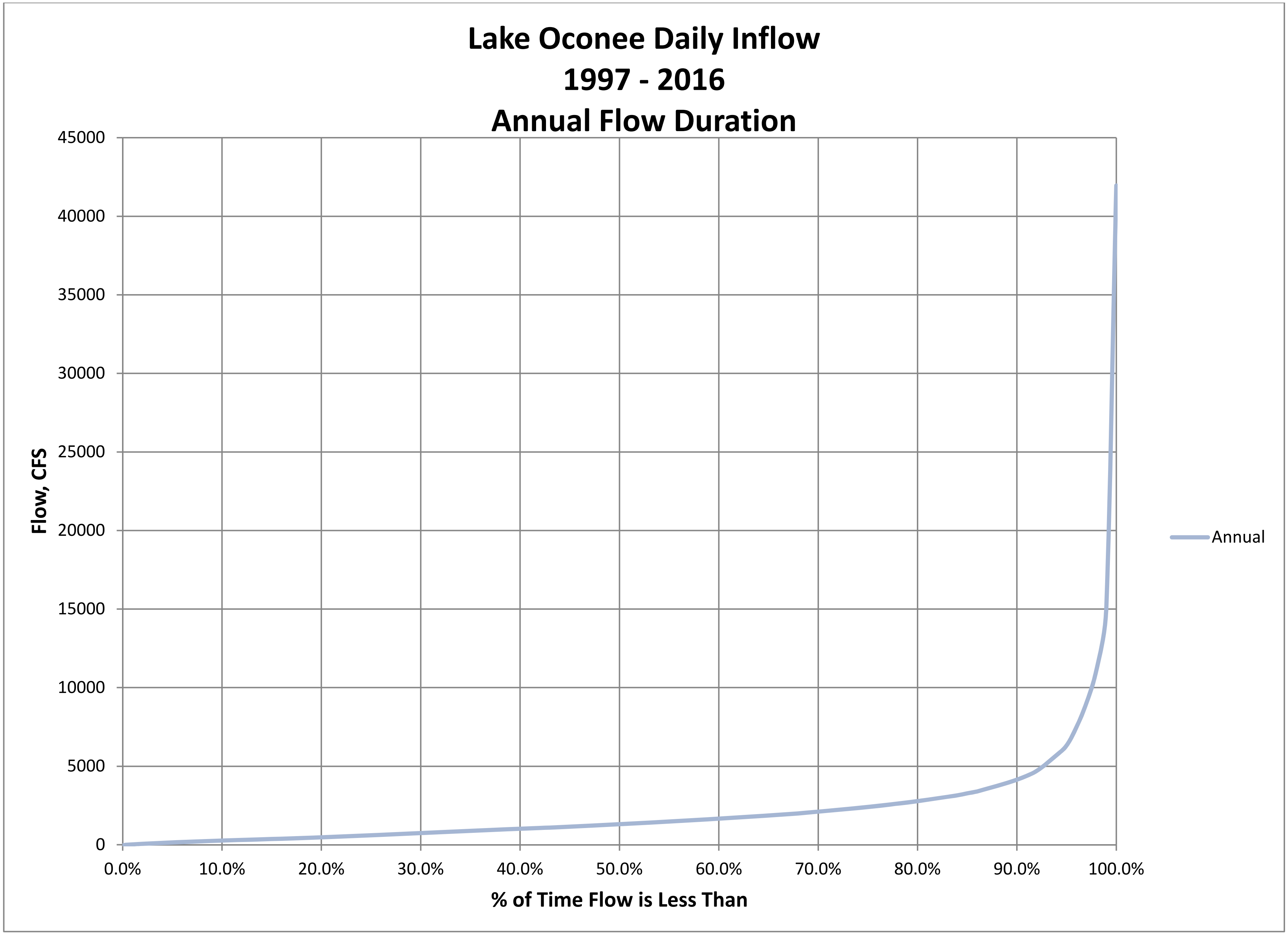
Lake Oconee Daily Inflow
1997 - 2016
October Flow Duration
Flow, CFS
30000
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Oct



Lake Oconee Daily Inflow
1997 - 2016
November Flow Duration
30000
25000
20000
15000
10000
5000
0
Flow, CFS
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Nov



Lake Oconee Daily Inflow
1997 - 2016
December Flow Duration
35000
30000
25000
20000
15000
10000
5000
0
Flow, CFS
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Dec


Lake Oconee Daily Inflow
1997 - 2016
Annual Flow Duration
Flow, CFS
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
% of Time Flow is Less Than
Annual