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May 23, 2003

Jennifer Huff
Resource Management
Duke Power
PO Box 1006
Charlotte, NC 28201-1006

Re: Draft "National Register of Historic Places Eligibility Study of Seven Hydroelectric Projects in the Nantahala Area, North Carolina," Swain County, ER02-8205

Dear Ms. Huff:

Thank you for your letter of November 8, 2001, transmitting the above referenced draft study. We apologize for the extremely long delay in our response, but staff shortages and changes prevented our replying in a timelier manner. We very much appreciate your understanding of our inability to provide the following comments until now.

To assist in your and your consultant's review of our comments we are returning a copy of the draft study, which has notations that correspond to some of our comments. In general, the notations are marked with tabs. However, there are also places where the reviewer highlighted items or added notes.

General comments on opening chapter:

Overall the history of waterpower for electricity is fine, but the National Register rationale needs additional consideration. For example, the significance/criteria discussion (page 30) has assigned "Engineering" to Criterion A. We feel it should be Criterion C. The Criterion B discussion includes significant designers, engineers, and architects, who are more appropriately discussed in Criterion C.

There is no discussion of a period of significance, and the registration requirements refer only to the integrity of "original" materials, rather than "historic" materials from the period of significance. Thus, the importance of developing a period of significance. There is also no discussion about how the level of integrity for Criterion A might differ from what one would expect under Criterion C. Since the report goes through 1955, there also needs to be some discussion of the less than fifty year-old resources and the exception significance requirement.

History/technology:

Although found at most of the North Carolina plants, there is very little history or description of the tainter gates. These are significant features, in addition to the concrete dams themselves. There are very few references to the North Carolina plants in the property type descriptions. While each property is described later in the report, there is little linkage between the property type information and these particular properties.

Resource evaluation:

Most of these properties have a dam and powerhouse, plus associated gatehouse, etc. However, the study evaluates each of these elements separately, rather than evaluating the property as a whole or inter-related complex.

The eligibility rationale for the powerhouses appears to be solely based on their architectural character – style, finishes, etc., and not on their technology. Similarly, the eligibility of the dams appears to be based on the exterior finishes of the concrete. By concentrating on the exteriors, the report fails to balance the integrity of the outer shell/exterior of the dams and powerhouses with the importance of the inner workings/technology that may be present. It may be that alterations to the exteriors of the resources do not sufficiently detract from the property, as a whole, to render it ineligible for listing. In particular, the coating of a dam with gunite may not have damaged the integrity of the dam or of the plant complex to such a degree that it/they are not eligible under Criterion A.

Property evaluations:

Dillsboro – The study recommends that nothing is eligible, but the 1927 dam was altered by the addition of only two feet at the top. Is it still readable as a dam? While the 1940 powerhouse has been covered with metal, are the interiors and machinery still in tact so that the property might be eligible under Criterion A?

Bryson – The study finds both resources not eligible. Although the windows have been blocked up and the dam covered with gunite, the property as a whole may be eligible under Criterion A. Certainly, we have determined numerous industrial buildings with blocked up windows eligible for the National Register since this is a reversible treatment.

Mission – The study's findings for this property are inconsistent. The introduction finds the powerhouse eligible, but not the dam. The conclusion recommends that they are both eligible. We concur with the conclusion that both are eligible.

Franklin – The powerhouse was determined eligible for listing and placed on the State Study List. The study concurs with this finding, but recommends that the gunite-covered dam is not eligible. As outlined above, we question whether or not the gunite coating renders the dam ineligible.

West Fork – Comprised of Thorpe and Tuckasegee. Thorpe, including the dam and powerhouse, was placed on the State Study List in 1992 and determined eligible for the National Register in 1999 as part of the Section 106 review process. Tuckasegee, a later addition to provide more power, was built in 1950 and is intact. Why is it not considered eligible?

Nantahala – Main project and three separate, smaller dams. The main property was determined eligible and the report notes this. However, there is almost no information on the three dams on which to make a determination other than that they appear to be intact.

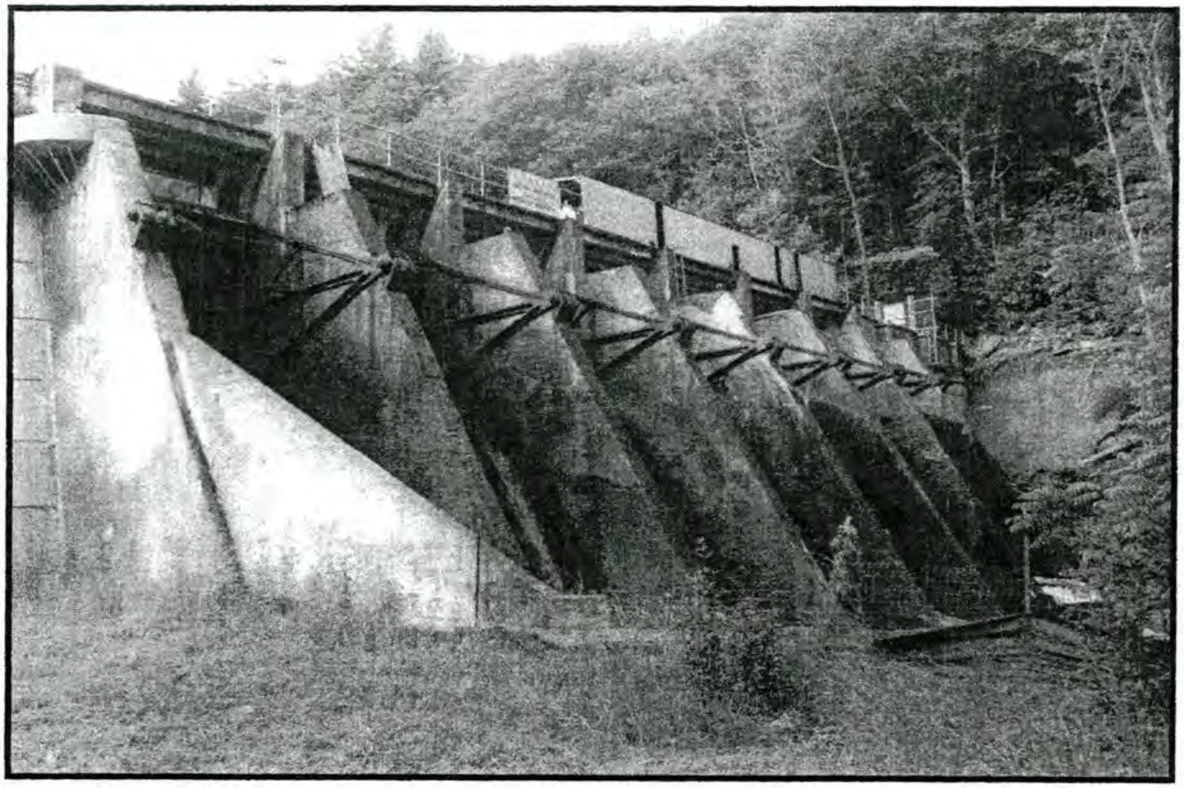
East Fork – Four dam components that are judged not eligible. One dates from 1952 and the other three are before 1955. There is no discussion of the less that fifty-year criteria and very little information about these properties, except that they are "typical of their period." Need more information on them and on why the 1952 plant is not eligible since it is intact.

Given how long we have kept the draft study, we understand that it may take your consultants some time to reacquaint themselves with the report and revise it. Any questions about our comments may be directed to me at 919/733-4763. Again, we very much appreciate your patience and understanding of our staffing situation.

Sincerely,

Renee Gledhill-Earley
Environmental Review Coordinator

bc: ✓Southern/RGE
Swallow
Van Winkle/WO
106
County



NATIONAL REGISTER OF HISTORIC PLACES ELIGIBILITY STUDY OF SEVEN HYDROELECTRIC PROJECTS IN THE NANTAHALA AREA, NORTH CAROLINA (RFQ 7536-RLH)

SUBMITTED TO:
DUKE POWER
526 SOUTH CHURCH STREET
CHARLOTTE, NORTH CAROLINA 28201

SUBMITTED BY:
THOMASON AND ASSOCIATES
PRESERVATION PLANNERS
NASHVILLE, TENNESSEE

DECEMBER, 2003

TABLE OF CONTENTS

I. Management Summary ... 1

II. Introduction ... 2

III. The Technology of Hydroelectric Power ... 5

IV. The Development of Hydroelectric Power in North Carolina, ca. 1900 to 1955 ... 11
1. The Early Years of Hydroelectric Power ... 11
2. Notable Early Companies - The Aluminum Company of America (Alcoa) ... 12
3. Notable Early Companies - Carolina Power & Light Company ... 16
4. Notable Early Companies - Duke Power Company ... 17
5. Hydroelectric Power in North Carolina to 1955 ... 20

V. The Hydroelectric Plants of Alcoa and the Nantahala Power & Light Company ... 23

VI. Hydroelectric Power and National Register Eligibility ... 29
1. Significance of Hydroelectric Power in North Carolina ... 29
2. Hydroelectric Power Property Types and Registration Requirements ... 37

VII. National Register Assessments of Seven Hydroelectric Projects of the Nantahala Power & Light Company ... 48
1. Dillsboro Hydroelectric Project, Jackson County ... 48
2. Bryson Hydroelectric Project, Swain County ... 58
3. Mission Hydroelectric Project, Clay County ... 70
4. Franklin Hydroelectric Project, Macon County ... 78
5. West Fork Hydroelectric Project, Jackson County ... 90
6. Nantahala Hydroelectric Project, Clay and Macon Counties ... 120
7. East Fork Hydroelectric Project, Jackson County ... 148

VIII. Summary ... 173

Bibliography ... 177

Appendix A - Operating Hydroelectric Plants Built in North Carolina Prior to 1955

Appendix B - Operating Hydroelectric Plants Built in North Carolina Prior to 1940

Appendix C - Retired Hydroelectric Plants Built in North Carolina Prior to 1940

I. MANAGEMENT SUMMARY

On behalf of Duke Power, Thomason and Associates evaluated the following hydroelectric projects located in the mountains of North Carolina to determine if they are eligible for the National Register of Historic Places (NRHP): Bryson, Dillsboro, East Fork, Franklin, Mission, Nantahala and West Fork. This project was undertaken in support of Duke Power's efforts to re-license these projects. The evaluation consisted of background research, field surveys, and photography of properties. Structures evaluated during this study included powerhouses, dams, pipelines and other associated structures. All structures were evaluated to determine if they were eligible for the NRHP.

