

Prepared for

SCE&G, VC Summer Station
Highway 215 and Bradham Blvd
Jenkinsville, South Carolina 29065

**COOLING WATER INTAKE
STRUCTURE DATA
V.C. SUMMER NUCLEAR STATION UNIT 1
40 CFR § 122.21(r)(3)**

**SOUTH CAROLINA ELECTRIC & GAS COMPANY
JENKINSVILLE, SOUTH CAROLINA**

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LIST OF ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
cfs	cubic feet per second
CWA	Clean Water Act
CWIS	cooling water intake structure
FERC	Federal Energy Regulatory Commission
ft	feet
fps	feet per second
ft	feet
FPSF	Fairfield Pumped Storage Facility
gpm	gallons per minute
hp	horsepower
MSL	mean sea level
MW	megawatts
NGVD29	National Geodetic Vertical Datum of 1929
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
psi	pounds per square inch
rpm	revolutions per minute
SCDHEC	South Carolina Department of Health and Environmental Control
SCE&G	South Carolina Electric and Gas Company
VCSNS	Virgil C. Summer Nuclear Station

1. INTRODUCTION

This report provides cooling water intake structure (CWIS) data for South Carolina Electric & Gas Company's (SCE&G's) Virgil C. Summer Nuclear Station (VCSNS) Unit 1. VCSNS Unit 1 is an existing nuclear-powered generating facility located on Monticello Reservoir in the Broad River basin near Jenkinsville, Fairfield County, South Carolina. SCE&G operates VCSNS Unit 1 under National Pollutant Discharge Elimination System (NPDES) Permit Number SC0030856. The information provided in this report supports the facility's compliance with section 316(b) of the Clean Water Act.

The U.S. Environmental Protection Agency published 316(b) regulations for cooling water intake structures (CWISs) at existing power generating and manufacturing facilities that became effective October 14, 2014. The final 316(b) rule requires the submittal of applicable CWIS information under 40 CFR § 122.21(r) to the South Carolina Department of Health and Environmental Control (SCDHEC), the NPDES permitting agency in South Carolina.

As provided in the NPDES permit application requirements at 40 CFR § 122.21(r)(3), all existing facilities with CWISs must submit the following CWIS data:

- (i) *A narrative description of the configuration of each of your cooling water intake structures and where it is located in the water body and in the water column;*
- (ii) *Latitude and longitude in degrees, minutes, and seconds for each of your cooling water intake structures;*
- (iii) *A narrative description of the operation of each of your cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation and seasonal changes, if applicable;*
- (iv) *A flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges; and*
- (v) *Engineering drawings of the cooling water intake structure.*

For the purposes of this report, the CWIS means the total physical structure and any associated constructed waterways used to withdraw cooling water from waters of the U.S.

(40 CFR § 125.92). The CWIS extends from the point at which water is withdrawn from the surface water source up to, and including, but not limited to, the intake pumps. VCSNS Unit 1 uses Monticello Reservoir as its source waterbody.

2. FACILITY AND CWIS DESCRIPTIONS

VCSNS Unit 1 is a single-unit, 972.7-megawatt (MW), nuclear-fueled, base-load facility located at the southern end of Monticello Reservoir, a freshwater impoundment (Figure 1). Unit 1 operates using a single CWIS located along the shoreline (Figure 2). It has a design intake capacity of approximately 533,122 gallons per minute or 768 million gallons per day (MGD). The actual intake flow of the CWIS is greater than 125 MGD. Although the cooling water system operates in a “once-through” mode, Monticello Reservoir was constructed for the purpose of serving as part of the cooling water system (U.S. Nuclear Regulatory Commission [NRC], 2004). Thus, the use of Monticello Reservoir as a cooling impoundment for VCSNS Unit 1 has been determined by SCDHEC and EPA to be a closed-cycle recirculating system under 40 CFR, Part 125, Subpart J, §125.92(c)(2).

Monticello Reservoir is a 6,500-acre freshwater lake with 51 miles of shoreline. It is located on a small tributary of the Broad River. Monticello Reservoir was built in the Frees Creek valley in 1978 to serve as the upper pool for the Fairfield Pumped Storage Facility (FPSF) and the cooling water source for VCSNS Unit 1 (NRC, 2004). The reservoir is hydrologically connected to a 300-acre sub-impoundment that is managed for recreational boating and fishing by SCE&G and the South Carolina Department of Natural Resources. Monticello Reservoir has a total storage capacity of approximately 400,000 acre-feet (Kleinschmidt, 2015) with an average depth of 59 feet (ft) and a maximum depth of 125 ft.

Monticello Reservoir and Parr Reservoir serve as the upper and lower pools, respectively, for FPSF. FPSF is part of the Parr Hydroelectric Project operated by SCE&G, which is licensed by the Federal Energy Regulatory Commission (FERC). FPSF pumps water from Parr Reservoir, a freshwater impoundment of the Broad River, into Monticello Reservoir (Figure 2). Parr Reservoir was enlarged in 1977 from 1,853 to 4,398 acres for added pumped storage exchange with Monticello Reservoir and as makeup water for evaporative losses from Monticello Reservoir due to VCSNS Unit 1 operations (SCE&G, 2002). FPSF generates hydroelectricity by releasing water from Monticello Reservoir into Parr Reservoir using active storage of 29,000 acre-feet (Kleinschmidt, 2015). During off-peak power demand periods, FPSF turbines reverse and once again pump water back into Monticello Reservoir for the next generation cycle.

