Prepared for:

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FINAL REPORT

COMPREHENSIVE 316(b) DEMONSTRATION STUDY PROPOSAL FOR INFORMATION COLLECTION

Virgil C. Summer Nuclear Station

SOUTH CAROLINA ELECTRIC AND GAS COMPANY JENKINSVILLE, SOUTH CAROLINA

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1. INTRODUCTION

The U.S. Environmental Protection Agency's (EPA) Phase II 316(b) rule (69 Fed. Reg. 41576, July 9, 2004) applies to the cooling water intake structure (CWIS) at South Carolina Electric & Gas Company's (SCE&G) Virgil C. Summer Nuclear Station (Summer Station). The rule requires the use of Best Technology Available (BTA) to meet performance standards for reducing impingement mortality, and where applicable, entrainment at affected facilities. Applicable performance standards are determined based on source waterbody type, generating capacity utilization rate, and/or ratio of water withdrawal to mean annual flow (rivers). Source waterbody type is the determinant for Summer Station.

Summer Station, operating as a base-load facility, is a single-unit, 974-megawatt (MW) nuclear-fueled electric power generating facility located near Jenkinsville, Fairfield County, South Carolina (Figure 1-1). The facility uses a once-through cooling water system that withdraws cooling water from Monticello Reservoir via a single shoreline-positioned cooling water intake structure (CWIS) located at the south end of the reservoir (Figure 1-2). Debris and fish are subject to impingement on the CWIS's six vertical traveling screens. Impinged items are collected at a central location for ultimate disposal; thus fish are subject to 100 percent mortality. After the cooling water leaves the condensers, the heated water is conveyed to a "discharge bay" and then through a 1,000 ft discharge canal leading into Monticello Reservoir. Monticello Reservoir, recognized by the Nuclear Regulatory Commission (NRC) as a 6,500 acre "cooling pond", is the upper reservoir for the Fairfield Pumped Storage Facility (FPSF) that pumps and discharges water between Monticello Reservoir and Parr Reservoir, the latter an impoundment of the Broad River.

1.1 Applicable Performance Standards

The applicable performance standard for facilities withdrawing cooling water from lakes or reservoirs is a minimum 80 percent reduction in impingement mortality from a "Calculation Baseline". Facilities that withdraw cooling water from lakes or reservoirs are exempt from having to address entrainment. The Phase II 316(b) rule (40 CFR § 125.93) defines a lake or reservoir as:

"*...any inland body of open water with some minimum surface area free of rooted vegetation and with an average hydraulic retention time of more than 7 days. Lakes or reservoirs might be natural water bodies or impounded streams, usually fresh, surrounded by land or by land and a man-made retainer (e.g., a dam). Lakes or reservoirs might be fed by rivers, streams, springs, and/or local precipitation*".

Monticello Reservoir meets the 316(b) regulatory definition of a lake or reservoir. Thus, Summer Station must meet the performance standard for reducing impingement mortality by 80 to 95 percent from a "Calculation Baseline" to be determined from historical data, current information, new field studies, or a combination thereof.

1.2 Purpose

The rule specifies that a Comprehensive Demonstration Study (CDS) be conducted at facilities that have not met applicable performance standards, the results of which are to be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) upon application for NPDES permit renewal. In accordance with the 316(b) rule, this document represents SCE&G's Proposal for Information Collection (PIC), which comprises the first component of the CDS. The purpose of the PIC is to inform SCDHEC of the information that will be collected to support the CDS. The rule requires that the PIC be submitted prior to the start of information collection activities to allow for review and comment by SCDHEC. SCE&G would appreciate timely review of the PIC so that responsive modifications can be made in its information collection plans, to the extent SCDHEC recommends modifications.

Based on the rule, this PIC provides:

- A description of the proposed and/or implemented technology(ies) and/or supplemental restoration measures to be evaluated in the CDS;
- A list and description of historical studies characterizing impingement mortality and/or the physical and biological conditions in the vicinity of the CWISs and their relevance to this proposed study;
- A summary of past, ongoing, or voluntary consultations with appropriate Federal and State fish and wildlife agencies that are relevant to this study and a copy of written comments received as a result of such consultation; and

- A sampling plan for any new field studies proposed for developing a scientifically valid estimate of impingement mortality at Summer Station as part of the Impingement Mortality Characterization Study (IMCS) of the CDS.

2. PROPOSED TECHNOLOGIES AND RESTORATION MEASURES

Under the 316(b) rule, SCE&G is required to identify potential technologies, operational measures, and/or restoration projects it may consider during the CDS for implementation at Summer Station, depending on the extent of impingement mortality at the facility. SCE&G is currently evaluating three technological options (coarse mesh Ristroph screens, barrier net system, and a skimmer wall-block net combination) for potential application at Summer Station. Restoration measures may also be evaluated, in whole or in part, to meet the impingement mortality performance standard. At this time, SCE&G does not view operational measures as potentially feasible BTA at Summer Station.

2.1 Ristroph Traveling Screens

Ristroph screens are modified conventional vertical traveling screens fitted with a collection "bucket" beneath each screen panel so that impinged fish can be handled with minimal stress and mortality. The water-filled lifting buckets collect impinged fish and transport them to a return system. These buckets hold impinged fish in water after the buckets clear the water surface and until the screen rises to a point where the fish are delivered to a bypass, trough, or other conveyance. Ristroph screens often employ a dual low-pressure and high-pressure wash system to reduce impinged fish mortality and still effectively remove debris. The first wash uses a low-pressure spray to gently wash fish into a recovery trough. The second wash uses the typical high-pressure spray to remove debris into a second trough.

An essential feature of modified traveling screens with a fish return system is continuous screen operation during periods when fish are being impinged. Fish removed from the screens are typically returned to the source waterbody by sluiceway or pipeline. At Summer Station, a fish return system might require a conveyance structure extending several hundred feet to release fish into Monticello Reservoir at a point where hydraulic influence of the CWIS is minimal.

2.2 Fish Barrier Net System

Fish barrier nets are wide-mesh nets that are placed in front of the entrance to intake structures to exclude fish. The size of the mesh needed is a function of the species that are targeted for reduction of impingement mortality. The mesh must be sized to prevent fish from passing through the net or becoming gilled. Relatively low velocities are maintained through the net because the area through which the water can flow is usually large. Barrier nets can provide a high degree of impingement reduction and have been used at many facilities where the seasonal presence of fish requires fish diversion for only specific times of the year to obtain reduction in impingement mortality. Where the system must be deployed for extended periods, biofouling can be a problem, particularly in southern climates. As for other facilities, special care will need to be taken to assure the net is well-anchored and does not become dislodged and drift into the Summer Station CWIS or into the intake of FPSF. Placement of a barrier net for Summer Station should not be an issue with anglers because the barrier net would be placed within the current nuclear exclusion zone for Summer Station.

2.3 Skimmer Wall-Block Net Combination

An integrated skimmer wall-block net/screen structure will be evaluated to assess the feasibility to accomplish dual objectives of attaining compliance with the 316(b) rule and enhancing facility performance. The objective of the skimmer wall would be to maximize withdrawal of cooler deeper water within the reservoir during summer months to improve power generation efficiency. While the skimmer wall itself may provide some benefit in reducing impingement of surface oriented fish species, the skimmer wall opening would be designed to accommodate a barrier net system that could be deployed as necessary to achieve compliance with the performance standard.

Among other factors, the size of the skimmer wall will depend upon reservoir bathymetry proximate to the CWIS, availability of cool water resources during summer months, optimal depth to water of the desired temperature, daily reservoir level fluctuation, and cross-sectional area needed underneath the skimmer wall to accommodate netting or screening with a minimal through-screen velocity (less than 0.5 fps). Though initial costs for this approach might exceed other practicable BTA for

complying with the 316(b) performance standards, the long-range benefits of increased power output at the facility could exceed such costs.