The following recommendations regarding the NRHP eligibility were made:

- **Bryson (FERC No. 2601), Swain County**: The Bryson Powerhouse and Dam meet NRHP criterion A.
- **Dillsboro (FERC No. 2602), Jackson County**: The Dillsboro Powerhouse and Dam meet NRHP criterion A.
- **East Fork (FERC No. 2698), Jackson County**: The Cedar Cliff Dam and Powerhouse, Bear Creek Dam and Powerhouse, Wolf Creek Dam, and East Fork Dam and Powerhouse meet NRHP criterion A.
- **Franklin (FERC No. 2603)**: The Franklin Powerhouse is eligible for the NRHP under criteria A and C. The Franklin Dam meets NRHP criterion A.
- **Mission (FERC No. 2619), Clay County**: The Mission Powerhouse meets NRHP criteria A and C, and the Mission Dam meets NRHP criterion A.
- **Nantahala (FERC No. 2692), Clay & Macon Counties**: The Nantahala Powerhouse, Dam, pipelines, and tunnels meet NRHP criteria A and C. The White Oak Creek, Dicks Creek and Diamond Valley Dams and associated pipelines meet NRHP criterion A.
- **West Fork (FERC No. 2686), Jackson County**: The Thorpe Powerhouse, Dams, pipeline, tunnels and associated gatehouses meet NRHP criteria A and C. The Tuckasegee Powerhouse and Dam meet NRHP criterion A.

II. INTRODUCTION

Nantahala Power & Light, a Division of Duke Energy Corporation, is the Federal Energy Regulatory Commission (FERC) licensee for the following hydroelectric projects: Franklin, East Fork, West Fork, Nantahala, Bryson, Mission and Dillsboro. This report has been prepared for Duke Power, a Division of Duke Energy Corporation (Duke Power), in support of the re-licensing of these seven projects. One of the issues for consideration during the re-licensing process is the assessment of historic properties. In April of 2001, Duke Power selected TRC Garrow Associates, Inc. (TRC) to perform the historical and architectural assessment of their facilities. As a sub-consultant to TRC, the firm of Thomason and Associates, Preservation Planners of Nashville, Tennessee, (Consultant) completed tasks necessary for the assessment of significance of these resources.

Section 106 of the National Historic Preservation Act (NHPA) requires that FERC take into account the effects of its re-licensing decision on historic properties, and to allow the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on FERC's re-licensing decision. To meet these requirements, a thorough review of the history and architecture of Duke Power's hydroelectric plants was required along with evaluations and recommendations for properties meeting the criteria of the NRHP.

The Duke Power facilities reviewed for this re-licensing study include the following seven hydroelectric facilities:

- the Bryson Hydroelectric Project (FERC No. 2601);
- the Dillsboro Hydroelectric Project (FERC No. 2602);
- the East Fork Hydroelectric Project (FERC No. 2698);
- the Franklin Hydroelectric Project (FERC No. 2603);
- the Mission Hydroelectric Project (FERC No. 2619);
- the Nantahala Hydroelectric Project (FERC No. 2692); and,
- the West Fork Hydroelectric Project (FERC No. 2686).

These seven hydroelectric plants are all located in the mountainous region of western North Carolina (Figure No. 1). The oldest of these plants is the dam and powerhouse at Dillsboro which was completed in 1913. The Bryson, Mission, and Franklin plants were all built in the 1920s to supply electric power for the communities of Bryson City, Andrews, and Franklin. These four plants were later purchased and incorporated into the system operated by the Nantahala Power and Light Company (NP&L), a subsidiary of the Aluminum Company of America (Alcoa). During the early 1940s, the NP&L constructed the Thorpe and Nantahala plants to help supply power to Alcoa's large aluminum smelting complex in Blount County, Tennessee. The East Fork and West Fork Projects were also completed by NP&L in the late 1940s and early 1950s to supply additional electricity to the Thorpe Powerhouse. The NP&L system was purchased by Duke Power from Alcoa in 1988. These plants are now the subject of the present re-licensing effort.

Previous NRHP assessments of these properties have occurred for the Franklin Hydroelectric Plant, the Nantahala Hydroelectric Plant, and the Thorpe Plant which is part of the West Fork Hydroelectric Project. In 1994, both the Franklin and Nantahala Hydroelectric Plants were determined to be potentially eligible, and placed on the Study List for the NRHP as part of a countywide survey in Macon County of historic resources. The Thorpe Powerhouse and adjacent worker's housing were also determined to be potentially eligible, and placed on the Study List in 1992 following a survey of Jackson County. The Thorpe Dam Complex Historic District was determined to be eligible for the NRHP in 1999 following an environmental review of the North Carolina Department of Transportation's request to replace the bridge over the dam.[1]

Overall, previous evaluations of the historical and architectural significance of North Carolina hydroelectric facilities have been limited. Currently the Narrows Dam and Power Plant Complex in Stanly County is the only hydroelectric facility listed on the NRHP. These properties were listed on the NRHP in 1983 for their architectural and historical significance as part of the Badin Multiple Resource Area nomination. Badin was developed by Alcoa in the 1910s and employed over 1,000 workers in the 1920s.

Another complex, the Walters Hydroelectric Plant in Haywood County, was determined eligible for the NRHP in 1995. A Cultural Resources Management Plan for this complex was completed by Brockington and Associates of Atlanta. The plan concluded that the Walters Hydroelectric Plant was eligible as an historic district under NRHP criteria A and C for its significance in engineering and for its architectural design. Associated workers housing was also recommended for inclusion within the district boundary. In 1994, the Highlands Hydroelectric Plant in Jackson County was determined to be potentially eligible, and placed on the Study List for the NRHP following the countywide survey.

In addition to the review of the seven hydroelectric projects for Duke Power, this study also provides an overview of the growth and development of hydroelectric power in North Carolina from ca. 1900 to 1955. The purpose of this overview is to examine the significance of hydroelectric power during these years, and to assist in the assessment of the seven facilities within an overall statewide context. This discussion includes a listing of property types associated with hydroelectric power, and registration requirements to meet NRHP criteria.

This report includes photographs and site plans of each hydroelectric facility. Detailed elevations and schematic drawings of the dams and powerhouses have been excluded from this report in compliance with the intent of 18CFR 388 and FERC Order 630. The content of these drawings are considered "Critical Energy Infrastructure Information." They will be filed in accordance with the requirements of 18CFR 375 and 18 CFR 388.

[1] Letter from Clay Griffith, Preservation Specialist, North Carolina Department of Cultural Resources to Jennifer Huff, Duke Power, 22 August, 2000.

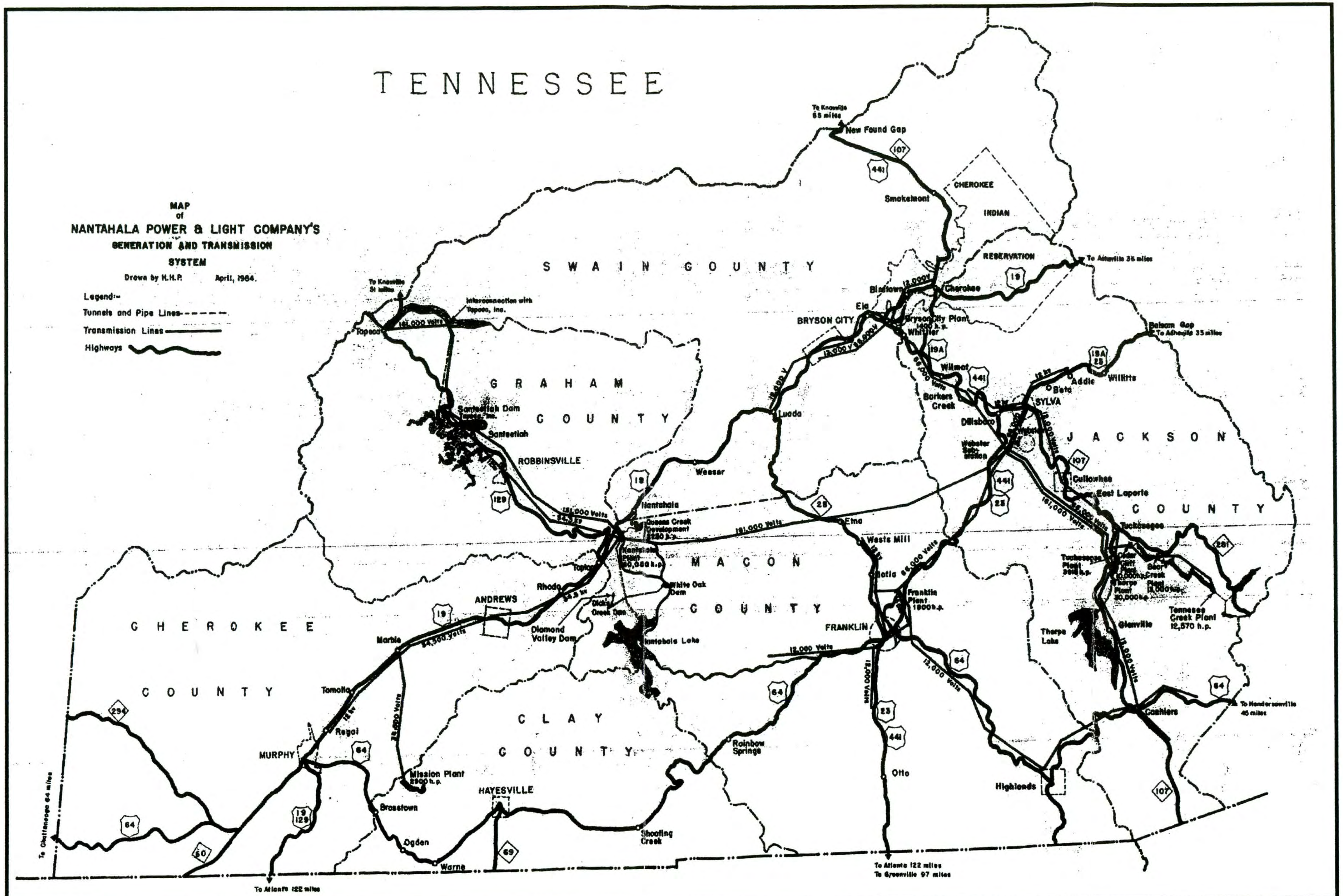


Figure No. 1. Map of the NP&L's system in western North Carolina.