The full-pool elevation of Monticello Reservoir is typically managed to 425 ft mean sea level (MSL, NGVD29). Monticello Reservoir experiences daily fluctuations in surface elevation of up to a maximum of 4.5 ft due to pumped storage operations (Kleinschmidt, 2015). Under the FERC license for the Parr Hydroelectric Project, SCE&G manages Monticello Reservoir elevations within an operating range of 420.5 to 425.0 ft.

2.1 Cooling Water Intake Structure Configuration

The VCSNS Unit 1 CWIS consists of an inlet bay created by two embankments, which both support an electrical transmission tower and concludes at the circulating pump house structure positioned parallel to the southern shoreline of Monticello Reservoir near the FPSF. The cooling water inlet bay is about 550 ft wide east to west at its widest dimension and about 200 ft in length north to south at its longest dimension between the transmission tower embankments (Figure 2). The water depth in the inlet bay ranges from 30 to 40 ft. Bathymetry of the intake bay measured using acoustic Doppler current profiling techniques (Geosyntec Consultants, Inc., 2005) is presented in Figure 3.

The circulating pump house intake structure is 93 ft wide with six intake bays each approximately 13-ft wide. Parallel concrete retainer walls extend out into the inlet bay a distance of approximately 30 ft. Trash racks comprised of steel bars with 10-inch spacing are located along the upstream face of the pump house structure to prevent large debris from entering the intake bays. The trash racks are mounted to the bottom of a skimmer wall that extends from the water surface to a depth of 9.5 ft (415.5 ft MSL) at normal high water (425 ft MSL). The skimmer wall is designed to exclude floating debris from entering the cooling water system and, combined with the pump house retainer walls, to optimize withdrawal of the coolest water from mid depth of the water column at the pump house. Vertical traveling water screens are located 25 ft behind the trash racks to strain out smaller debris. A bar grid structure is located between the traveling screens and the circulating pumps. Three circulating water pumps convey screened flow to the condensers. At normal full pool, the CWIS is designed to withdraw water from the water column between elevations 415.5 ft and 390 ft MSL; or from a depth of 9.5 ft to 35 ft.

After leaving the condensers, the heated cooling water discharges to Monticello Reservoir via a 1,000-foot-long discharge canal located east of the CWIS beyond the service water pond and jetty (Figure 2).

Following is a summary of pertinent CWIS specifications/data for VCSNS Unit 1:

1. NPDES Permit: SC0030856;
2. EPA ID #: AUT0345;
3. Permit Expiration Date: May 31, 2019;
4. Estimated design intake flow: 768 MGD or 1,187.8 cubic feet per second (cfs);
5. Intake velocity is: 1.31 feet per second (fps) through the traveling screens;
6. Water Level Elevations are:
 - a. High elevation: 425.0 ft;
 - b. Low elevation: 420.5 ft; and
 - c. Emergency elevation: 418.0 ft.
7. Water depths in the intake bay are 35 ft maximum (normal high water) and 28 ft minimum (emergency drawdown elevation);
8. Intake structure:
 - a. Location: Southern end of cooling impoundment;
 - b. Configuration (relative to shore): onshore and parallel to shoreline;
 - c. Length: 93 ft; and
 - d. Number of bays: 6.
9. Traveling water screens:
 - a. Location: 25 ft downstream from trash racks;
 - b. Number: 6;
 - c. Rotation speeds: 2.5 and 10 feet per minute (fpm);
 - d. Width: 10 ft;
 - e. Mesh size and geometry: 3/8 in. square mesh openings;

- f. Spray nozzle configuration: front;
 - g. Volume: 225 gallons per minute (gpm);
 - h. Pressure: 60 pounds per square inch (psi);
 - i. Fish return: 3-ft wide x 2-ft deep debris/fish trough;
 - j. Trough configuration: slopes downward to south side structure; and
 - k. Other: timer-actuated (all six screens concurrently) every 12 hours or by differential pressure switch, screens replaced every 6 years.
10. Circulating water pumps:
- a. Location: 35 ft center to center, downstream of traveling water screens;
 - b. Number of pumps: 3;
 - c. Type of pumps: SAFV, vertical solid shaft; and
 - d. Flow per pump: 395.94 cfs (177,700 gpm).
11. Screen wash pumps:
- a. Location: Two; discharge side of circulating water pump no. 1C; and
 - b. Flow per pump: 4.46 cfs (2,000 gpm).
12. Clarifier raw water pumps:
- a. Location: Two; just east of circulating water pump no. 1A; and
 - b. Flow per pump: 4.46 cfs (1,200 gpm).

Plan and section view engineering drawings and specifications for the VCSNS Unit 1 CWIS are provided on SCE&G Drawing E-026-101 included in Appendix A.

2.2 Cooling Water Intake Structure Coordinates

The circulating cooling water pump house intake structure is located in Fairfield County, South Carolina, at Latitude: 34° 17' 59.0640" N and Longitude: 81° 18' 51.9012" W. It is at the southern shore of Monticello Reservoir with a top deck elevation of 438.0 ft MSL and an invert elevation of 390.0 ft MSL.