2.4 Restoration

SCE&G also plans to consider potential restoration projects that may be acceptable to SCDHEC and the South Carolina Department of Natural Resources (SCDNR). Restoration can be "in-kind" or "out-of-kind", and must address "species of concern" identified in consultation with Federal and State fish and wildlife management agencies (40 CFR § 125.95(b)(5)). The stocking of fish in Monticello Reservoir as an "in-kind" or "out-of-kind" 316(b)-associated restoration measure represents one example of restoration.

2.5 Other Compliance Options

SCE&G recognizes that EPA has identified other technologies that if properly applied, may also enable a facility to achieve reductions in impingement mortality. Therefore, the described technologies are not to be viewed as exclusive options for Summer Station. As SCE&G develops information concerning impingement mortality at the Summer Station CWIS, it will investigate existing and emerging technologies that may be applied to achieve compliance objectives.

The above discussion notwithstanding, SCE&G reserves the option to request a site-specific determination of BTA for reducing impingement mortality at Summer Station where the costs of such BTA, including restoration, may significantly outweigh the benefits afforded, as provided for in the 316(b) rule (§ 125.94(a)(5)).

3. HISTORICAL STUDIES

The Phase II 316(b) rule requires that the PIC include a list and description of historical studies characterizing impingement and/or the physical and biological conditions in the vicinity of the CWIS and their relevance to the IMCS. Table 3-1 provides a list of known studies applicable to Summer Station and the Monticello Reservoir fishery.

3.1 Historical Impingement and Fisheries Data

Impingement at the Summer Station CWIS was evaluated from October 1983 through September 1984 as part of a 316(b) demonstration conducted by SCE&G contractor Dames and Moore (Table 3-2). No other specific impingement studies at Summer Station have been conducted, although other general fisheries studies were conducted from 1987-1989 and 1995-1996 by SCDNR (Table 3-3). Fish present in Monticello Reservoir that are potentially most vulnerable to impingement at the CWIS are schooling, non-benthic species including threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), white perch (*Morone americana*), and white bass (*Morone chrysops*). Impinged fish were collected from the Summer Station vertical traveling screens for one 24-hour period every two weeks from October 1983 through September 1984 (Dames & Moore, 1984). Overall, 17 species were collected from the screens representing six fish families.

The most frequently impinged fish were gizzard shad (83 percent), yellow perch (*Perca flavescens*; 7.6 percent) and sunfish (*Lepomis* sp.; 4.8 percent). A total of 5,140 fish was collected, and annual impingement was estimated to be 85,000 fish weighing 515 kg (1,133 lbs). Impingement was greatest during January when cold shock was implicated by the collection of high numbers of young-of-the-year gizzard shad, which are particularly affected by cold temperatures. Impingement rates were highest from December 1983 through March 1984 when rates averaged 609 fish per day (range of 67 to 2,532) with a standard deviation (S.D.) of 817 fish. In contrast, impingement rates were substantially lower in the fall and summer months when rates averaged 25 fish per day.

Based on the standing stock data, the abundance of the primary species subject to impingement during the 1983-84 study has generally increased since 1984 (Table 3-3). The Monticello Reservoir fish community exhibited shifts in species composition and abundance from 1985 through 1996 as the result of the introduction of white perch and blue catfish. Fish standing crop in 1984, approximately two years after Summer Station began operating, was dominated by bluegill (*Lepomis macrochirus*) and gizzard shad, with substantial populations of pumpkinseed (*Lepomis gibbosus*) and channel catfish (*Ictalurus punctatus*) (Table 3-3). Dominant fish in 1986-1987 included gizzard shad, bluegill, channel catfish, and white catfish (*Ameiurus catus*). In 1989 and 1995, blue catfish and white perch were collected from Monticello Reservoir for the first time. By 1996, blue catfish was the most dominant species and white perch was the sixth most dominant species. Sub-dominant species included gizzard shad, bluegill, channel catfish, and white catfish. Other recently introduced and/or recently collected species include green sunfish (*L. cyanellus*), brook silversides (*Labadesthes sicculus*), and swallowtail shiner (*Notropis procne*).

3.2 Fishery in the Vicinity of CWIS

Relevant data on the fish community of Monticello Reservoir in the vicinity of the Summer Station CWIS is provided from the SCDNR studies conducted in 1987-1989 and 1995-1996, which were used to support the recent renewal of the NRC operating license for Summer Station (NRC, 2004). These data, combined with the previous 316(b) study conducted by Dames and Moore (1985), and information from historical impingement studies conducted at other power plants in the southeastern U.S. (Loar et al., 1978), suggests that current impingement on the Summer Station traveling screens is likely to be dominated by shad and white perch. Shad represent the primary forage base in Monticello Reservoir, and threadfin shad represented approximately 90 percent of the fish impinged at 15 southeastern power plants (Loar et al., 1978). Additional sampling proposed by SCE&G (Section 6) to characterize current impingement mortality at Summer Station is expected to confirm this hypothesis.

4. PROTECTED SPECIES REVIEW

The potential for State or Federally listed threatened or endangered fish species to occur in Monticello Reservoir and/or in the vicinity of the Summer Station CWIS was evaluated based on habitat requirements of listed fish and freshwater mussel species known to occur in a four-county area surrounding the reservoir. A desktop review was conducted using the South Carolina Natural Heritage Program county lists for Fairfield County and the surrounding counties Fairfield, Lexington, Newberry, and Richand (http://www.dnr.state.sc.us/pls/heritage/county_species.list). Based on that review and the review used to support renewal of the NRC operating license for Summer Station (NRC, 2004), there are no known threatened or endangered fish or shellfish species in Monticello Reservoir that could potentially be susceptible to impingement at the Summer Station CWIS.

The aquatic species listed in the four-county area included two Federally endangered species, the freshwater mussel Carolina heelsplitter (*Lasmigona decorata*) and shortnose sturgeon (*Acipenser brevirostrum*) (Table 4-1). The Carolina heelsplitter was historically found in South Carolina in the Pee Dee River system (NRC, 2004). Before a 1987 U.S. Fish and Wildlife Service (USFWS) survey, the Carolina heelsplitter had not been recorded in South Carolina since the mid-19th century. The USFWS conducted intensive surveys between 1987 and 1990 and found only two surviving populations in the Pee Dee River system. None were found in the Broad River system near the Summer Station. There are no recorded occurrences of the Carolina heelsplitter in Monticello Reservoir or Parr Reservoir (SCDNR, 2001).

The shortnose sturgeon occurred historically in the Broad River in Lexington and Newberry Counties, but has been extirpated from that stretch of the Broad River. Passage of this species up the Broad River is blocked by dams. There are no recorded occurrences of this species in streams or rivers associated with Summer Station (SCDNR, 2001).

Twelve additional species are listed by the State as species of special concern. There are no recorded occurrences of these species in the vicinity of Summer Station (SCDNR 2005) and their habitat requirements are not met in Monticello Reservoir or in the vicinity of the Summer Station CWIS. Species of special concern listed in the four-county area include two submerged aquatic plants found in shallow water, Piedmont

watermilfoil (*Myriophyllum laxum*) and algae-like pondweed (*Potamogeton confervoides*). Recorded occurrences of these plant species are in Lexington and Richland Counties, respectively.