III. THE TECHNOLOGY OF HYDROELECTRIC POWER

The history of hydroelectric power stretches well before the twentieth century. Over 3,000 years ago, the Chinese used crude wheels on the Yellow River to create power by raising the water of the rivers for irrigation and grinding corn.[2] Over 2,000 years ago, the Greeks used water to power grinding wheels for turning wheat into flour. By the 1700s, there was widespread use of mechanical hydropower for milling and pumping.

Hydroelectric systems consist of a variety of components and equipment that work together to produce energy. Among these are dams, intake structures, water delivery systems, and prime movers (Figure No. 2). Water delivery systems can be canals, flumes, tunnels, pipelines, or penstocks. Plants with high heads also typically have surge tanks, stand pipes, and relief valves. The term "head" refers to the amount of water pressure exerted to provide energy. The higher the head the greater the water pressure to drive the prime movers. Prime movers are the water turbines or impulse wheels, which drive electrical generators. This equipment along with the generators usually are enclosed in a powerhouse, which also contains the control and switching equipment.[3]

The earliest hydroelectric plants were direct current stations built to power arc and incandescent lighting. The first use of hydroelectric power in the United States took place at Niagara Falls, New York. In 1861, a canal was built through the town of Niagara Falls to a powerhouse at the edge of the gorge, below the falls. The Niagara Falls Hydraulic Power & Manufacturing Company was formed in 1872. It operated for five years furnishing water to several water wheels of different manufacturing companies. This method proved inefficient and a central powerhouse was built in the early 1880s. The Niagara Falls plant was the first U.S. hydroelectric plant built for major power generation and it is still in use.[4] The first hydroelectric plant in America with a central station was built in 1882 in Appleton, Wisconsin. The Appleton plant provided light to two paper mills and a home.[5]

By the mid to late 1880s, the number of hydroelectric plants began to grow rapidly in response to the growth of the electric light industry. In 1886, forty to fifty electric light plants were either on line or under construction in the United States and Canada. The largest plants existed at Rochester and Niagara Falls, New York; Holyoke and West Somerville, Massachusetts; Lynchburg, Virginia; Columbus, Georgia, and Laconia, Maine.[6] The *American Electrical Directory* for 1889 listed 560 electric companies in the United States. Two hundred of these companies utilized waterpower for generation of part or all of their current. Waterpower was also being used for smelting, aluminum production, mining, and milling.[7]

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[2]David B. Rushmore and Eric A. Lof, *Hydro-Electric Power Stations* (London: John Wiley & Sons, Inc., 1923), 1.

[3]Duncan Hay, *Hydroelectric Development in the United States, 1880-1940* (Washington, DC: Edison Electric Institute, 1991), 43.

[4]Bureau of Reclamation, *The History of Hydroelectric Development in the United States* (Bureau of Reclamation Hydropower Program, n.d., http://www.usbr/gov/power/edu/history.htm), 1; Rushmore and Lof, 4.

[5]Bureau of Reclamation, *The History of Hydroelectric Development in the United States*, 1.

[6]Duncan Hay, *Hydroelectric Development in the United States, 1880-1940*, vol. 1 (Washington, DC: Edison Electric Institute, 1991), 15-16.

[7]Ibid., 16.

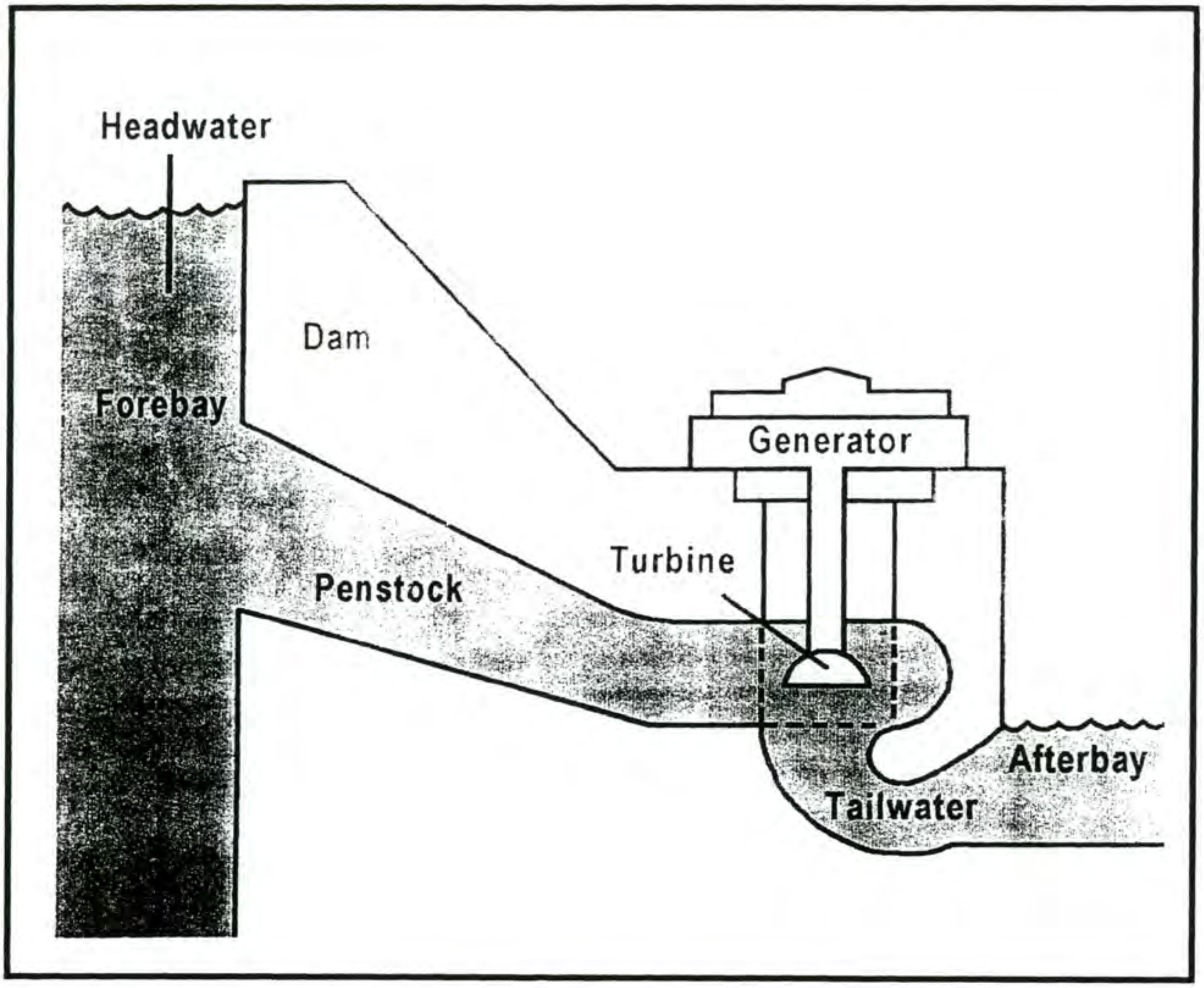

Figure No. 2. Diagram of a typical hydroelectric system. (U.S. Bureau of Reclamation).

During the late 19th century, three styles of hydroelectric development emerged: industrial waterpower sites with low heads close to markets for electricity, largely found in the East; systems with heads ranging from several hundred to over a thousand feet located far from populated areas, which were typically built in the West; and the development of large waterpower sites to provide inexpensive electrical power to electrochemical manufacturers, which produced items such as calcium carbide and aluminum.[8]

Hydroelectric systems generate power through moving water. First a reservoir of water is created by damming a river. Water flow is controlled and a constant water level is maintained. This stored water is then piped into turbines through a delivery system such as a penstock. Penstocks are controlled by valves or turbine gates in order to adjust the flow rate. Water enters and leaves the turbines through what is called a tailrace. Turbines are rotary engines that convert the energy of moving water into mechanical energy by driving the axles of the generators. "The basic element in a turbine is a wheel or rotor with paddles, propellers, blades, or buckets arranged on its circumference in such a fashion that the moving fluid exerts a tangential force that turns the wheel and imparts energy to it."[9] The design of the turbine depends on the available head of water; high heads require a Francis-type turbine, while low heads use Kaplan or propeller-turbines. Attached to the top of the turbines via a vertical drive shaft are electric generators. The mechanical energy created by the turbines is transferred through the drive shaft to operate the generators. Water that flows through the turbines is recycled in pumped storage plants.[10]

As Duncan Hay points out in his work on the history of hydroelectric power, the design, arrangement, use, and combination of the various elements within a hydroelectric system, "varies enormously from site to site and often is a product of the time during which a particular plant was designed."[11] The technology of dam construction, delivery systems, and prime movers evolved as the industry developed and demand for electricity increased.

Dam construction is one of the largest and most expensive undertakings in the development of a hydroelectric plant. Early hydroelectric plants often used existing dams for their projects. Dam construction in the 19th century included those made of masonry, earth, and timber. As hydroelectric power became a viable enterprise, dams were constructed solely for this purpose. The first large masonry dam built for a hydroelectric plant was the Austin Dam across the Colorado River in Austin, Texas. Completed in 1893, the dam was 1,300-foot long and 65-foot high. Flood waters, however, caused the structure to collapse in 1900.[12] Concrete and timber dams were also constructed in the late 19th century for use at hydroelectric plants. In 1897, an 800-foot long concrete dam was completed at Mechanicville, New York. Also during the 1890s, timber crib dams were constructed in New Hampshire, Maine, and Montana. Although less permanent, timber dams were also less expensive to build than those of stone or concrete.[13]

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[8]Ibid., 13.

[9]*Encarta Encyclopedia*, 1995 edition, s.v. "hydroelectricity."

[10]*Webster's Concise Desk Encyclopedia*, (New York: Barnes and Noble, 1992), 279.

[11]Hay, 43.

[12]Ibid., 45.

[13]Ibid., 45-46.

In the following decades dam building technology was fueled by the desire to lessen the expense of dam construction. Efforts focused on using smaller volumes of material and on designs that employed less costly materials and fewer skilled laborers. Arch dam designs reduced the volume of required construction materials by transferring thrusts to the abutments, which meant the dam itself could be thinner. The first such dam constructed was the 1885 Bear Valley Dam near San Bernardino, California. The dam was slender for its time with a twenty-foot thick base, and supported a 65-foot head. The use of steel in dam construction also came into play in the late 19th century, but it did not come into general use.[14]

Innovative designs in dam construction appeared in the early 20th century with the work of Nils Frederick Ambursen and John S. Eastwood. In 1903, Ambursen patented a slab and buttress design for a reinforced concrete dam in which the weight of the water was distributed across an inclined upstream face. The design calls for a row of triangular buttresses that support cast-in-place reinforced concrete slabs. In 1904, Ambursen patented a curved sloping downstream spillway to carry water from the crest. This design created a "shell-dam" with a hollow core between the buttresses. Some power companies who used this design elected to install the facility's powerhouse inside the dam's hollow interior rather than build a separate structure.[15] In the early 20th century John S. Eastwood developed a multiple arch dam that featured "a series of reinforced concrete cylinder sections (arches) set at an angle . . . joined at their edges, and resting on triangular buttresses reminiscent of those used by Ambursen."[16] This design greatly reduced the amount of material needed as the arches were very thin.