2.3 Cooling Water Intake Structure Operation

VCSNS Unit 1 is designed to operate in one cooling mode, closed-cycle utilizing Monticello Reservoir. Cooling water is drawn in at the pump house, passed through the steam condenser as well as the auxiliary condensers, and discharged back to Monticello Reservoir via a discharge canal located east of the CWIS (Figure 2). The U.S. Energy Information Administration (2017) rated VCSNS Unit 1 in 2010 at 971 MW summer capacity, 6,913,294 megawatt-hours net generation, and an 81.3 percent summer capacity factor.

2.3.1 Traveling Screen Operation

The VCSNS Unit 1 CWIS traveling water screens are timer-actuated, operating all six screens concurrently, every 12 hours or earlier as may be dictated by differential pressure across the screens. Each screen is designed to rotate at either 2.5 or 10 fpm, depending on the extent of debris loading. A 60-psi front wash system cleans the screens.

Screen-wash water is supplied to each traveling screen at a volume of 225 gpm (0.5 cfs) from two 100-percent capacity screen wash pumps. Each pump draws from the discharge side of circulating pump number 1C located on the west side of the pump house. Each screen wash pump is rated at 200 horsepower (hp) at 1,750 revolutions per minute (rpm) and provides approximately 2,000 gpm (4.46 cfs) for screen wash. Screen-wash water collects in a debris trough that conveys the debris and any impinged organisms to a screened collection basket located in a trash sump on the west side of the pump house. Collected debris and any associated organisms are retrieved from the collection basket and discarded approximately every two weeks depending on debris load. Screen-wash water having passed through the screened collection basket is directed back to the pump house between the traveling screens and circulating water pump number 1C.

2.3.2 Circulating Water Pumps

VCSNS Unit 1 has three, vertical, wet-pit type circulating water pumps located 35 ft downstream of the traveling water screens. The operating design point of each pump is 395.94 cfs at 2,095 hp and 294 rpm. Three pumps are required when at full power, with an average total flow of 1,187.8 cfs. Flow from the individual pumps combine into a single intake pipe before reaching the condensers.

At design flows, the velocity through the trash racks is 0.72 fps at emergency drawdown elevation of 418.0 MSL. At the same water level, through-screen velocity at the traveling screens is 1.31 fps (Appendix A, SCE&G Drawing No.: E-026-101).

2.3.3 Clarifier Raw Water Pumps

The CWIS has two 100-percent capacity clarifier raw water (non-cooling water) pumps to provide raw water to the plant water treatment system, which in turn provides clean and treated water for a multitude of processes. Each pump is a vertical, wet-pit type pump that draws from the pump house basin. Each clarifier raw water pump provides approximately 1,200 gpm (2.67 cfs) when operating. Although the water balance shown on SCE&G drawing D-921-931, Rev 2 indicates that this process flow is 0.262 MGD (182 gpm), SCE&G site personnel indicate that one of the two pumps essentially runs continuously, thus daily flow is approximately 1.73 MGD or 2.67 cfs. A small portion of the treated water is used as make-up to the on-site cooling tower, which is a closed-loop cooling water system used to cool various turbine building cooling loads, such as the steam turbine lube oil and generator hydrogen coolers.

2.4 Flow Distribution and Water Balance

The distribution of cooling water flows at VCSNS Unit 1 and associated water balance diagram are presented in Figure 4.

2.5 Engineering Drawings

Appendix A includes Drawing Number M000-SKM-003, Rev A which presents a concise plan view of the VCSNS Unit 1 CWIS and associated intake bay. This drawing is based on SCE&G Drawing Number E-036-001, which includes most of the VCSNS Unit 1 facility. Plan and section view engineering drawings and specifications for the VCSNS Unit 1 CWIS are provided on SCE&G Drawing E-026-101 also included in Appendix A.

Additional detailed engineering drawings prepared by SCE&G for the VCSNS Unit 1 cooling water system will be made available upon request.

3. SUMMARY AND CONCLUSION

VCSNS Unit 1 is a single-unit, 972.7-MW, nuclear-fueled, base-load power generating facility located at the southern end of Monticello Reservoir in Fairfield County, South Carolina. Monticello Reservoir is a 6,500-acre freshwater impoundment constructed for the purpose of serving as part of the VCSNS cooling water system. The single, shoreline CWIS is part of a cooling water system that has been determined by SCDHEC and EPA to be a closed-cycle recirculating system under the definition at 40 CFR §125.92(c)(2). The CWIS has a design intake flow of approximately 768 MGD. Monticello Reservoir also serves as the upper pool for the FPSF, which is part of SCE&G's Parr Hydroelectric Project.

The VCSNS Unit 1 CWIS begins as an inlet bay on the south shore of Monticello Reservoir with a depth of 30 to 40 ft. The circulating pump house intake structure within the bay is 93 ft wide and has six intake bays. Parallel concrete retainer walls on either side of the pump house and a skimmer wall extending 9.5 ft below the full pool elevation direct the withdrawal of cooling water from the deeper, seasonally cooler mid-depth portion of the reservoir. Six vertical 3/8-inch mesh traveling water screens strain out debris and any impinged organisms, which are conveyed by the screen-wash system to a trash sump for disposal. Three circulating water pumps convey the screened intake flow to the condensers.