Animal species of special concern listed in the four-county area included the Saluda crayfish (*Distocambarus youngineri*), a crustacean that is known from Newberry County at two localities over 40 km (25 mi) west of Summer Station. The gravel elimia (*Elimia catenaria*) is an aquatic snail listed as a species of special concern from Richland County.

Five freshwater mussel species of special concern are reported in the four-county area surrounding Monticello Reservoir, all of which are generally associated with flowing water habitats. The yellow lance (*Elliptio lanceolata*) is found in clean sands in flowing water and is listed as a species of special concern for Newberry County. The Eastern floater (*Pyganodon cataracta*) is a mussel found in mud, sand, and gravel in ponds, lakes, and streams; it is listed for Fairfield County. The squawfoot (*Strophitus undulatus*) is a mussel found in mud, sand, or gravel in streams and small rivers; it is listed as a species of special concern in Richland County. The Eastern creekshell (*Villosa delumbis*) is a mussel found in mud or soft sand in small rivers and creeks; it is listed as a species of special concern for Fairfield and Richland Counties.

In addition to the shortnose sturgeon, there are four fish species of special concern in the four-county area surrounding Monticello Reservoir. As for the mussels, these species are generally associated with stream habitats. Carolina darter (*Etheostoma collis*) is a small bottom-dwelling fish of warm pools and runs in small streams; it is listed for Fairfield and Richland Counties. The banded killifish (*Fundulus diaphanus*) is a small topwater fish of quiet shallow backwaters of lakes, ponds, rivers, and estuaries; it is listed for Richland County. The redlip shiner (*Notropis chiliticus*) is a small minnow of pools and runs in small streams; it is listed as a species of special concern for Richland County and blacknose dace (*Rhinichthys atratulus*) is a small minnow found in small streams with clear water and a gravel bottom; it is listed for Richland County.

The NRC reported in 2004 that no endangered fish or freshwater mussels were known to occur in Monticello Reservoir (NRC, 2004). A review of the South Carolina lists for counties surrounding the reservoir suggests that potentially suitable habitat does not occur in Monticello Reservoir for any of the listed aquatic species known to occur

in a four-county area (Table 4-1). Listed mussels and fish species are also strongly associated with stream/river habitats that do not occur in Monticello Reservoir. Based on the known distribution of the listed species, the likelihood that any would be impinged at Summer Station is remote.

5. AGENCY CONSULTATIONS

The Phase II 316(b) rule requires that a summary of past, ongoing, or voluntary consultations with State and/or Federal agencies relevant to the CDS be provided in the PIC along with a copy of written comments received as a result of the consultations. To date, SCE&G has met with SCDHEC on two occasions, 21 July 2004, and 25 January, 2005. The SCDNR was not present at these meetings. Written comments were not received by SCE&G as a result of these consultations.

The first meeting involved representatives from power companies in South Carolina whose facilities are affected by the Phase II 316(b) rule. Utility representatives presented a briefing on their understanding of the new rule and associated requirements, and discussed with SCDHEC how the department might implement the rule within the state's NPDES permitting program. Specific facilities were also discussed. The second meeting was held exclusively between SCE&G and SCDHEC to further discuss the rule, its application to specific power plants, and compliance strategies for affected facilities.

SCE&G intends to continue dialog, as appropriate, with SCDHEC and SCDNR concerning the 316(b) rule to ensure proper implementation and compliance with the performance standards.

6. SAMPLING PLAN

SCE&G will document current impingement mortality at Summer Station during this 316(b) investigation by conducting new field studies in 2005-2006 to supplement the 1983-84 316(b) study. The sampling plan proposed herein will be implemented for the IMCS starting in July 2005. Sampling will be conducted for a period of 12 months to document current impingement mortality at the Summer Station CWIS. The resulting dataset will provide the information necessary to determine the appropriate Calculation Baseline against which compliance with the performance standard will be evaluated. Also, the dataset will assist in the evaluation and selection of appropriate technologies and/or restoration measures needed for Summer Station to meet the impingement mortality performance standard.

This sampling plan includes a description of the study area (including the area of influence of the cooling water intake structure), and documents the methods and quality assurance/quality control (QA/QC) procedures for the IMCS (40 CFR § 125.95(b)(3)).

6.1 Study Area Description

The IMCS will focus on the collection of fish impinged on the Summer Station CWIS traveling screens. The CWIS, located in the southwest portion of Monticello Reservoir is designed to withdraw water from the available water column. Design intake flow totals approximately 513,000 gallons per minute (gpm) or 738.7 million gallons per day (MGD). The CWIS is comprised of three pump bays each with two entrances. Each entrance is 13 feet wide and 25.5 feet high, extending from the bottom of the pump house to the bottom of a conventional skimmer wall. Each entrance is equipped with a vertical traveling screen (mesh size ~3/8-inch) and two sets of trash racks for removing debris and impinged organisms.

Traveling screens are activated by timer approximately every 12 hours, or more frequently if differential pressure across the screens becomes excessive. High pressure screen wash water is used to clean the screens of debris and impinged organisms and conveys removed items to a trash sump where they are accumulated in a collection basket. The screen wash water is then returned to the intake pumps downstream of the

traveling screens. As the collection basket reaches capacity its contents are discarded, thus resulting in 100 percent mortality for impinged organisms.

6.1.1 Area of Hydraulic Influence

SCE&G's contractor, GeoSyntec Consultants, conducted a survey to quantify the area of hydraulic influence attributable to the Summer Station CWIS using Acoustic Doppler current profiling (ADCP) technology. The survey was facilitated by use of the Sentinel Self-Contained Broadband Acoustic Doppler Current Profiler manufactured by RD Instruments, Inc. The ADCP unit emits sound pulses referred to as "pings". The instrument uses the Doppler effect (the observed shift in sound pitch that results from relative motion) by transmitting repeated pings at a fixed frequency (1200 kHz) and "listening" to echoes returning from sound "scatterers" which occur as suspended particles and plankton in the water column. The ADCP does not measure current velocity at a single point; rather, it measures velocities throughout the water column. The ADCP calculates both water velocity and vector information. As the ADCP unit is moved through the water it obtains a measurement of boat speed from acoustic returns off the lake bottom thereby allowing determination of the distance and speed traveled.

The ADCP survey was conducted 20-21 April 2005 with all three circulating water pumps operating. Based on pumping records provided by Summer Station, intake flow was at full capacity (739 MGD) throughout the survey period (Table 6-1). The survey included three hydraulic data collection events conducted over a 24-hour period to monitor representative diel changes in lake elevations, which normally are managed near 425 ft msl. Lake level elevation varied 3.9 feet during the survey (Table 6-1). Lake level changes occur daily due to operation of the FPSF. Survey events represented: (i) high water stage, (ii) declining water stage, and (iii) low water stage.

During each event, portions of the lake located on both sides and out from the CWIS were surveyed with the ADCP. Acoustic Doppler data were collected by navigating the boat and operating the ADCP along parallel-shoreline transects each placed further away from the CWIS with each successive pass. Up to six transects and several roving data collection traverses were conducted during each survey to delineate the outer boundary of flow vectors (i.e., direction) associated with the CWIS.

Real time and post-processed acoustic Doppler data were used to detect and map the extent of the area of hydraulic influence and reservoir bathymetry in the vicinity of the CWIS. The boundary demarcating the area of greatest extent of hydraulic influence from Summer Station was determined as the distance at which water velocities and flow vectors attenuated to the point of no longer being dominantly oriented toward the Summer Station CWIS based on all survey events.