Engineers also explored various labor saving devices to reduce dam costs. Advancements in earthmoving equipment encouraged the development of rock fill and earth dams. Hydraulic fill earth dams were developed around the turn of the century. These dams require high pressure streams of water to wash fill from hillsides. The fill is then carried via sluices to the dam site. Semi-hydraulic dams used dump cars that ran on parallel elevated trestles to carry the fill from pits to the dam site.[17]

An important development in dam technology was the formation of Tainter gates to control water flow. Jeremiah Burnham Tainter (1836-1920) developed this water control device in 1886 while working at a lumber mill in Wisconsin. Tainter improved on the basic design of a common radial or paddle gate, which had been patented in 1827. Refinements of the radial gate occurred over the years, with Tainter's design proving to be the most superior. The Tainter gate design employs the force of gravity and the movement of the water to help open and close the device. The gates thus operated with a minimum of manpower, were easy to manipulate, and were more efficient than previous models. The Tainter gate consists of two arched girders connected by a metal sheet. The gate is supported by a system of trunion arms that rotate along an axis when the gates are lowered and raised. The arched gate is convex on the upstream side and the rush of water helps to open and close the gate.[18] The Tainter gate system came to be used in dams and locks throughout the world. Over time, stronger and more rigid models of the Tainter gate were developed, including submersible versions.

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[14]Ibid., 47-48.

[15]Ibid., 48-50.

[16]Ibid., 51.

[17]Ibid., 52-54.

[18]Larry Lynch and John Russell, ed. *Where the Wild Rice Grows: A Sesquicentennial Portrait of Menomonie 1846-1996* (Menomonie, WI: Menomonie Sesquicentennial Committee, 1996).

The water delivery systems that carry water from the dams and associated reservoirs include canals, flumes, tunnels, pipelines and penstocks. With the development of hydroelectricity, only subtle changes occurred in the construction of canals and flumes, which had been in use for irrigation and other purposes for centuries. Changes focused on streamlining and efficiency. Rectangular timber flumes were common and manufacturers began to offer semicircular flumes constructed of both wood and sheet metal. Some concrete flumes were produced, but were cost prohibitive. In the eastern United States, closed conduits were more common than flumes. Plank lined and later concrete lined pressure tunnels enabled companies to connect streams, storage reservoirs, and power plants while bypassing ridges and other obstacles.[19]

Pipelines and penstocks transfer the water to the turbines. Pipelines are defined as "pressure conduits that run from a dam or the foot of a canal to the surge tank or standpipe."[20] Pipelines are connected to turbine cases by penstocks. Penstocks typically have steep slopes and are able to withstand high pressures. Pipelines and penstocks are often confused, and it is not uncommon for the entire system to be referred to as a penstock. Throughout the late 19th century wood stave pipelines were used in hydroelectric facilities to carry water along gentle slopes. Plate steel penstocks then delivered the high head water to the turbines. It was found that rivets in the penstocks weakened the steel plate and caused internal surface friction, so welded steel versions became the norm. A few pipelines and penstocks were constructed of pre-cast or cast-in-place reinforced concrete; however, the material could not withstand pressure without seepage and so was not widely used.[21]

Pressure within long pipelines and penstocks often calls for pressure relief devices or venting in the system. Early hydroelectric systems installed safety valves known as standpipes to relieve pressure along the lines. Intense surges and rising pressure forced water to spill out of the top of the standpipes. Larger and taller pipes created simple surge tanks to conserve this water. In 1911, the differential surge tank was introduced. This piece of equipment contains a riser that is similar in diameter to the pipeline that is enclosed by a much larger diameter tank. It featured ports midway up the riser that helped to prevent oscillations within the tank and conduit.[22]

Prime movers of a hydroelectric system are the impulse wheels or turbines. The design of impulse waterwheels changed little from the 1880s to the 1920s. Pelton wheels, as they were commonly called, revolved around horizontal shafts that could be connected directly to generators. Early versions were connected to generators with flexible rawhide. In the 1890s, overhung waterwheels avoided misalignment problems by connecting directly to an extension of the generator shaft.[23] Control mechanisms such as needle valves and jet deflectors were also common features at high head installations.

Low and medium head hydroelectric developments turned to water turbines in the late 19th and early 20th centuries. Turbines are reaction wheels that are driven by the flow and pressure of water that moves against vanes or buckets. Early turbines were either outward or inward flow units, which are distinguished by the path of water as it travels through the unit. "Inward flow runners receive water through guide vanes

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[19]Ibid., 54-56.

[20]Ibid., 57.

[21]Ibid., 57-58.

[22]Ibid., 58-59.

[23]Ibid., 60.

mounted around their periphery and discharge it at their centers."[24] Axial wheels force water along a path parallel to the runner shaft.

The majority of hydroelectric plants in the United States have what are known as Francis or mixed flow turbines. These units combine inward flow and axial flow. Several patented variations of the mixed flow turbine emerged in the late 19th century. Despite this fact, stock pattern turbines emerged that met the needs of most hydroelectric plants. Turbines were arranged in either vertical or horizontal configurations and were enclosed in cylindrical plate iron cases. Multiple runners per shaft also made duplex, triple, and quadraplex installations common.

Stock pattern turbines, however, could not meet the needs of large-scale hydroelectric facilities that developed in the 20th century. These installations required custom designed turbines to fit their specific needs. Impulse wheels continued to be used at sites of a thousand feet or more at the turn of the century, but Francis turbines became the norm for moderate to high head developments in the 20th century. A key factor in this change was the development of the Kingsbury bearing, an oil film pressure wedge bearing connecting the turbine and generator and allowing vertical suspension of the turbine. Invented by Albert Kingsbury in 1898, it was first used in a commercial hydroelectric plant in 1912. The design did not require pumps or other external pressure equipment and the bearings had the capacity to carry vertical reaction turbines of great magnitude. This greatly altered power plant design. The Kingsbury bearing and variations of the design were commonplace by 1915, and large-scale plants were being built with vertical reaction turbines, which hung from the new bearings. By 1920, vertical Francis turbines were built that had up to 60,000 horsepower at heads of over 600 feet.[25]

Propeller turbines were first used in low head hydroelectric facilities in 1916. Several versions of the propeller design emerged but all were "smaller, lighter, and less prone to damage from passing ice and debris than their Francis counterparts."[26] In addition, propeller runners operated at high speeds and were more economical. The design was perfected by Dr. Viktor Kaplan, who invented a propeller turbine with blades "that were continuously adjustable in synchrony with wicket gate angles."[27] Kaplan units first appeared in the United States in 1929 at a plant in Texas.[28]

The seven hydroelectric projects studied for this re-licensing effort reflect this history of the growth and development of hydroelectric technology. Most dams are of concrete or rock and earth fill. The powerhouses of the Bryson, Mission, Nantahala, Tuckasegee, and East Fork Hydroelectric Projects all employ vertical Francis turbines. The Franklin Powerhouse has a vertical propeller turbine, while Dillsboro's original turbine is a Smith-Kaplan design. The Thorpe Powerhouse has the highest head in North Carolina, and employs a double, overhung, Pelton Wheel for its power generation. Additional descriptions of these facilities are located in Chapter VI.

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[24]Ibid., 62.

[25]Ibid., 72-75.

[26]Hay, 79.

[27]Ibid., 80.

[28]Ibid., 80.

IV. THE DEVELOPMENT OF HYDROELECTRIC POWER IN NORTH CAROLINA, CA. 1900 TO 1955

1. The Early Years of Hydroelectric Power

In the late 19th century, electrical power in North Carolina was limited to small direct current dynamos and generators used to power individual homes and businesses. The hydroelectric potential of the state's many rivers and streams remained untapped until the successful demonstration of the use of alternating current generation at New York's Niagara Falls in 1895. Unlike direct current (DC), alternating current (AC) allowed electricity to be generated at one voltage, increased through transformers to a higher voltage for transmission, and then decreased through transformers for distribution to consumers. Alternating current was also more economical since it could transmit high voltages via copper wires through long distances. This allowed for the possibility of electrical generation at one source, and the transmission of current to consumers in urban areas or to industrial clients.

The earliest use of large-scale hydroelectric power to provide electricity in the state was the Idols Hydroelectric Plant on the Yadkin River. In 1898, the Fries Power and Manufacturing Company built North Carolina's first hydroelectric plant to power textile mills, streetcars, and small manufacturing plants in the nearby towns of Salem and Winston. When it was constructed, the plant transmitted electric power thirteen and one-half miles to a substation in Salem.[29] By 1940, this small power plant had been acquired by Duke Power and produced 1411 kw of electricity.

The Idols Plant was the first of dozens of hydroelectric facilities which would be built in North Carolina over the next several decades. Numerous companies were formed to build dams and power plants in these years with varying degrees of success. The Duncan Hay study of *Hydroelectric Development in the United States* documented the existence of fifty-three (53) hydroelectric plants in the state built prior to 1940 (see Appendices B and C). Some plants operated only for a short period of time before they proved uneconomical and went out of business. Others were eventually purchased or consolidated with emerging larger utility companies such as Duke Power or Alcoa.

Representative of the evolution of the state's early hydroelectric companies is the history of the Cape Fear Power Company. The Cape Fear Power Company was developed by W.M. Morgan and Captain R. Percy Gray in 1899. The purpose of the company was to develop power on the Cape Fear and Deep rivers. In late 1905, after six years of construction, workers completed the Buckhorn Dam. This company experienced financial problems and by 1906, the company went into receivership. That same year, the property was purchased by Electric Bond and Share.[30] Despite problems with the labor force and equipment, the Buckhorn Hydroelectric Plant began operation on January 1, 1908. In February, Central Carolina Power Company took over the Cape Fear properties. The plant proved successful, providing power to several mills in the area and to the cities of Raleigh, Fayetteville and Sanford. The Buckhorn Plant eventually became the property of Carolina Power & Light Company.[31]

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[29]North Carolina Department of Cultural Resources, Badin Multiple Resource Nomination, Statement of Significance. *National Register of Historic Places Inventory-Nomination Form* (Raleigh, NC: North Carolina Department of Cultural Resources, Division of Archives and History, 1974), 5-6.