After leaving the condensers, the heated cooling water discharges to Monticello Reservoir via a discharge basin and a 1,000-foot-long discharge canal located east of the CWIS beyond the service water pond and jetty.

A water balance diagram and engineering drawings of the VCSNS Unit 1 CWIS are provided herein. Additional detailed engineering drawings of the CWIS will be made available by SCE&G upon request.

4. REFERENCES CITED

Geosyntec Consultants, Inc. 2005. Delineation of the Area of Hydraulic Influence Attributable to the Virgil C. Summer Nuclear Station Cooling Water Intake Structure. South Carolina Electric & Gas Company, Jenkinsville, South Carolina.

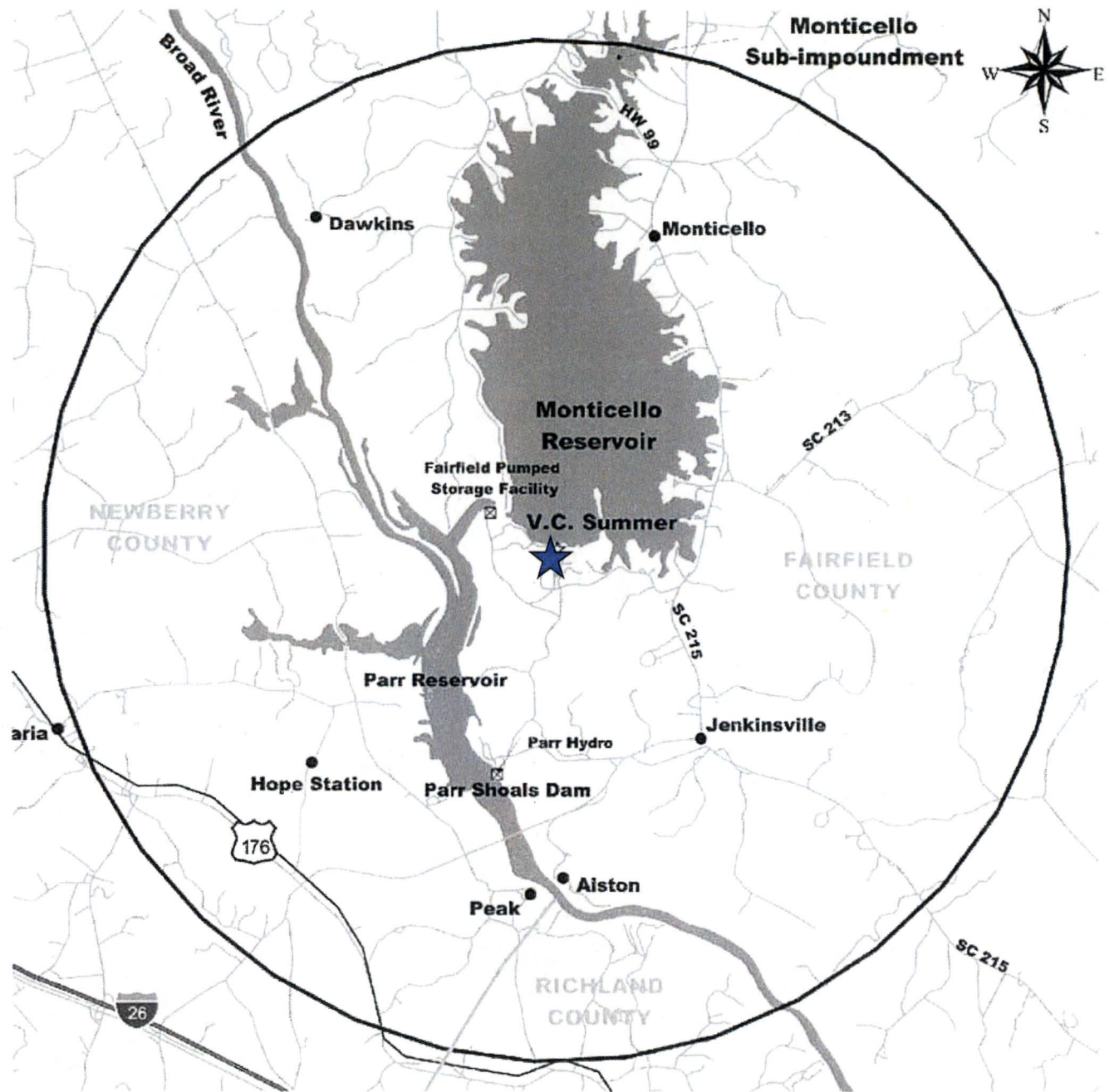
Kleinschmidt. 2015. Pre-application Document, Parr Hydroelectric Project, FERC Project No. 1894. Prepared for South Carolina Electric and Gas Company, Cayce, South Carolina. January 2015.