The maximum extent of hydraulic influence from the Summer Station CWIS was associated with the lowest lake level (420.7 ft; Table 6-1) observed during the study. As defined by the attenuation of current vectors to the point of no longer being dominantly oriented to the CWIS and for the purpose of compliance with the Phase II 316(b) rule, the area of hydraulic influence occupied an area of approximately 2.92 surface acres in Monticello Reservoir adjacent to the CWIS structure (Figure 6-1). The most distant boundary of the area of hydraulic influence (determined by locating the presence of vectors that were predominantly unrelated to the Summer Station CWIS) at the low lake stage extended out to a distance 555 ft away from the CWIS (Figure 6-1). Considering the average of the five closest water column profiles at this location, average water column velocity was 0.09 ft/s with an average flow direction of 205.80°N (representing a 39.6° flow direction from that observed immediately at the CWIS), thus indicating predominate flow direction away from the CWIS.

The bathymetry (i.e., depth) of the reservoir near the CWIS and the unconfined approach to the CWIS (i.e., absence of an intake canal) combined to provide rapid attenuation of the hydraulic influence of Summer Station withdrawals, thus resulting in a relatively small zone of hydraulic influence. Water depth along the face of the intake structure was 33.7 ft at the highest recorded lake elevation (424.6 ft). Water depth progresses to 48.8 ft deep within 392 linear ft of the CWIS (Figure 6-2). Where velocity alone is considered, the survey data indicates fish exposed to the immediate approach (Transects T1 and T2) to the CWIS would be the most susceptible to impingement.

6.2 Impingement Mortality Characterization Study

The Phase II 316(b) rule requires that the IMCS characterize fish susceptible to impingement "*in the vicinity*" of the CWIS and must include:

- Taxonomic identification of fish and their life stages;
- Description of abundance and temporal/spatial characteristics;
- Characterization of annual, seasonal, and diel variations in impingement mortality (e.g., related to climate/weather differences, spawning, feeding and water column migration);
- Documentation of current impingement mortality of all life stages of fish at the facility; and
- Identification of any Federal and/or State protected species

6.2.1 Fish Community Characterization

The fish community occurring in the vicinity of the Summer Station CWIS and potentially susceptible to impingement will be characterized through new impingement sampling at the CWIS as proposed below, and the use of existing data on the fish community found in the vicinity of Summer Station in Monticello Reservoir (Table 3-1).

6.2.2 Documentation of Current Impingement Mortality

Impingement monitoring of the CWIS traveling screens will be conducted to provide documentation of current impingement mortality at Summer Station. These new data, along with the 1983-84 impingement mortality data, will identify fish most susceptible to impingement "*in the vicinity*" of the CWIS, provide the basis for estimating annual impingement mortality, and provide the data necessary for establishing the appropriate Calculation Baseline against which compliance with the performance standard will be determined. Impingement samples will be collected on a bi-weekly (every two weeks) basis from July 2005 through June 2006 on a pre-set sampling schedule under representative operational flows. As a base-load facility, all Summer Station circulator pumps are typically in operation except during scheduled maintenance outages. Therefore, in certain instances, impingement sampling may be scheduled during outages as it is practically unavoidable under any reasonable pre-set schedule. Outages are a normal operational characteristic that will be considered when

extrapolating annual impingement mortality attributable to operation of the CWIS and in development of the appropriate Calculation Baseline estimate.

A pressure screen-wash system removes debris, as well as fish, that collect on the vertical traveling screens. The screen-wash water and its contents are sluiced to a sump where the debris and organisms that accumulate on the vertical traveling screens are collected and removed for disposal. The collection basket currently in use will be used to collect impingement samples; it is equipped with the same screen mesh as are the vertical traveling screens and will be emptied prior to initiating impingement sampling.

Each impingement sampling event will represent a 24-hour collection period split into two equal 12-hour periods. The "daytime sample" will proceed from about 0800 hours to about 2000 hours on day one, and the "nighttime sample" will proceed from about 2000 hours on day one until the following morning at about 0800 hours on day two. Specific sampling times will be coordinated with the existing 12-hour work shift at Summer Station. The vertical traveling screens will be cleaned prior to initiating each 24-hr sampling event and at the end of each daytime and nighttime sampling period.

Impinged fish will be sorted by species and counted to provide estimates of the number and species composition of impinged fish at the Summer Station CWIS for each day-night collection period. Each sample will be completely processed unless the number of fish or amount of debris prohibits sorting and handling all fish in a sample.

The size distributions of impinged fish in each sample will be based on processing up to 100 representative individuals for each species in a sample. Up to 50 specimens of each species will be individually measured (total length in millimeters [mm]) and weighed (in grams [g]). If more than 50 individuals of a given species occur in a sample, an additional 50 specimens will be placed in 10-mm size classes to provide further characterization of the size distribution of impinged fish. Should more than 100 individuals of a given species occur in any given sample; up to 300 additional individuals will be handled as batch counts and batch weights. If more than 400 individuals of a given species occur in a sample, the number of fish in excess of 400 will be estimated based on the total weight of those additional fish divided by the average weight obtained from the batch counts and batch weights. Based on other impingement studies in the southeast, it is anticipated that sub-sampling would most likely be required for gizzard shad, threadfin shad, and perhaps white perch.

Data collected during each impingement study will be recorded on pre-printed data sheets that provide for documenting plant operating conditions during each sample, as well as the species and size distributions of impinged fish (Appendix A). The data forms will accommodate batch counts and/or batch weights as outlined above in the event large numbers of impinged individuals representing a given species are collected.

Plant operational parameters recorded for Summer Station, including intake water flow rates and condenser inlet water temperature, will be obtained and used in conjunction with the study-specific plant operation information recorded on the data sheets (including information on trash rack loading and vertical traveling screen operations, as provided by assisting Summer Station staff). Daily operation records will be used to develop the Calculation Baseline estimate and to evaluate factors affecting impingement at Summer Station. Low water temperatures could be a key factor influencing impingement at Summer Station because of the abundance of shad in Monticello Reservoir and their susceptibility to swimming impairment and/or mortality due to low water temperatures during winter months (Loar et al., 1978).

Extrapolation of the impingement rates to an annual total will be calculated using the equation:

$$\sum E_i = R_i \times D_i$$

where
E_i = estimated number of fish impinged for time period i
R_i = average daily impingement rate per biweekly period i
D_i = Days of pump operation for the mode that the sample was collected

Time periods will bracket the interval between sampling events and will collectively account for 12 months of plant operation. The exact time intervals used for extrapolation will depend on actual plant operations but will generally represent approximately bi-week intervals. A 95-percent confidence limit will be placed on the annual estimate to account for expected diel, seasonal, and operational variability.

The Calculation Baseline for Summer Station, as provided by § 125.93 of the rule, will be an estimate of impingement mortality that occurs on the basis that:

- The CWIS was designed as a once-through system;

- The opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screens are oriented parallel to, the shoreline near the surface of Monticello Reservoir; and

- Operational practices, procedures, and structural configuration are those that are maintained without structural or operational controls for the purposes of reducing impingement mortality.

The rule allows for the Calculation Baseline to be estimated using historical and current biological and impingement mortality data collected in the vicinity of CWIS structure and through the use of data from other facilities with comparable design, operational, and environmental conditions. SCE&G will develop the Calculation Baseline for Summer Station founded on:

- The results of the proposed one-year study from July 2005 through June 2006;

- Historical studies that characterized impingement at Summer Station in 1983-1984 (Dames & Moore, 1985);

- Fish community data collected by the State of South Carolina (see Table 3-1); and

- A review of historical impingement studies at other facilities in the southeast with comparable design, operational, and environmental conditions.