[30]Jack Riley, *Carolina Power & Light Company* (Raleigh, NC: Jack Riley, 1958), 38-40.

[31]Riley, 40, 42, 44-47.

The construction of hydroelectric plants in the 1910s and 1920s played a significant role in the development of North Carolina's industry. The advances made in electro-chemical (aluminum, calcium carbonate, etc.), refining operations at Niagara Falls proved that hydroelectric power could provide the energy for this highly consumptive type of manufacturing. In 1895, the Pittsburgh Reduction Company moved to Niagara Falls, becoming the first customer of the hydroelectric plant located there. Renamed Aluminum Corporation of America (Alcoa), the company built hydroelectric plants in other locations in the east. Starting in the early 1900s, an Alcoa subsidiary, Southern Aluminum Company, began building hydroelectric plants in North Carolina.[32] Over the next several decades, North Carolina became a leading producer of hydroelectric power in the country.

By the 1920s, three companies had emerged as the leading producers of hydroelectric power in the state. These were the Aluminum Company of America (Alcoa), the Carolina Power & Light Company, and Duke Power. The history of these companies are notable for the impact they had on the development of the state's hydroelectric resources.

2. Notable Early Companies - The Aluminum Company of America (Alcoa)

Beginning in 1910, the Aluminum Company of America (Alcoa), began to acquire property in North Carolina for its planned hydroelectric developments. Much of this purchased land included the headwaters of the Tuckasegee, a large river with terrain that was ideal for a high-head hydropower plant. During the next sixteen years land procurement went smoothly and continued so until a land boom hit western North Carolina and land prices increased. When Alcoa created the subsidiary Nantahala Power and Light Company (NP&L) in 1929, fewer than 2,000 people had electric service in the region. The creation of this new power company would increase the amount of power available to businesses and homes in these mountain counties by allowing for the development of the undeveloped water sources owned by Alcoa in western North Carolina.[33]

Alcoa, the Aluminum Company of America, is one of the foremost aluminum manufacturers in the United States. A pioneer in modern aluminum production, the company is rooted in the late 19th century scientific efforts and discoveries of Charles Martin Hall. In 1886 at age 22, Hall discovered a new process for making low-cost aluminum. Hall's process involved "passing an electric current through a fused bath of cryolite and alumina," and separated aluminum from its oxide.[34] Because the procedure could be done relatively inexpensively, it made commercial use of the metal feasible.

In 1888, Hall went to Pittsburgh where he found financial backers to support his ideas. Chief among the interested parties was Captain Alfred E. Hunt, a preeminent metallurgist. Hunt and five other professionals in the Pittsburgh steel industry invested a total of $20,000, and on October 1, 1888, The Pittsburgh Reduction Company was chartered. The funds were used to build and equip a small plant where Hall immediately began work on developing a commercially feasible aluminum smelting process.[35]

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[32]Hay, 37-38.

[33]Barbara McRae, The Development of the Thorpe Project. (*Remarks for Sylva speech group*. November 23, 1992), 1-2. Nantahala Power & Light Company, Franklin, NC.; *NP&L History*, http://www.nantahalapower.com/history.html, 1999; J.E.S. Thorpe, *History of Nantahala Power & Light Company* (n.p., 1939), 1.

[34]Charles C. Carr, *Alcoa: An American Enterprise* (New York: Rinehart & Company, Inc., 1952), 24.

[35]George David Smith, *From Monopoly to Competition: The Transformations of Alcoa, 1888-1986*. (New

By 1890, the company was producing around 475 pounds of aluminum per day. The small Pittsburgh plant was becoming inadequate and the company needed to enlarge its operations. In March 1891, the organization moved to New Kensington, Pennsylvania, along the Allegheny River. The new plant produced pig aluminum ingot, and within two years the company added a sheet-rolling mill. In 1895, the company opened a second plant at Niagara Falls, New York.[36]

The company experienced rapid success and growth in the late 19th and early 20th centuries as markets for aluminum increased dramatically. The metal was used for a variety of products including kitchen utensils, medical and surgical instruments, foils, bottle caps, military implements, wire baskets and brushes, automobiles, and eventually airplanes. Stock in the company sold well and attracted major investors such as Andrew W. and Richard B. Mellon. The Mellon family became involved with the company first as bankers to secure loans for a new plant. Impressed with the organization, the Mellons invested in its stock and by 1925 held over 35 percent of its preferred and common stock.[37]

The company's initial success was aided by the fact that it held a secure patent on Hall's unique process and thus was the only aluminum manufacturer in the country. However, the company's long-term success and growth were due to the foresight of its leaders, particularly Captain Hunt, who implemented a strategy of vertical integration and self-sufficiency. Hunt was aware that Hall's patent would expire in 1906 and that the larger political and economic climate was shifting away from tariff protection, which meant a possible increase in competition from overseas. In 1897 Hunt wrote to Hall that "it must be our policy now for the next few years to strengthen and solidify the position of The Pittsburgh Reduction Co. that we shall be independent of both the tariff and the patent situation."[38] In order to gain this independence and strengthen the company's position in the industry, the company developed a policy of expanding its manufacturing facilities and taking greater control of the raw materials and energy its product required.

Aluminum production required the raw materials alumina, cryolite, and carbon, as well as vast amounts of electricity. Rather than purchase these materials, the company saw that it was in their best interest to produce them. Control of these basic ingredients enabled the company to prevent inflated costs and lessen potential technical problems. As early as 1894, The Pittsburgh Reduction Company was producing carbon anodes and furnace linings at its New Kensington facility.[39]

Alumina (aluminum oxide) is primarily found in the ore bauxite, deposits of which are located in the United States in Georgia, Alabama and Arkansas. To secure a supply of bauxite, Hunt purchased some acreage of bauxite reserves in Arkansas in 1899. As this became inadequate, the company purchased the General Bauxite Company of Arkansas and its 15,000 acres in mineral rights in 1906. In 1909, it acquired the Republic Mining & Manufacturing Company and became directly involved with mining operations. At this point, the aluminum company became a seller of bauxite to other companies.[40]

York: Cambridge University Press, 1986), 25.

[36]Carr, 42-43; 125.

[37]Ibid., 42-45; 110.

[38]Smith, 95.

[39]Ibid., 94-95.

[40]Ibid., 97.

The aluminum company also began to produce cryolite, a solvent that is used in the smelting bath for alumina. Cryolite existed in Greenland and was mined by the Danish Government. The Pennsylvania Salt Company had an exclusive contract with the Danish Government and was the principal source of cryolite in the United States. Rather than depend on this as a sole source, in 1910 the aluminum company began to produce a synthetic version of cryolite, which was less expensive.[41] In 1905, the company began to manufacture aluminum fluoride at a plant in East St. Louis.[42]

In addition to raw materials, Hall's process required extraordinary amounts of electrical power, and so the company sought out the least expensive methods for its production. The search for inexpensive electricity led the company to hydroelectric power. Its initial plant at New Kensington operated on steam power from coal and gas, which proved to be costly. With its second plant in Niagara Falls, the company began to experiment with hydroelectric power. The Niagara Falls Power Company provided "mechanical power," from its turbine shafts. The Pittsburgh Reduction Company was responsible for converting the power into electrical energy through its generators. The hydroelectric system proved to be the best and most cost efficient energy system for aluminum production, and the Pittsburgh Reduction Company soon transferred all of its smelting operations to the Niagara Falls facility. The New Kensington plant was reserved for making aluminum sheet, tubing and other semi-fabricated products.[43]

From this point on the company became actively engaged in seeking its own hydroelectric sites and building and managing its own power plants. It also became important to locate its aluminum reduction facilities near sources of hydroelectric power because "it is easier to bring the raw materials to the vicinity of adequate hydro power than to send the electricity long distances to sections where raw materials are in abundance."[44] In 1899, the company acquired a site at Shawinigan Falls on the Saint Maurice River in Quebec in anticipation of establishing future manufacturing facilities in Canada. In 1903, The Pittsburgh Reduction Company built a reduction works at Massena, New York, near the St. Lawrence River. This plant received energy from the St. Lawrence Power Company. In 1906, the aluminum company acquired the St. Lawrence Power Company, which was experiencing financial distress. In addition to the power plant and riparian rights, this purchase brought the additional concerns of real estate, railway transportation, city lighting, and water supply. Also in 1906, The Pittsburgh Reduction Company built its own power plant in Niagara Falls, New York, to support another plant at that location.[45]

In 1907, the company changed its name to the Aluminum Company of America, or Alcoa, to reflect its role as the industry leader. Captain Hunt, a significant leader in the company, died in 1899 from complications of malaria, which he contracted on a combat mission in Puerto Rico. But his guidance had assured the survival of the company in its early years. Upon Hunt's death, Arthur V. Davis assumed the position of general manager. Charles Martin Hall, who had invented the process that led to the development of the company, remained a key figure in the research and development phases of the organization, and moved to

[41]Ibid., 100-101.

[42]Carr, 127.

[43]Smith, 94-95; Carr, 88-90, 92.

[44]Carr, 90.

[45]Carr, 92-93; Smith 96.