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FIGURES



LEGEND

- 10-km (6-mi) radius of V.C. Summer
- Interstates
- Major Roads
- Minor Roads
- County Boundaries
- Lakes and Rivers

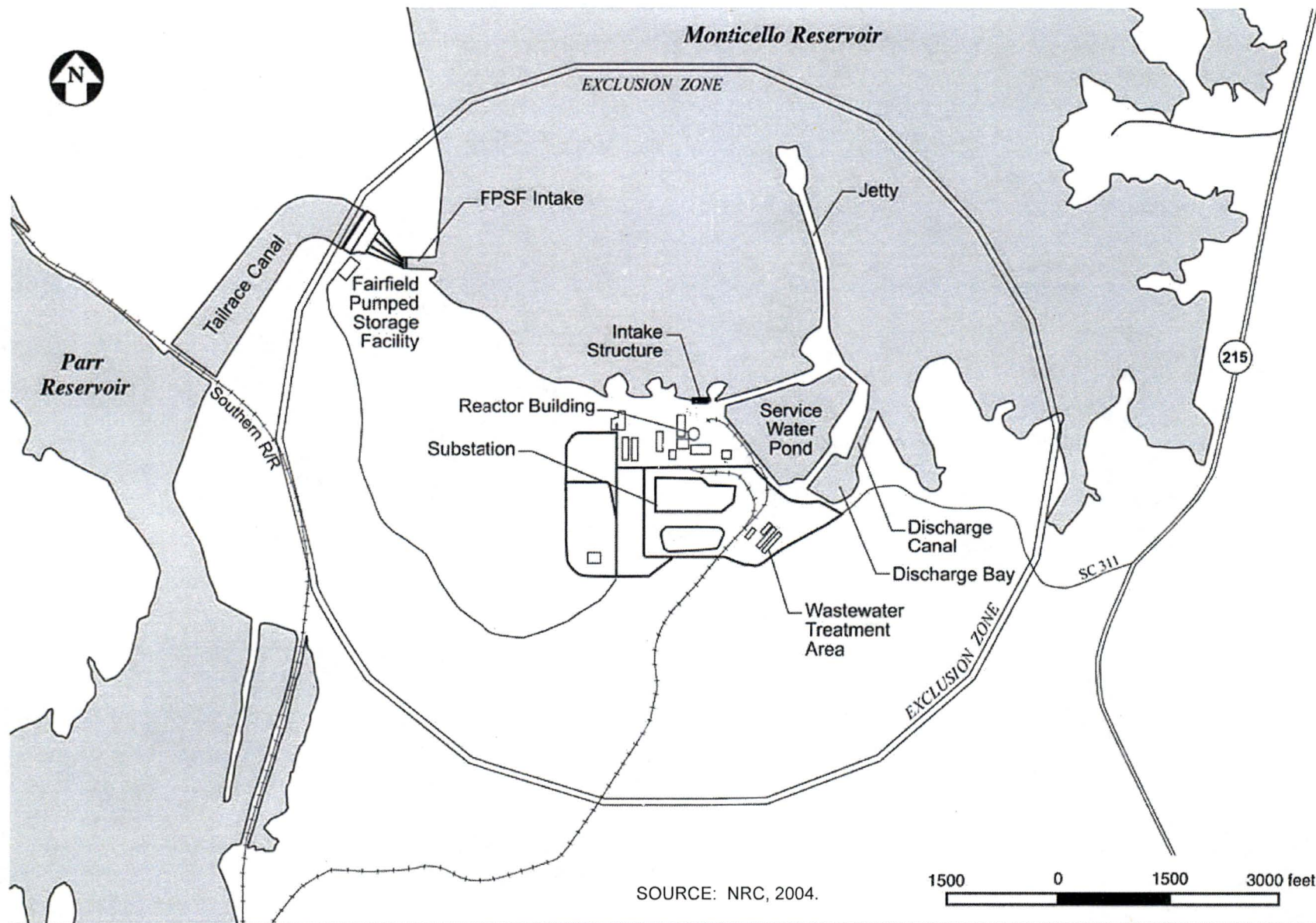


Source: NRC, 2004.