6.2.2 Quality Assurance and Quality Control

Project quality assurance/quality control (QA/QC) for the IMCS will be consistent with GeoSyntec's "Quality Assurance Project Plan" (QAPP) prepared for SCE&G that is applicable to the information and analyses required by the IMCS. Activities will include active participation of the GeoSyntec team task manager in four of the bi-weekly IMCS sampling events. The four sampling event audits will include the initial sampling event (projected to be July 2005), and thereafter with one sampling event representing, summer, fall, and spring seasons. During each QA/QC sampling event the task manager will document sampling procedures and data processing performed by the GeoSyntec team members. Results of each QA/QC sampling event conducted and

any associated recommendations will be documented in Technical Memoranda to SCE&G.

Sample processing will be conducted under South Carolina's "State Environmental Laboratory Certification Regulation 61-81" that assures data submitted to SCDHEC are scientifically valid and defensible. GeoSyntec has been certified for taxonomic identification of freshwater fishes, marine/estuarine fishes, and ichthyoplankton. (Laboratory I.D. 98022). Field personnel will follow GeoSyntec's "*Standard Operating Procedures for Collection, Processing, and Identification of Fish Samples*" and will have access to a species checklist of fishes known to occur in the study area and appropriate field guides. Although the majority of impinged organisms will be processed in the field, a project specific reference collection will be maintained and voucher specimens will be retained when verification is required.

7. REPORTING

Upon completion of the 316(b) investigations as provided in this sampling plan, SCE&G will prepare a final report of the IMCS for submittal to SCDHEC by 7 January 2008, in accordance with SCDHEC's approval of SCE&G's request for an extended schedule for completing the Summer Station CDS. The report will present the results of the IMCS and include:

- Review of historical studies, presented in the context of the findings of the 316(b) investigations;
- Characterization of the fish community and species/life stages potentially susceptible to impingement in the vicinity of the CWIS;
- Documentation/characterization of current impingement mortality at Summer Station for the study period; and
- Estimation of the Calculation Baseline for Summer Station based on representative operational flows for the CWIS and other applicable considerations.

8. REFERENCES CITED

Dames & Moore. 1985. 316(b) Demonstration for the Virgil C. Summer Nuclear Station for the South Carolina Department of Health and Environment and the Nuclear Regulatory Commission. Prepared for South Carolina Electric & Gas, Columbia.

Loar, J.M., J.S. Griffith, and K.D. Kumar. 1978. An analysis of factors influencing the impingent of threadfin shad at power plants in the Southeastern United States. Pages 245-255 in L.D. Jensen, ed. Forth National Workshop on Entrainment and Impingement EA Communications, Melville, NY.

South Carolina Department of Natural Resources (SCDNR). 2001. Letter from J. Holling of SCDNR Heritage Trust Program to S. A. Byrne of SCE&G, responding to request for information on listed species and important habitats. South Carolina Department of Natural Resources Heritage Trust Program. February 15, 2001 (cited in NRC, 2004).

South Carolina Department of Natural Resources (SCDNR). 2005. South Carolina Rare, Threatened & Endangered Species Inventory (species by county). Accessed at http://www.dnr.state.sc.us/pls/heritage/county_species.select_county_map on April 28, 2005.

NRC. 2004. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Supplement 15 Regarding Virgil C. Summer Nuclear Station. Final Report. U.S. Nuclear Regulatory Commission, Washington, DC.

TABLES

Table 3-1. List of Historical Studies Associated with Impingement at Summer Station.

1. Christie, R. W. and R. M. Stroud. 1997. Fisheries Investigations in Lakes and Streams --- District IV. South Carolina Department of Natural Resources Annual Progress Report F-63-3-4.

2. Christie, R. W. and R. M. Stroud. 1998. Fisheries Investigations in Lakes and Streams --- District IV. South Carolina Department of Natural Resources Annual Progress Report F-63.

3. Christie, R. W. and R. M. Stroud. 1999. Fisheries Investigations in Lakes and Streams --- District IV. South Carolina Department of Natural Resources Annual Progress Report F-63-4-4.

4. Dames and Moore. 1985a. Environmental Monitoring Report January 1983–December 1984 for the Virgil C. Summer Nuclear Station for the South Carolina Department of Health and Environmental Control and the Nuclear Regulatory Commission. April 1985.

5. Dames and Moore. 1985b. 316(b) Demonstration for the Virgil C. Summer Nuclear Station for the South Carolina Department of Health and Environmental Control and the Nuclear Regulatory Commission. March 1985.

6. Nash, V. S., R. W. Christie, and R. M. Stroud. 1990. Fisheries Investigations in Lakes and Streams ---District IV. South Carolina Wildlife and Marine Resources Department Annual Progress Report F-11-25.

7. NRC. 2004. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Supplement 15 Regarding Virgil C. Summer Nuclear Station. Final Report. U.S. Nuclear Regulatory Commission, Washington, DC.

8. South Carolina Department of Natural Resources (SCDNR). 2001. Letter from J. Holling of SCDNR Heritage Trust Program to S. A. Byrne of SCE&G, responding to request for information on listed species and important habitats. South Carolina Department of Natural Resources Heritage Trust Program. February 15, 2001 (cited in NRC, 2004).

9. South Carolina Department of Natural Resources (SCDNR). 2005. South Carolina Rare, Threatened & Endangered Species Inventory (species by county). Accessed at http://www.dnr.state.sc.us/pls/heritage/county_species.select_county_map on April 28, 2005.

Table 3-2. Fish Comprising More Than One Percent of Impingement at the Summer CWIS, 1983-1984.[a]

Species	Percent Occurrence	Percent Weight
Gizzard shad	82.6	51.8
Yellow Perch	7.6	8.0
White catfish	2.4	17.6
Bluegill	1.5	2.1
Channel catfish	1.3	4.7
Black crappie	1.3	2.5
Pumpkinseed	1.1	1.1
Threadfin shad	0.8	0.7
Warmouth	0.6	2.8
White bass	0.3	5.2
White crappie	0.3	3.3
Other species	<0.1	0.2

[a] Dames and Moore, 1985.

Table 3-3. Standing Stock (kg/ha) of Dominant Fishes of Monticello Reservoir[1,2].

Species	1984	1987	1988	1989	1995	1996
Gizzard shad	13.69	84.4	37.0	25.2	46.8	103
Threadfin shad	0.14	16.5	10.6	10.4	1.71	2.8
Channel catfish	2.78	62.7	75.9	31.5	36.1	98.7
White catfish	0.70	25.7	55.6	30.5	0.38	48.3
Blue catfish	--	--	--	4.9	7.67	123.7
White perch	--	--	--	--	0.50	24.6
White bass	present	0.7	0.3	1.0	30.0	0.2
Bluegill	14.69	57.3	70.9	70.9	18.5	56.0
Pumpkinseed	3.48	3.5	5.49	4.6	0.86	3.1
Black crappie	0.03	8.7	6.16	0.3	0.01	0.5
Largemouth bass	1.04	6.4	6.4	3.9	4.19	6.5
Yellow perch	0.59	10.0	9.7	9.7	--	4.4
Total	40.13	306.3	204.5	204.5	154.3	482.3

[1]Source: NRC. 2004.
[2]Standing crop expressed as kilograms per hectare (kg/ha).

Table 4-1. Aquatic Species Listed as Endangered by the USFWS or the State of South Carolina that Occur or Potentially Occur in the Vicinity of Summer Station.