Niagara Falls to be near the company's facilities. Hall died at age 50 in 1914 from a spleen disease. He had become a wealthy man and at the time of his death had a reported worth of $30 million.[46]

Continuing its search for inexpensive electric power, Alcoa spent several years trying to procure property along the Long Sault Rapids of the St. Lawrence River on which to build a large hydroelectric plant. But coordinating the proper legislation with the various levels of government in the United States and Canada proved too difficult. In 1909, looking elsewhere for potential hydroelectric sties, the company focused on the Little Tennessee River and its tributaries in the Great Smoky Mountains region of Tennessee and North Carolina. Alcoa gained riparian and power rights along the mountainous waterways through the purchase of the Knoxville Power Company and the Union Development Company in Tennessee, and the Tallasee Power Company in North Carolina.[47] In March, 1914, Alcoa began operations at its large new smelting plant at Alcoa, Tennessee, the largest aluminum plant in the country.[48]

To supply the new Tennessee facility with power, Alcoa built its own dams and power stations along the Little Tennessee and its tributaries. These hydroelectric developments include Cheoah, Santeetlah, and Calderwood. The falling water from the dams flowed through the penstocks and into the turbines to create electricity. The power then traveled from the powerhouses to the reduction works at Alcoa, Tennessee. Cheoah, the first to be constructed, began operation in April 1919. Its dam of 225 feet was the highest overfall dam in the world to date, and the powerhouse operated at an 110,000 KW capacity. The Santeetlah development followed in June 1928 with a 212 foot dam. At this location a five-mile tunnel and pipeline were constructed for water from the associated reservoir to travel to the powerhouse, which has a 45,000 KW capacity. The Calderwood facility, completed in April, 1930, has a 232 foot high dam and a 121,500 KW capacity powerhouse.[49]

In 1915, Alcoa purchased the floundering Southern Aluminum Company of North Carolina. The company had initiated a smelting operation and waterpower site at Badin on the Yadkin River, located in the Piedmont area of North Carolina. Alcoa completed a dam and powerhouse and the plant began operating in July, 1917. Later dams were constructed at Yadkin Falls in 1919, and High Rock in 1927.[50]

In 1929, the Nantahala Power & Light Company (NP&L), a wholly owned Alcoa subsidiary, was formed. NP&L served as a public utility company that provided electric power for residential and commercial use in the Great Smoky Mountains area of North Carolina. Its key role was to develop power sites that had been owned by the Tallassee Power Company, which Alcoa had purchased in 1914. NP&L acquired the hydroelectric systems at Mission, Franklin, and Bryson City, North Carolina. It later built and operated the Glenville and Nantahala Dams and power stations. The first of these was completed in October 1941 with a dam of 150 feet and a 21,600 KW capacity. The Nantahala facility began operation in July, 1942, with a capacity of 43,200 KW and a 253-foot dam.[51]

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[46]Smith, 24; Carr, 18; 45.

[47]Smith, 96; Carr, 93-94.

[48]Carr, 94.

[49]Ibid., 95-96; 106.

[50]Carr, 100-102; Smith, 96.

[51]Carr, 94-95.

In addition to integrating backwards to produce the raw materials and energy required to make aluminum, Alcoa also moved forward in manufacturing aluminum products. The company became involved in this primarily to create a market for its product. When it initially created aluminum ingot in the 1890s, there was little demand for aluminum. To work the metal into usable forms required the construction of special rolling mills and other machinery. Early on, the Pittsburgh Reduction Company tried to persuade brass and steel mills to roll aluminum sheets, but these manufacturers were reluctant to process a competing metal. So the aluminum company established its own rolling mills. Likewise, it began manufacturing aluminum wire and cable. Alcoa also was the first to extrude aluminum into usable shapes using hydraulic presses. Eventually, the company became involved in the manufacture of cooking utensils, bottle caps, and aluminum furniture.[52] Alcoa continues to be America's largest manufacturer of aluminum, and its operations in Blount County employ over 2,000 workers.

3. Notable Early Companies - Carolina Power & Light Company

Carolina Power & Light Company (CP&L) was formed in 1908 with the mergers of the Raleigh Electric Company, Cape Fear Power Company and Consumers Light and Power Company. This was accomplished with the backing of the Electric Bond and Share Company, an electric holding and management company that had previously been owned by General Electric. Electric Bond's first transaction was the purchase of the securities of the Raleigh Electric Company in 1905. In September 1906, Electric Bond purchased Cape Fear Power, followed in November by the acquisition of Consumers Light and Power.[53]

The three companies were then consolidated into one. Improvements in and construction of transmission lines began immediately. The first hydroelectric plant built in North Carolina had been built in Wake County on the Neuse River near Milburnie. This plant had been constructed by the Raleigh Electric Company ca. 1903 and was now part of the CP&L system. The Buckhorn Hydro Plant, constructed by Cape Fear Power Company in 1907, now had CP&L lines connecting it to Raleigh, Sanford, and Jonesboro, North Carolina. CP&L also rebuilt the Buckhorn to Fayetteville transmission line. Other plants in the system included a 1,000-kilowatt steam plant in Raleigh and a 75-kilowatt plant at Sanford.[54]

CP&L also began acquiring smaller electric companies in the state. In 1911, the Oxford Electric Company had been transferred to CP&L. That same year the North State Hydro Electric Company, financed by Electric Bond, was formed to build transmission lines. This company was soon acquired by CP&L. In 1912, CP&L acquired Asheville Power & Light Company as well as the electric system at Goldsboro, North Carolina.[55]

In 1916, CP&L acquired the Manchester hydroelectric plant on the Little River. The plant had been built in 1903 to sell wholesale energy to the town of Fayetteville. That same year, the company bought the Milburnie plant, which had been operated under a lease from the Raleigh Ice and Electric Company; this plant was dismantled two years later. As power demands increased in the state, CP&L directors authorized the acquisition of sites on the Yadkin and Rocky Rivers.[56] By 1918, CP&L had become a sizable company,

[52]Carr, 128-131.

[53]Riley, 57.

[54]Ibid., 32, 57-58, 63.

[55]Ibid., 70, 73.

[56]Ibid., 86-87.

supplying electric light and power in numerous cities on North Carolina. By 1926, CP&L customers had grown to 19,800.[57] Today, CP&L operates 19 power plants in North and South Carolina, and provides power to 1.2 million customers.

4. Notable Early Companies - Duke Power Company

The Duke Power Company was North Carolina's largest producer of hydroelectric power in North Carolina in 1940. The company operated ten hydroelectric plants throughout the state producing over 100 kw of electricity. The Duke Power Company's roots lay with three men: North Carolina tobacco heir James Buchanan (Buck) Duke, W. Gill Wylie, an engineer and physician who was involved in the early development of hydroelectric power, and William States Lee, an engineer from South Carolina. Wylie and Lee had organized the Catawba Power Company in 1900 and in 1901, they were granted a charter by the state of South Carolina to build and operate a hydroelectric station near Fort Mill. This plant supplied power to the Victoria Cotton Mills at Rock Hill, using water to turn the generators brought from the waterwheels.[58] By the end of 1904, transmission lines had been extended to the South Carolina towns of Rock Hill, York, Clover, Fort Mill, and Pineville, and to Charlotte, North Carolina.

Wylie, for whom Lee had built the Catawba plant, shared Buck Duke's interest in hydroelectric power. Dr. Wylie first met Buck Duke when he performed an appendectomy on him in 1899. In ensuing conversations with the doctor, Duke asked about the Catawba Power plant and its success. Duke then requested that Wylie bring Lee to him to discuss possible development of other similar hydro operations in the South. The result of this meeting between Duke, Wylie, and Lee was the organization of the Southern Power Company, with Mr. Duke raising the majority of funding. The company was founded on the idea of developing an entire river valley into a hydroelectric system that fed a transmission network serving customers throughout its territory.[59]

Buck Duke and his older brother Ben, in fact, had been following the development of alternative power sources since the 1890s. In 1897, Ben Duke received a letter from a North Carolina entrepreneur discussing the potential of using the Yadkin and Catawba Rivers for water power.[60] By 1899, Buck and Ben Duke organized The American Development Company to acquire land and water rights on the Catawba River and other water sites in North and South Carolina.[61]

Large investments by both Duke and Wylie enabled Lee to purchase property on which to construct another hydroelectric plant. On April 30, 1904, the Catawba Power Company's Catawba Hydro Station began operation on the Catawba River in York County, South Carolina. This company had been incorporated by Dr. Wylie and his associates and was later bought by Buck Duke and dissolved. Nevertheless, April 30,

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[57]Ibid., 91.

[58]*The Duke Power Company* (n.d., copy on file at Duke Power Company Archives, Franklin, NC), 4.

[59]Ibid.; William S. Lee, *Duke Power Company, The Roots that Nourish the Future* (Princeton: Newcomen Society of the United States/Princeton University Press, Publication No. 1279, 1987), 8-9; Joe Maynor, *Duke Power The First Seventy-five Years* (Albany, NY: Delmar, 1980), 13.

[60]Maynor, 14.

[61]*Duke Power Overview*, Duke Power Company, http://www.dukepower.com/aboutdukepower/history, 1.

1904 is seen as the birthdate of Duke Power Company.[62] By July 1905, Southern Power Company, the predecessor to Duke Power, was incorporated, with Buck Duke, his brother Ben, Dr. Wylie and his brother Robert, and three others, as the first board of directors.[63] The early concept for these hydroelectric plants was unique in that it called for multiple plants to be linked through transmission lines in order to carry power to an entire region as opposed to using one plant to power just one town.[64]

Southern Power built its first hydroelectric station, the Great Falls (South Carolina) Hydro Station in 1907. It consisted of two concrete dams whose spillways directed water into the canal. The bulkhead at the powerhouse had no spillway. The dams' spillways, however, were located in the main bed of the river, over a mile away from the powerhouse.[65]

By 1909, Southern Power had built the first double-circuit 100,000-volt transmission line in the country. It produced 18,000 horsepower. The line ran 143 miles, from Great Falls Hydro Station to Greenville, South Carolina.[66] Two years later, a 10,000 horsepower plant had been completed at Rocky Creek, two miles below Great Falls. Less than two years following Rocky Creek, Ninety-Nine Islands on the Broad River added 24,000 horsepower to the company's production output.[67]

In the early years of hydroelectric power in the Carolinas, Southern Power sometimes had difficulties selling its power to the textile mills. Alternating current electric power had gained notoriety as being the source of power used in many legal executions. Some mill owners therefore feared the use of electricity in their operations. To encourage mill owners, the Duke brothers began to invest in mills in the Piedmont. This financial backing from the Dukes succeeded in promoting the union between the textile industry and the hydroelectric companies as "New sources of power spawned new mills, and the South began to hum with its newfound industrial activity."[68]

In 1910, J.B. Duke became president of Southern Power, succeeding Dr. Wylie. In the same year, the Mill-Power Supply Company was created by Mr. Duke to sell equipment and supplies to textile mills in an effort to convert the mills from steam to electrical power. Mill-Power served as Duke Power's purchasing agent until 1989.[69]

Electric power had been originally developed for industrial uses only. But as more mill owners took advantage of hydropower, they began to bargain with Southern Power to make hydropower available to the residents of their mill communities. Residential electric power usage opened up new markets for Southern

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[62] Ibid., 2.

[63] Lee, 8-9.

[64] Ibid., 9.

[65] Maynor, 32.

[66] *Duke Power Overview*, 3.

[67] Ibid., 1; Maynor, 13, 32.

[68] Maynor, 34.

[69] *Duke Power Overview*, 2.