Site Vicinity of VCSNS Unit 1
Jenkinsville, South Carolina

Geosyntec
consultants
Atlanta, Georgia

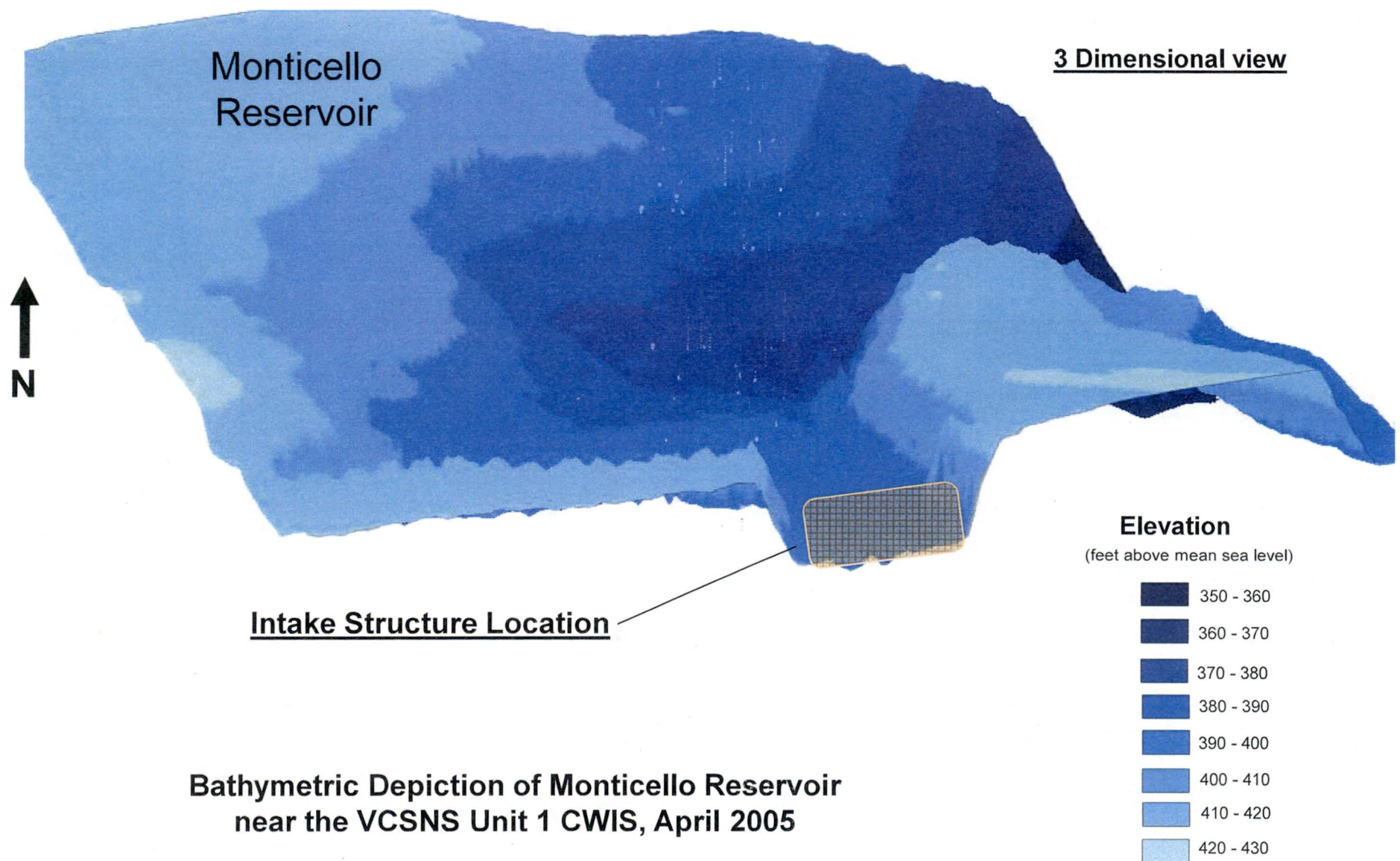
Figure
1



Site Layout of the VCSNS Unit 1 Cooling Water Intake Structure and the Fairfield Pumped Storage Facility
Jenkinsville, South Carolina

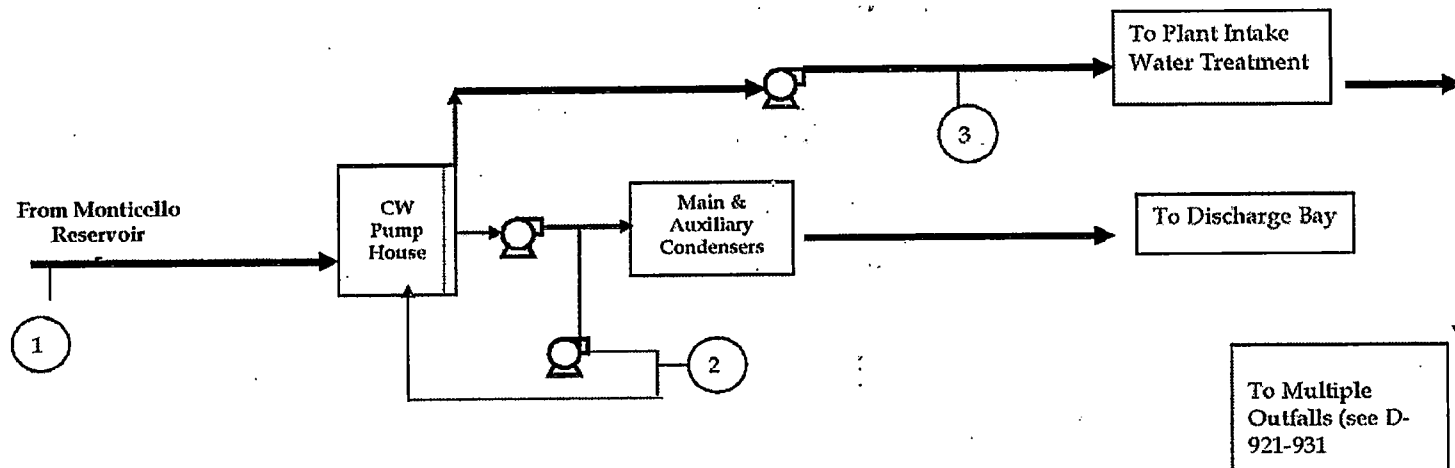
Geosyntec
consultants
ATLANTA, GEORGIA

Figure
2



**Bathymetric Depiction of Monticello Reservoir
near the VCSNS Unit 1 CWIS, April 2005**

V C Summer Nuclear Station Water Balance Diagram



① = 767.67 MGD = Main and auxiliary condensers.