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Plants			
Myriophyllum laxum	Piedmont watermilfoil	--	SC
Potamogeton confervoides	algae-like pondweed	--	SC
Crustaceans			
Distocambarus youngineri	Saluda crayfish	--	SC
Mollusks			
Elimia catenaria	gravel elimia	--	SC
Elliptio lanceolata	yellow lance	--	SC
Lasmigona decorata	Carolina heelsplitter	E	SC
Pyganodon cataracta	Eastern floater	--	SC
Strophitus undulatus	squawfoot	--	SC
Villosa delumbis	Eastern creekshell	--	SC
Fish			
Acipenser brevirostrum	shortnose sturgeon	E	--
Etheostoma collis	Carolina darter	--	SC
Fundulus diaphanus	banded killifish	--	SC
Notropis chiliticus	redlip shiner	--	SC
Rhinichthys atratulus	blacknose dace	--	SC

(a) E = endangered, SC = South Carolina species of special concern, -- = no listing.

Table 6-1. Summary of the Hydraulic Influence of the Summer Station CWIS Based on ADCP (Acoustic Doppler Current Profile) Survey Results, 20-21 April 2005.

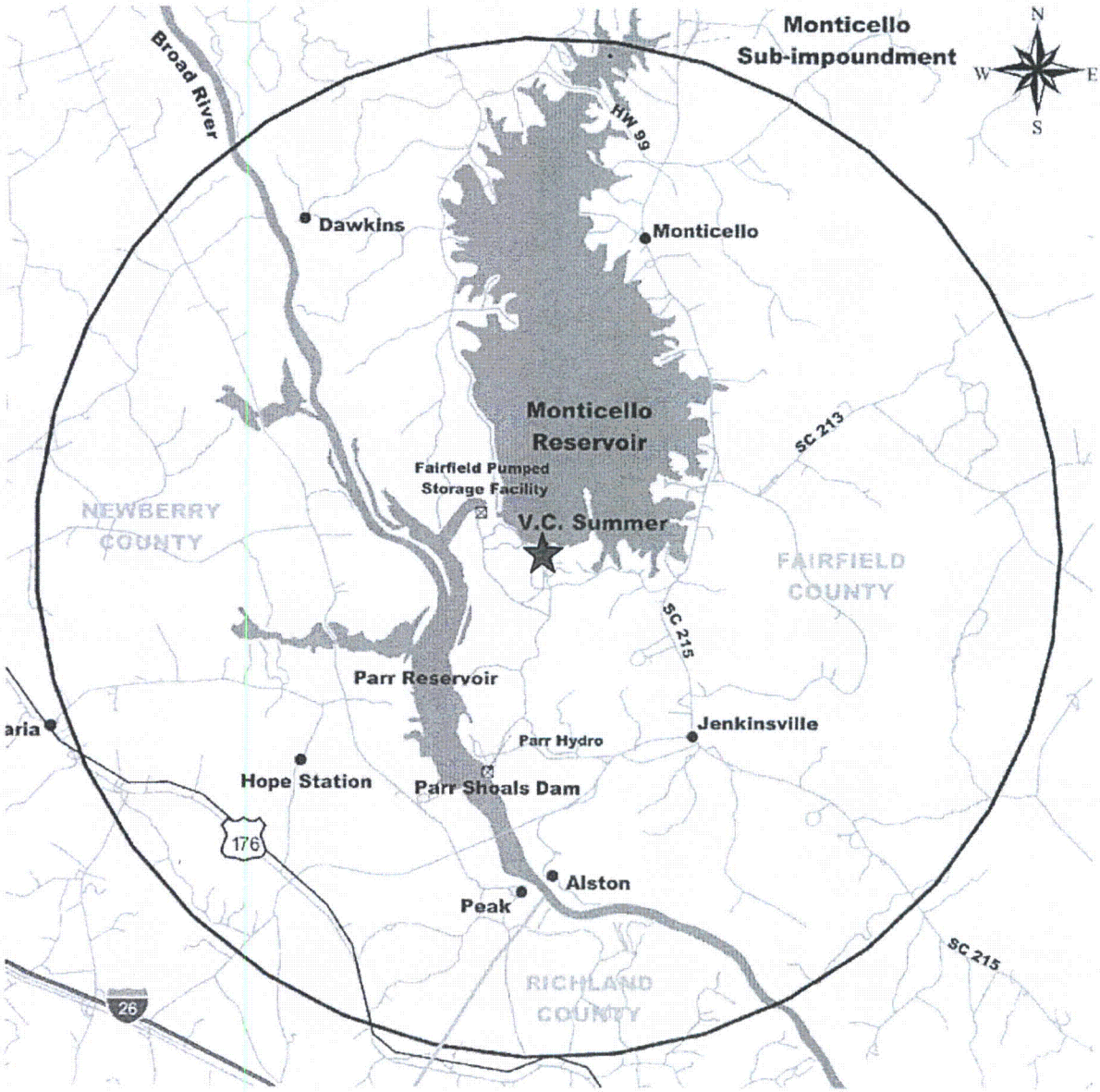
Date	5/20/2005									5/21/05								
Time	1200	1300	1400	1500	1600	1700	2100	2200	2300	0000	0100	0200	0300	0400	0500	0600	0700	0800
Summer CWIS[1]																		
Lake Elevation (ft)[2]	424.3	424.1	423.9	423.4	422.9	422.4	420.9	420.7	420.8	421.1	421.7	422.2	422.9	423.5	424.0	424.5	424.6	424.5
ADCP Survey	Survey 1 (declining stage)							Survey 2 (low stage)								Survey 3 (high stage)		
(survey time)	1300 to 1430 hrs							2231 to 2342 hrs								0648 to 0823 hrs		
Avg. Flow Direction at CWIS (degrees mag. N)[3]	180.14							166.18								182.90		
Avg. Flow Vel. (ft/s) at CWIS Intake[4]	0.35							0.45								0.36		
Areal Extent (ac) of CWIS Influence	2.01							2.44								1.71		

Notes:

1 = three (3) circulator pumps running at rated capacity of 738.7 MGD (million gallons per day) during the survey.
2 = lake elevations as feet above mean sea level, provided by SCE&G.
3 = for general reference, the compass bearing directly toward the center of the CWIS is ~180 degrees from Magnetic N.
4 = based on cross-sectional transect in front of the CWIS.

FIGURES

Figure 1-1. Site Vicinity Map for Summer Station



Source: NRC, 2004.

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FIGURE NO.:	1-1
PROJECT NO.:	GK3601
DOCUMENT NO.:	GA050266
FILE:	Figure1-1.ppt