Power, beginning with household appliances. One of the first of these appliances powered by electricity was the iron:

> A Southern Power employee strapped a supply of them [electric irons] on the back of his bicycle and sold them door-to-door. He was the first appliance salesman for the company, and his success with the electric iron was the beginning of a whole new area of marketing.[70]

At the end of 1915, the first Southern Power hydroelectric plant in North Carolina, the Lookout Shoals Hydro Station in Iredell County, was completed. Located on the east side of the Catawba River, it was the first Duke plant to use vertical-shaft turbines.[71]

In July 1916, a series of cyclones and storms swept the Gulf coast of Alabama, resulting in overloaded streams and rivers jumping their banks causing widespread devastation throughout the region. Floods on the Yadkin and Catawba rivers and its tributaries washed out bridges, dams, and knocked down power lines, bringing power service to a halt. A rebuilding program by Southern Power began after the flood with crews working around the clock to bring power back on line.[72] Over the next several years, Southern Power constructed hydroelectric generating plants, transmission lines, and small stream stations. In the midst of this flurry of construction by Southern Power, the Southern Public Utilities Company, founded in 1913, served as the agency delivering electricity to businesses and homes.[73]

The subsidiaries of Southern Power were also busy building plants during the early 1900s. In 1919, the Wateree Power Company began operation at the Wateree Hydro Station on the Catawba River near Camden, South Carolina. The Dearborn Hydro Station began operation in 1923 and was operated by the Great Falls Power Company. This was followed later that year by the Mountain Island Hydro Station, built in Gaston County, North Carolina and operated by Catawba Manufacturing & Electric Power Company. The Western Carolina Power Company built the Rhodhiss Hydro Station in Caldwell County, North Carolina in 1925. Western Carolina also built the Oxford Hydro Station in 1928 in Catawba County, North Carolina.[74]

In late 1924, the Wateree Electric Company became the Duke Power Company. By 1927, the Southern Power Company and the Great Falls Power Company merged with Duke Power, followed by Southern Public Utilities Company merging with Duke Power in 1935. This now combined the generating and transmission operations with the retail distribution arm.[75]

For two decades, Southern Power's emphasis was on hydroelectric power. A severe drought in 1925 showed that it was unwise to depend on the rivers in the Piedmont to supply the increasing electricity requirements of the region. During the teens, engineer Lee had been constructing fossil fuel steam stations into the

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[70]Maynor, 36-37.

[71]*Duke Power Overview*, 5.

[72]Maynor, 41-42.

[73]*The Duke Power Company*, 4.

[74]*Duke Power Overview*, 5-7.

[75]Ibid., 2.

Southern Power system. These included stations at Eno, Tiger, Mt. Holly, and Greenville, South Carolina.[76] These stations were built to provide auxiliary power to the hydro plants and played a major role in the 1925 drought crisis. A few weeks before his death, Buck Duke authorized the construction of a steam plant and in 1926, the Buck Steam Station started operation. This plant burned pulverized coal, a first in the Southeast.[77]

One of the philosophies of James Duke for bringing hydroelectric power development in the Carolinas was to bring industry to an impoverished region. Duke believed that the textile industry centered in Fall River, Massachusetts could be duplicated in the Carolinas. He persuaded several northern textile manufacturers to move their operations south, where his hydroelectric plants could provide power to their plants. By 1927, his power system provided electricity to 3,000 textile mills and twenty Carolina cities.[78] Duke continued to increase its size through acquisitions of additional power companies after World War II and construction of additional coal-fired steam plants. During the 1960s and 1970s, the company built several nuclear power plants in the Carolinas and is today is one of the largest energy producers in the Southeast.

5. Hydroelectric Power in North Carolina to 1955

Through the efforts of Alcoa, Carolina Power & Light, Duke Power, and other smaller companies, North Carolina rapidly emerged as a leading producer of hydroelectric power in the 1920s. However, most of this power went directly to industry rather than residential and commercial customers. A water and power census in 1923 noted that since 1910, North Carolina had moved from twenty-third to tenth place in the value of its industries and from nineteenth to fourth in crop value. The total horsepower for the state was 360,000 divided between Southern (Duke) Power Company, Carolina Power & Light, Alcoa, Blue Ridge Power, and North Carolina Power. Thirty-two percent of this power was transmitted for use out of state and thirty-one percent went to use in the reduction of aluminum at the Alcoa Badin plant. The remaining forty-six percent went to private manufacturing in the state. Therefore, the only power available for use by the public had to be generated by public utility companies.[79]

This census further estimated that at the current rate of growth and power usage, North Carolina would need to increase its hydroelectric power capabilities. To further utilize the water resources of the state, the census also observed it would be vital to develop water storage facilities, steam auxiliary plants, and interconnection of power units. Storage reservoirs were vital to supply water in times of drought, for flood control, and for river navigation. Since there was a deficiency in water storage facilities in the state, steam power would be used in times of hydropower shortages. To further avoid power shortages, the power units would be interconnected to distribute excess power to other plants in times of need.[80] North Carolina continued to show tremendous increases in the power and transmission industry. From 1919 to 1923, the total output of electrical energy had increased over 100 percent, while the total output for 1923 exceeded one billion kilowatt hours.

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[76]Lee, 9; Maynor, 43.

[77]Lee, 9.

[78]Ibid., 16.

[79]Thorndike Saville, *The Water-Power Situation in North Carolina* (Chapel Hill: Circular No. 2, North Carolina Geological and Economic Survey, Water Resources Division, 32d Report, North Carolina Department of Labor and Printing, 1922), 5.

[80]Ibid., 13-14.

The census predicted that the rate of power produced in the state would increase in the coming years because the larger utility companies planned to construct several new waterpower developments.[81] These developments included the impoundment of rivers to create new reservoirs, and a steady supply of water power. The North Carolina Geological and Economic Survey had investigated several potential sites for hydropower facilities in Wilkes, Surry, Clay, Cherokee, and Randolph, Stokes, and Moore Counties. The survey had also determined that large, undeveloped power could be found on the Hiwassee, Nottely, French Broad, Watauga, Toe, and New rivers in western North Carolina and on the Yadkin, Deep, Haw, Dan, and Cape Fear rivers in the central part of the state.[82]

By 1924, North Carolina hydropower plants were producing 540,500 total horsepower. Tallassee Power Company (Alcoa), with the Badin, Yadkin, and Cheoah plants, was the largest producer. Next followed Southern (Duke) Power Company, with the Bridgewater, Lookout Shoals, and Mountain Island plants and Carolina Power & Light, who operated the Blewett Falls and Buckhorn Falls plants. Smaller companies included Blue Ridge Power Company (Tuxedo and Turner plants), North Carolina Electric Power (Ivy, Marshall, Weaver), Sandhill Power (Carbonton), Deep River Power Company (Lockville), and Roanoke Rapids Power (Roanoke Rapids).[83] In 1924, North Carolina ranked fourth in the United States in the amount of developed waterpower.[84]

Throughout the decade of the 1920s, the South had emerged as a leading producer of hydroelectric power in the country. The electric power production in the South increased by more than 700 percent from 1912 to 1929, while electric power in the rest of the country increased by 400 percent. North Carolina remained fourth in the country in hydroelectric development with Alabama, South Carolina, and Georgia ranking third, sixth, and seventh respectively. The use of interconnected transmission lines was also formulated in the South, and in 1931 when North Carolina experienced a drought, water power from Alabama and Tennessee kept power supplied to the state.

With the coming of the Great Depression, little new construction of hydroelectric plants occurred in the state in the 1930s. However, with the outbreak of World War II the need for additional power spurred the construction of both the Thorpe and Nantahala Hydroelectric Plants for Alcoa. Following World War II, several additional dams and reservoirs were built in the state to provide both hydroelectric power and flood control. By the mid-1950s however, other forms of energy such as steam power and nuclear power came into favor over hydroelectric power. These new forms of electrical generation would surpass the use of hydroelectric power to the point that by the mid-1970s, hydroelectric power provided only about five percent of Duke Power's electricity. Growing environmental concerns over the continued damming of the state's rivers and streams also arose in these decades. The trend away from construction of hydroelectric plants in North Carolina continued until the end of the century.

A comprehensive list of North Carolina hydroelectric plants known to be placed in operation before 1955 are located in Appendix A. Substantive data on the state's hydroelectric plants built prior to 1940 was

[81]Ibid., 8, 10.

[82]Thorndike Saville, *The Power Situation in North Carolina* (Chapel Hill: Circular No. 10, North Carolina Geological and Economic Survey, Water Resources Division, 32d Report, North Carolina Department of Labor and Printing, 1924), 21.

[83]Ibid., 4.

[84]Ibid, 4-6.

developed by Duncan E. Hay in his study "Hydroelectric Development in the United States, 1880-1940." His lists of operating and retired plants are located in Appendices B and C. Additional information from other published sources was used to develop the list from 1940 to 1955.

V. THE HYDROELECTRIC PLANTS OF ALCOA AND THE NANTAHALA POWER & LIGHT COMPANY

The mountains of western North Carolina are rich in such natural resources as timber, wildlife, and one of its greatest resources, water. Early settlers to the region quickly exploited the rich water resources they found by constructing mills on the mountain streams. These machines ground grain and provided power to belt-driven machinery. With the use of electricity spreading throughout the country, people began to look toward water as a source to produce power.[85] One of the first men in the region to experiment with electric generation was C.J. Harris, from Jackson County. In 1909 Harris built a dam and small hydroelectric plant at Dillsboro. This plant has been rebuilt and is now part of the NP&L system.[86]

Beginning in 1910, the Aluminum Company of America (Alcoa), began to acquire property in North Carolina for its planned hydroelectric developments. Much of this purchased land included the headwaters of the Tuckasegee, a large river with terrain that was ideal for a high-head hydropower plant. Alcoa gained riparian and power rights along the mountainous waterways through the purchase of the Knoxville Power Company and the Union Development Company in Tennessee, and the Tallasee Power Company in North Carolina.[87] In March, 1914, Alcoa began operations at its large new smelting plant at Alcoa, Tennessee, the largest aluminum plant in the country.[88]

To supply the new Tennessee facility with power, Alcoa built its own dams and power stations along the Little Tennessee and its tributaries. These hydroelectric developments include Cheoah, Santeetlah, and Calderwood. The falling water from the dams flowed through the penstocks and into the turbines to create electricity. The power then traveled from the powerhouses via transmission lines to the reduction works at Alcoa, Tennessee. Cheoah Dam in Tennessee was the first to be constructed, and began operation in April of 1919. Its dam of 225 feet was the highest overfall dam in the world to date, and the powerhouse operated at a 110,000 KW capacity. The Santeetlah Dam in North Carolina was completed in June of 1928 with a 212 foot dam. At this location a five-mile tunnel and pipeline were constructed for water from the associated reservoir to travel to the powerhouse, which has a 45,000 KW capacity. The Calderwood Dam in Tennessee, completed in April of 1930, has a 232 foot high dam and a 121,500 kv capacity powerhouse.[89]

In 1915, Alcoa purchased the floundering Southern Aluminum Company of North Carolina. The company had initiated a smelting operation and waterpower site at Badin on the Yadkin River, located in the Piedmont area of North Carolina. Alcoa completed a dam and powerhouse and the plant began operating in July, 1917. Later dams were constructed at Yadkin Falls in 1919, and High Rock in 1927.[90]

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[85]McRae, 1.