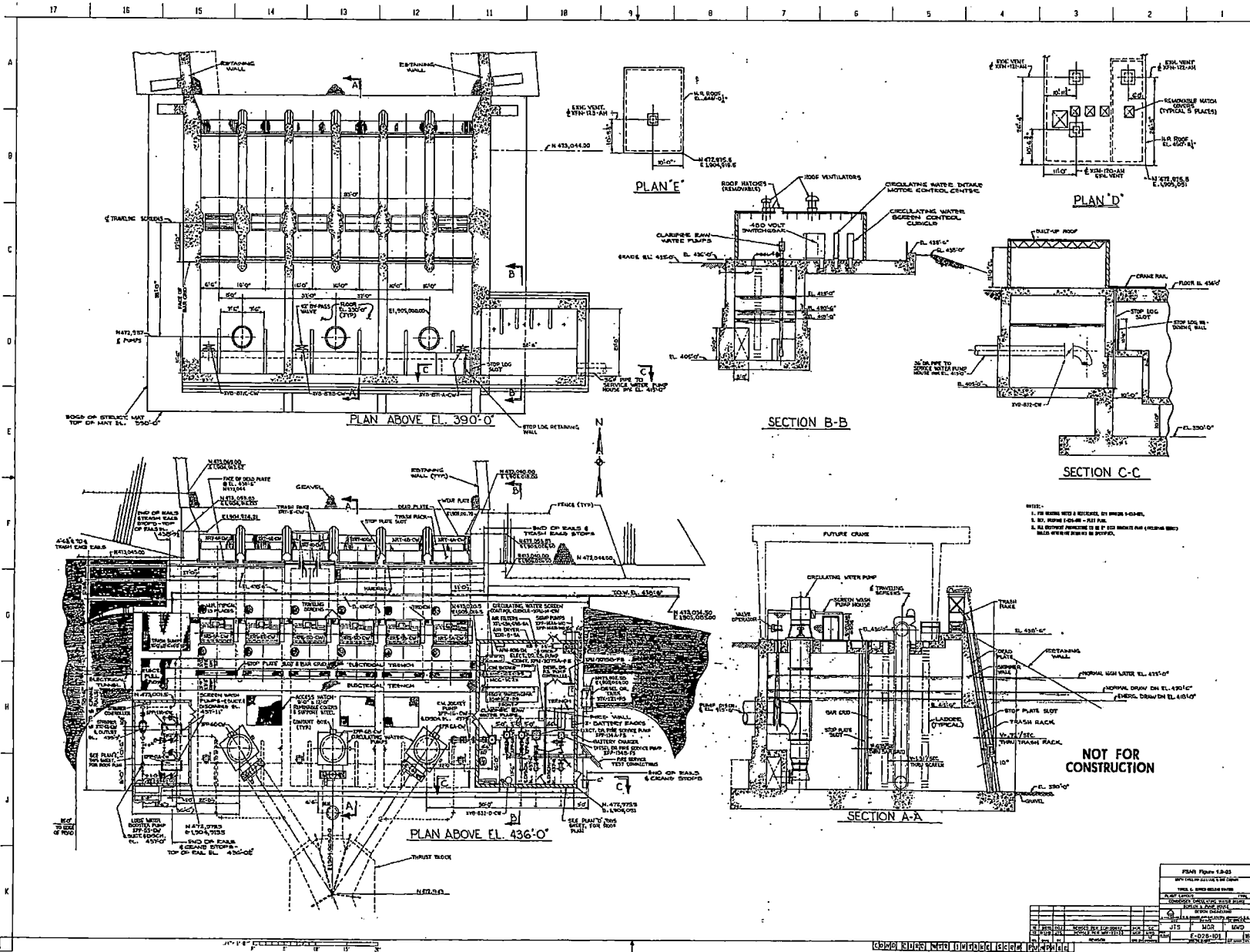
② = 2.88 MGD = Screen wash pump flow backwash for the traveling water screens

③ = 1.73 MGD = Clarifier raw water process (non-cooling water flow) to the on-site water treatment plant