Figure 1-2. Layout of the Summer Station CWIS

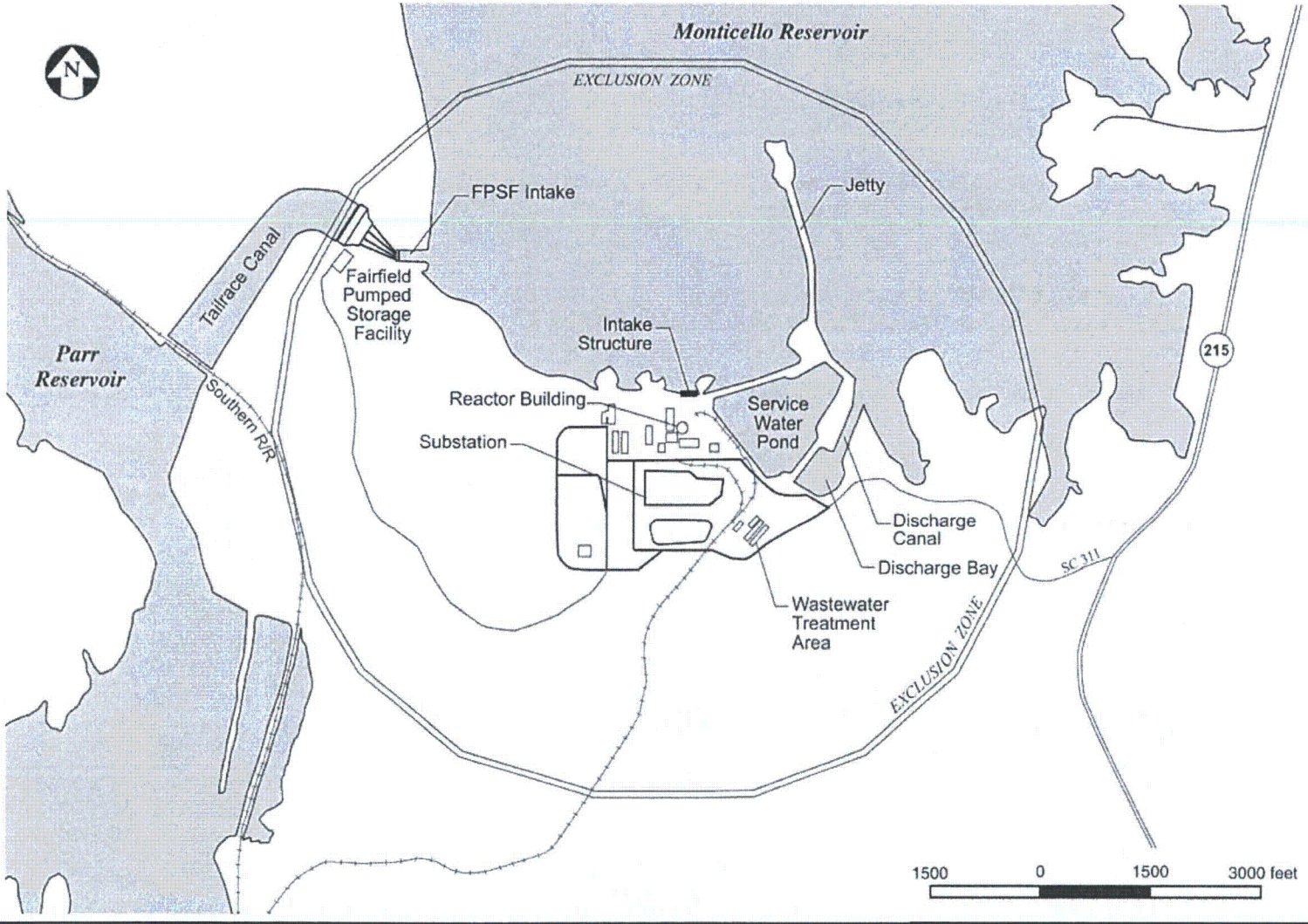

FIGURE NO.:	1-2
PROJECT NO.:	GK3601
DOCUMENT NO.:	GA050266
FILE:	Figure1-2.ppt

SOURCE: NRC, 2004.

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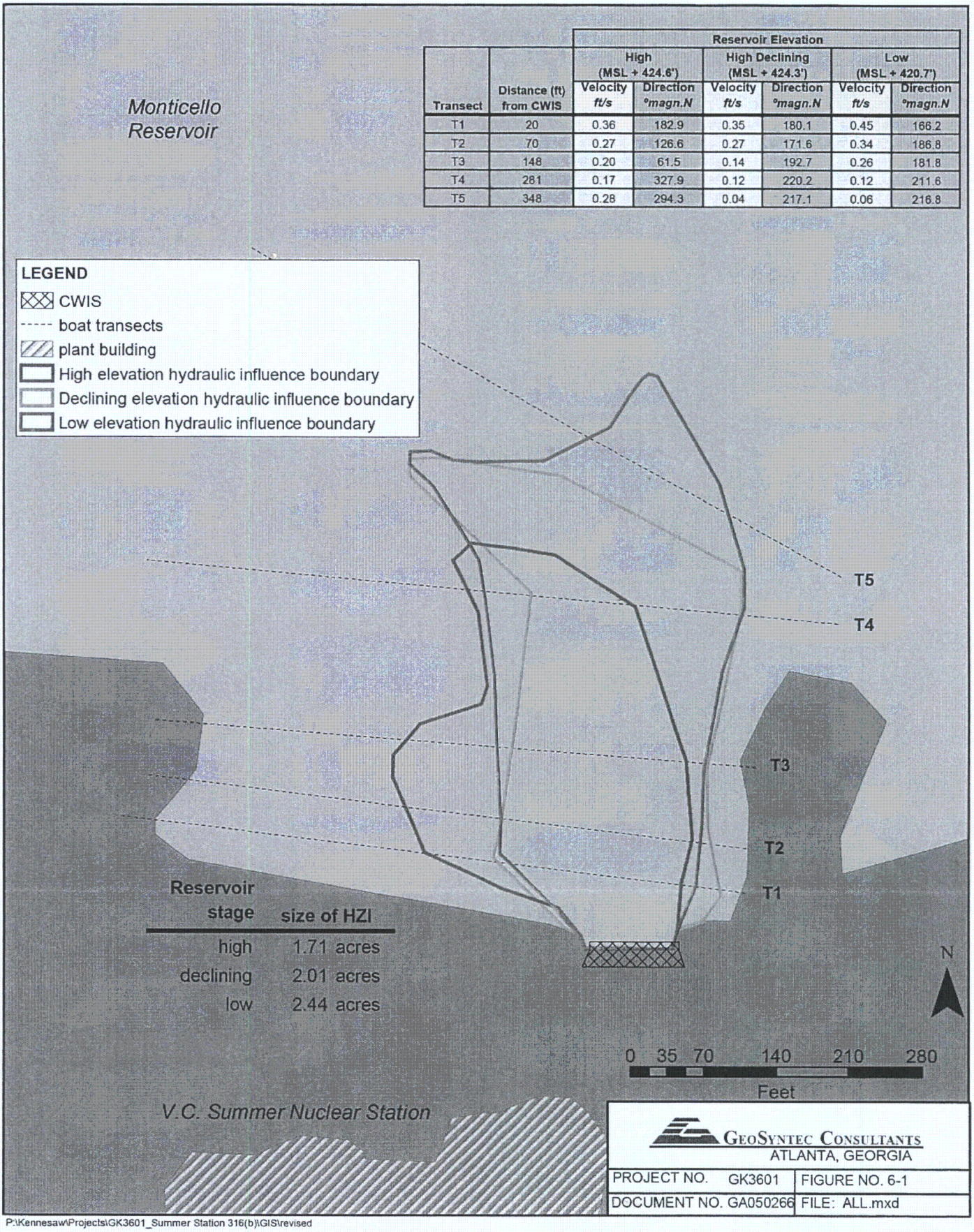
Figure 6-1. Hydraulic Influence of the Summer Station CWIS at Three Lake Levels, 20-21 April 2005

Transect	Distance (ft) from CWIS	Reservoir Elevation: High (MSL + 424.6') Velocity ft/s	High Direction °magn.N	High Declining (MSL + 424.3') Velocity ft/s	High Declining Direction °magn.N	Low (MSL + 420.7') Velocity ft/s	Low Direction °magn.N
T1	20	0.36	182.9	0.35	180.1	0.45	166.2
T2	70	0.27	126.6	0.27	171.6	0.34	186.8
T3	148	0.20	61.5	0.14	192.7	0.26	181.8
T4	281	0.17	327.9	0.12	220.2	0.12	211.6
T5	348	0.28	294.3	0.04	217.1	0.06	216.8