APPENDIX A

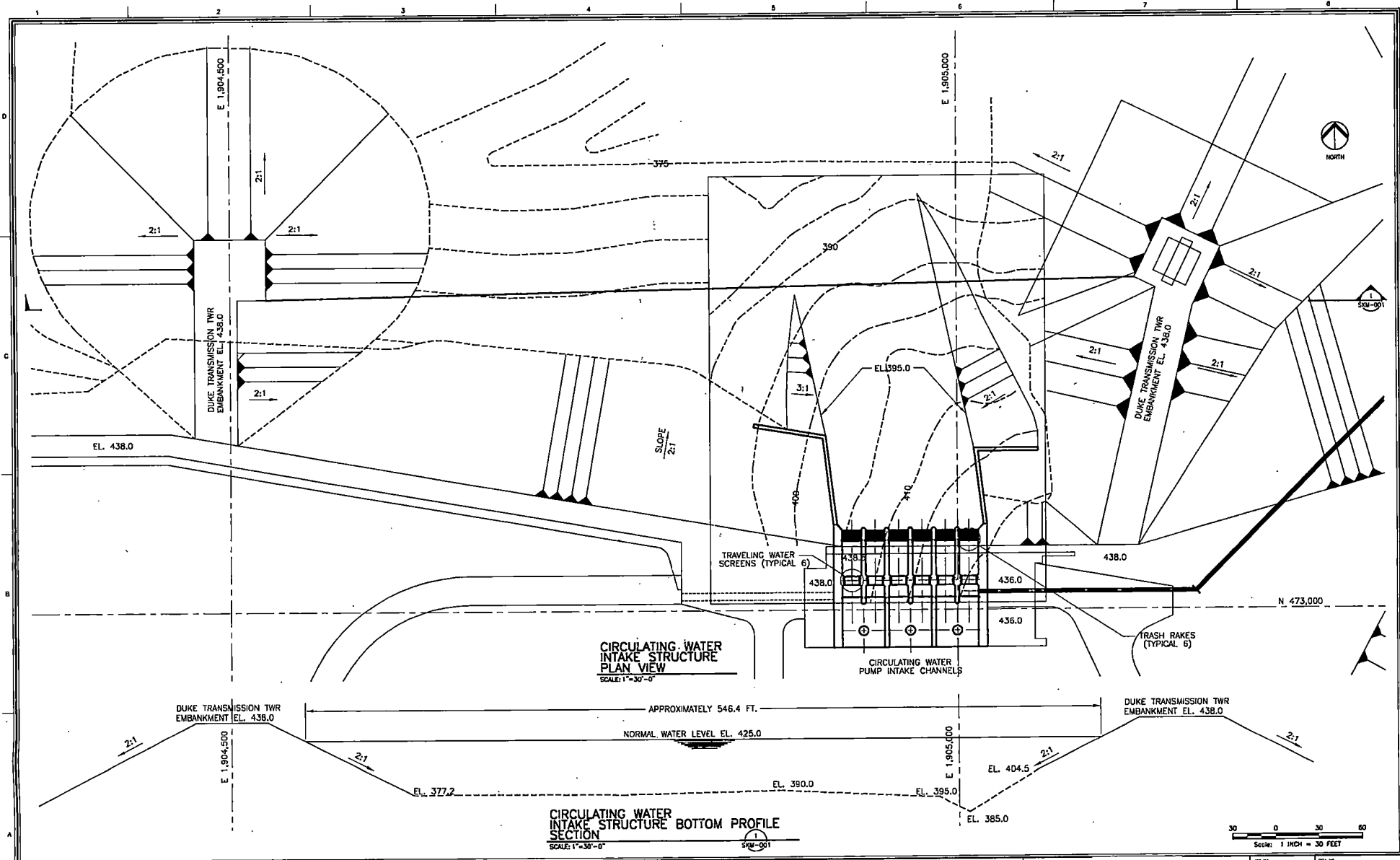
Engineering Drawings



PLAN 1.0-02

NO.	DESCRIPTION	DATE	BY	CHKD.
1	ISSUED FOR CONSTRUCTION	10/1/68	JTS	WSP
2	REVISION			
3	REVISION			
4	REVISION			
5	REVISION			

GROUP 1.0-02, 1.0-03, 1.0-04, 1.0-05, 1.0-06, 1.0-07, 1.0-08, 1.0-09, 1.0-10, 1.0-11, 1.0-12, 1.0-13, 1.0-14, 1.0-15, 1.0-16, 1.0-17, 1.0-18, 1.0-19, 1.0-20, 1.0-21, 1.0-22, 1.0-23, 1.0-24, 1.0-25, 1.0-26, 1.0-27, 1.0-28, 1.0-29, 1.0-30, 1.0-31, 1.0-32, 1.0-33, 1.0-34, 1.0-35, 1.0-36, 1.0-37, 1.0-38, 1.0-39, 1.0-40, 1.0-41, 1.0-42, 1.0-43, 1.0-44, 1.0-45, 1.0-46, 1.0-47, 1.0-48, 1.0-49, 1.0-50, 1.0-51, 1.0-52, 1.0-53, 1.0-54, 1.0-55, 1.0-56, 1.0-57, 1.0-58, 1.0-59, 1.0-60, 1.0-61, 1.0-62, 1.0-63, 1.0-64, 1.0-65, 1.0-66, 1.0-67, 1.0-68, 1.0-69, 1.0-70, 1.0-71, 1.0-72, 1.0-73, 1.0-74, 1.0-75, 1.0-76, 1.0-77, 1.0-78, 1.0-79, 1.0-80, 1.0-81, 1.0-82, 1.0-83, 1.0-84, 1.0-85, 1.0-86, 1.0-87, 1.0-88, 1.0-89, 1.0-90, 1.0-91, 1.0-92, 1.0-93, 1.0-94, 1.0-95, 1.0-96, 1.0-97, 1.0-98, 1.0-99, 1.0-100



CIRCULATING WATER
INTAKE STRUCTURE
PLAN VIEW
SCALE: 1"=30'-0"

CIRCULATING WATER
INTAKE STRUCTURE BOTTOM PROFILE
SECTION
SCALE: 1"=30'-0"

						DESIGNED BY
						CHECKED BY
						DATE
						CLIENT
						NO.
						DATE
						REVISION
						BY
						CHK.
						APP.

CH2MHILL
Lockwood Greene
Aiken, Georgia

SHEET TITLE

JOB NAME
SCE&G
V.C. SUMMER NUCLEAR STATION
JENKINSVILLE, SC 29065

JOB NO.	022725.01	REV. NO.	A
FILE NO.	MO006K003	DATE	
SCALE	1"=30'-0"	DWG. NO.	SKM-003