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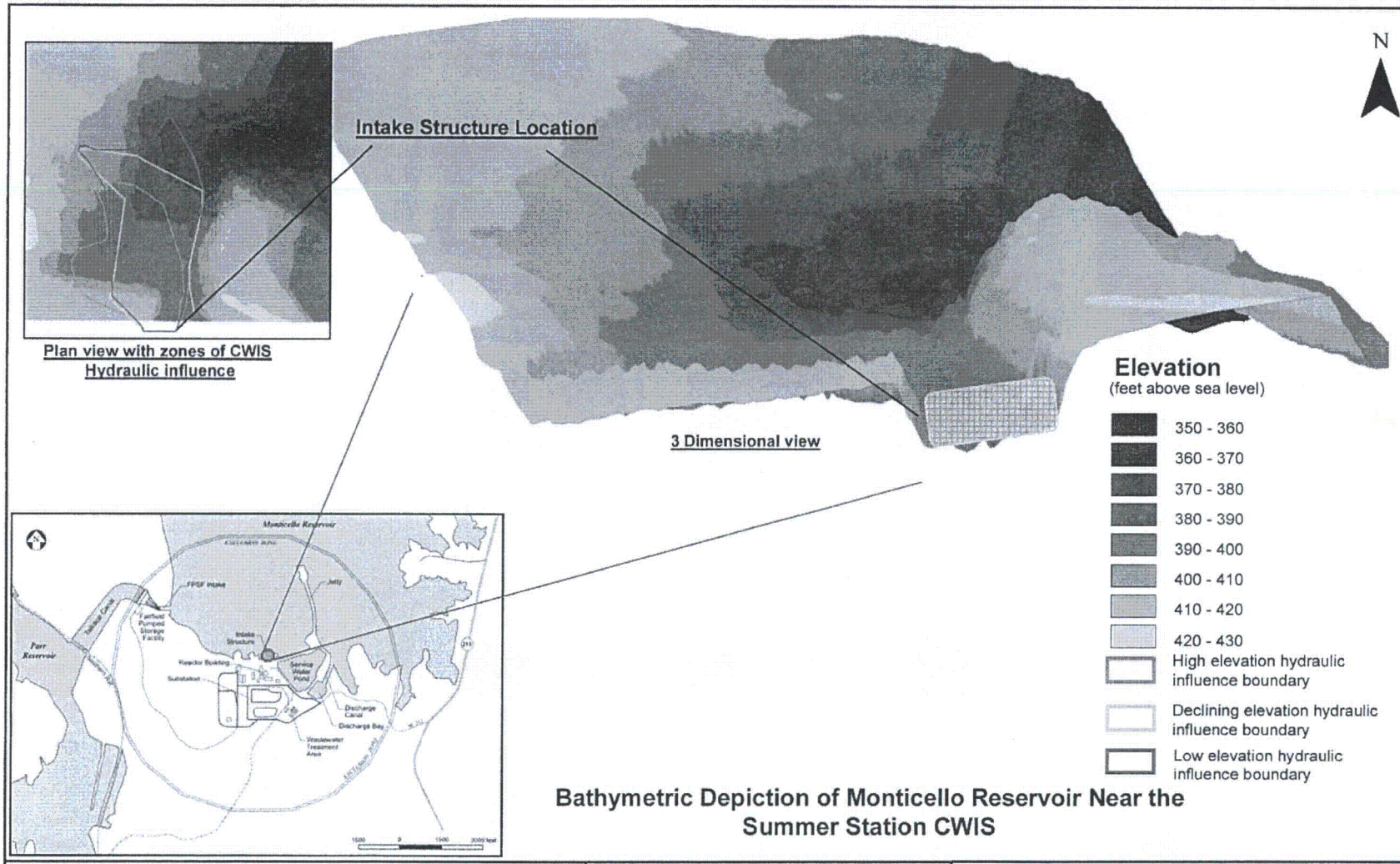
PROJECT NO. GK3601	FIGURE NO. 6-1
DOCUMENT NO. GA050266	FILE: ALL.mxd

P:\Kennesaw\Projects\GK3601_Summer Station 316(b)\GIS\revised



Bathymetric Depiction of Monticello Reservoir Near the Summer Station CWIS

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FIGURE NO.:	6-2
PROJECT NO.:	GK3601
DOCUMENT NO.:	GA050266
FILE:	Figure6-2.ppt

SOURCE: GeoSyntec 2005

APPENDIX A

IMPINGEMENT MONITORING DATA FORMS

SUMMER STATION IMPINGEMENT MONITORING DATA FORM

Sample Information Page:_____ of _____

Collector(s): _____

Remarks: _____

12-hour Period (circle)		DAY	NIGHT
Start Date		Time	
End Date		Time	
		Elapsed Time	

Plant and CWIS Operating Conditions

	% Load	Pump Flow (gpm)		No. of VTS Operating (1-6)	
Start					
Finish					

	Lake Level (ft.)
Start	
Finish	

Water Temperature (°C)	
Start	
Finish	

Field Conditions/Other Observations

Event #

Entered by:
Date: / /

SUMMER STATION IMPINGEMENT MONITORING DATA FORM

Sample Information

Collectors: ____________________

Page :___of__

Remarks: ____________________

12-hour Period (circle) **DAY** **NIGHT**

Start Date ________ **Time** ________

End Date ________ **Time** ________

Elapsed Time ________

Species ____________________ **Species** ____________________

TL (mm)	Weight (g)	Condtion	TL (mm)	Weight (g)	Condtion

Event #

Entered by:
Date: / /

SUMMER STATION HAMMOND IMPINGEMENT MONITORING DATA FORM

Sample Information Page:_____ of _____

Collectors: _____ Remarks: _____

12-hour Period (circle) Day or Night

Start Date:	**Time:**	
End Date:	**Time:**	
Elapsed Time		

Species:		**Species:**		**Species:**	
Size Class (mm	**Count**	**Size Class (mm**	**Count**	**Size Class (mm**	**Count**
20-29		20-29		20-29	
30-39		30-39		30-39	
40-49		40-49		40-49	
50-59		50-59		50-59	
60-69		60-69		60-69	
70-79		70-79		70-79	
80-89		80-89		80-89	
90-99		90-99		90-99	
100-109		100-109		100-109	
110-119		110-119		110-119	
120-129		120-129		120-129	
130-139		130-139		130-139	
140-149		140-149		140-149	
150-159		150-159		150-159	
160-169		160-169		160-169	
170-179		170-179		170-179	
180-189		180-189		180-189	
190-199		190-199		190-199	
200-209		200-209		200-209	
210-219		210-219		210-219	
220-229		220-229		220-229	
230-239		230-239		230-239	
240-249		240-249		240-249	
250-259		250-259		250-259	
260-269		260-269		260-269	
270-279		270-279		270-279	
280-289		280-289		280-289	
290-299		290-299		290-299	
Total Count		**Total Count**		**Total Count**	
Total Weight		**Total Weight**		**Total Weight**	
Batch Sample (N=101-400)	**Count Weight**	**Batch Sample (N=101-400)**	**Count Weight**	**Batch Sample (N=101-400)**	**Count Weight**
2		2		2	
3		3		3	
4		4		4	
Batch Sample (N=401+)	**Weight**	**Batch Sample (N=401+)**	**Weight**	**Batch Sample (N=401+)**	**Weight**
5		5		5	
6		6		6	
7		7		7	
8		8		8	
9		9		9	
10		10		10	

Event #

Entered by:
Date: / /

SUMMER STATION IMPINGEMENT MONITORING DATA FORM

Sample Information Page:___ of___

Collector(s):______________________

Remarks:

12-hour Period (circle) DAY NIGHT

Start Date		**Time**	
End Date		**Time**	
		Elapsed Time	

Species	TL (mm)	Weight (g)	Condition	Species	TL (mm)	Weight (g)	Condition

Event #

Entered by:
Date: / /