[86]Ibid..

[87]Smith, 96; Carr, 93-94.

[88]Carr, 94.

[89]Ibid., 95-96; 106.

[90]Carr, 100-102; Smith, 96.

In 1929, the Nantahala Power & Light Company (NP&L), a wholly-owned Alcoa subsidiary, was formed. NP&L served as a public utility company that provided electric power for residential and commercial use in the Great Smoky Mountain area of North Carolina. Its key role was to develop power sites that had been owned by the Tallassee Power Company, which Alcoa had purchased in 1914. NP&L's first operations began in August of 1929 in Robbinsville, North Carolina providing power to 86 customers. Later that year, the company acquired the distribution system for the town of Andrews and the Mission Dam and Powerhouse which was built in 1924. The main company office was first located at Bryson City but moved to Franklin in 1937.[91]

Over the next several decades, NP&L acquired a number of small dams and powerhouses in the region, and constructed others. The Franklin Hydroelectric Plant was acquired by NP&L in 1933. Built in 1925, the dam and powerhouse supplied electricity to the municipal customers of Franklin. By the time of the Depression, the town had sold the facility to Northwest Carolina Utilities, who let the plant fall into disrepair. In 1933, Northwest Carolina let the plant revert back to the town. In May of that year, the management of the plant was taken over by NP&L, and in November of 1933 the company bought the plant from the town.

During the 1930s and 1940s, Alcoa came to work closely with the newly formed Tennessee Valley Authority (TVA), a governmental authority which focused on power development and flood control in the entire valley of the Tennessee River and its tributaries, which include the Little Tennessee River. Having been operating in the area for twenty years, Alcoa had obtained over 200 miles of land along the Little Tennessee River and its tributaries. This included large amounts of land in the Fontana basin, where TVA planned to construct a large dam. Alcoa and TVA worked out an agreement in which Alcoa relinquished its properties in the Fontana region (a tract of close to 15,000 acres) as well as the engineering data it had assembled on dam construction for the area. TVA then agreed to construct a large dam and reservoir that would regulate the flow of water to Alcoa's Cheoah and Calderwood hydroelectric systems further downstream.[92]

With this agreement, Alcoa's water power operations became integrated with those of TVA. The Fontana Dam was completed in 1942 with a height of 477 feet and a capacity of 202,600 KW. Working together, the company and government agency were able to create the "maximum production of electric energy from the available water power" in the region.[93] The agreement between the two organizations and the construction of Fontana Dam were spurred on by the growing need for hydroelectric power brought on by World War II.

The beginning of World War II accelerated Alcoa's development of hydroelectric power in western North Carolina. When President Franklin D. Roosevelt ordered the War Department to send B-17 Flying Fortresses to England, he was dismayed to learn that the United States had only 49 bombers fit to fly. The nation then began a program of increased aluminum production.[94] As one of the major suppliers of aluminum during World War II, Alcoa played a major role in America's victory over the axis powers. The United States Military Aircraft Program fueled the need for sheet metal, and in October of 1940, the company began construction of a large sheet mill at Alcoa. This mill was designed to have a monthly capacity of five-million pounds.

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[91] *Thorpe Plant: Middle-aged but Still Full of Energy* (http://www.nantahalapower.com/glenville.html), 1-2.

[92] Carr, 96-99.

[93] Ibid., 99.

[94] McRae, 2.

Overall, wartime needs increased aluminum production in America by 500 percent, and aluminum was used for submarines, quonset huts, and other products. Aluminum's most significant use was in aircraft production. Air power played a dominant role in the victory of the Allies. Aircraft carriers became the most important surface ships on the ocean surpassing battleships. Attack aircraft led to major victories for America and its allies. The air campaign of the US Army Air Force and the Royal Air Force greatly disrupted Germany's industrial production, and diverted valuable resources away from offensive weapons to air defense. These achievements were gained above all by the "Allies' enormous industrial capacity which was the foundation of their air power."[95] By the beginning of 1945, Allied aircraft outnumbered their opponents by at least five to one.

Much of the focus of Alcoa's production was for the manufacture of bombers such as B-17s and B-24s. To respond to war demands, Alcoa's subsidiary, NP&L, constructed the Nantahala and Glenville (Thorpe) facilities in 1942. Begun in the late 1920s, construction of the Nantahala Dam by NP&L was suspended with the coming of the Depression. Work began again in 1940, and by June of 1942 the dam and powerhouse was completed. It was the company's second largest dam with a 251-foot rock-fill and a sloping earth core dam that proved to be economical and reliable and served as a model for later design and construction techniques at NP&L. Completion of the Nantahala facility was followed by the construction of the Glenville (Thorpe) Hydroelectric Plant in 1942. When the dam was dedicated its 1,462-acre lake was full. Three and one-half miles of tunnel and pipeline at the intake at the reservoir carried water to the powerhouse, 1,200 feet below the lake. In the *Engineering News-Record* of February 1942, Alcoa describe the construction of their Glenville and Nanatahala facilities as "More Power for Bomber Production."[96] The company boasted that an additional 1,230 B-17 "Flying Fortress" bombers would be produced through increased electrical generation.

In addition to the construction of the Nantahala and Glenville (Thorpe) facilities, NP&L purchased the Bryson City electric power system in 1942. Built on the Oconaluftee River, it consisted of a multiple arch type concrete dam, 241 feet long and 34 feet high; a brick power house that contained two hydroelectric units of 700 hp capacity each; a 6.6 mile, 12 kv transmission line running from the Bryson City Plant to Cherokee, North Carolina; a distribution system in the Town of Bryson City to Substation Bryson City; and a 60 year franchise granting NP&L exclusive rights to operate the distribution system. At the time of acquisition, 704 customers received power from this system.[97]

After World War II, NP&L, with its transmission and generating systems completed, began a program of rural electrification. From the close of the war till 1952, company crews built an average of 144 miles of distribution lines per year. By 1952, NP&L served 95% of area residents in its service area, with a customer base of 8,373. A shift in the aluminum industry also accelerated the company's need for electrical power. Following World War II, the War Surplus Property Board (SPB) sold the government subsidized plants that Alcoa had built and operated during the war, which resulted in the emergence of Alcoa's first major competitors in the aluminum business. The two main corporations that benefited from the sale were Reynolds Aluminum and Kaiser Aluminum. Both companies quickly became fully integrated producers. Alcoa, however, remained the top producer in the industry and in 1950 produced 50.86 percent of the market while Reynolds and Kaiser produced 30.94 and 18.20 percent respectively.[98]

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[95] I.C.B. Dear, ed. *The Oxford Companion to World War II* (New York: Oxford University Press, 1995), 22.

[96] *Engineering News-Record*, February 26, 1942, 56.

[97] *Thorpe Plant*, 1-7.

[98] Smith, 240-242.

As it turned out there was plenty of room for competition as the use of aluminum increased in the postwar years. Many industries were introduced to the metal during World War II, and consumption of the product rose as an inexpensive surplus was available at the war's end. By the mid-1950s, per-capita consumption of aluminum had doubled that of the pre-war era.[99] Another impetus to the aluminum industry in the 1950s was the United States involvement in the Korean Conflict and the Cold War. U.S. entry into the war in Korea prompted a new round of military purchases of aluminum. In December 1950, the Office of Defense Mobilization announced the "Controlled Materials Plan," in which primary aluminum producers "were authorized to increase capacity under accelerated five-year amortization certificates covering eighty-five percent of the investment costs."[100] Any surplus product that could not be sold commercially was to be purchased by the government for a stockpile. The nuclear arms race of the Cold War also drove government stockpiling of aluminum, which it anticipated might be needed in the event of a nuclear war. In a meeting with a member of President Dwight Eisenhower's Cabinet, aluminum executives were essentially told that "some towns like Washington might be put out of business, or Pittsburgh would, but the rest would go on and they'd use this aluminum to manufacture planes and defend themselves."[101]

Militarily, much of the Cold War was characterized by a continual readiness on the part of the United States to go to war, and aircraft were essential components of the country's ability to maintain a permanent state of military mobilization. Initial American Cold War strategy was one of deterring and, if necessary, repelling a Soviet invasion of western Europe, using nuclear weapons if necessary to stop numerically superior Soviet forces. To support this strategy, the United States maintained ground troops in western Europe and established a capability in the United States for quickly deploying atomic bombs, and the airplanes capable of delivering them, to Europe.

Soviet offensive forces required a constant vigilance by the U.S. military to detect any surprise attack and to defend critical military, industrial, and population centers within the U.S. The U.S. also developed reconnaissance systems capable of maintaining continual surveillance of military and industrial targets in the Soviet Union, and developed offensive forces capable of destroying them. Both defensive and offensive forces were embodied in aircraft. Defensive aircraft included fighter interceptor planes, such as F-86A jets, whose mission it was to intercept, identify, and if necessary, destroy enemy aircraft. The B-52 bomber became the principal aircraft of the Strategic Air Command (SAC) offensive mission during the Cold War. The SAC received its first B-52 bomber in 1955.[102]

Aircraft also proved indispensable during the Korean Conflict. The airpower of the U.S. Air Force, including B-29 bombers, F-86 Sabre fighters, and F-84 Thunderjets, were key instruments in U.S. victories in Korea. General James A. van Fleet is quoted as saying "The war that does the most damage to the enemy is from the air."[103] Airpower proved to be the decisive factor in the conflict. As a major producer of

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[99] Ibid., 250-251; Donald Albrecht, ed., *World War II and the American Dream*, (Cambridge, MA: MIT Press, 1995), 80.

[100] Smith, 253.

[101] Ibid., 254.

[102] SSgt Mark P. Stanley, *A Brief History of the 416th Bomb Wing and Griffiss Air Force Base, New York* (New York: Griffiss Air Force Base, 1994), 13.

[103] Martin Caidin, *Air Force, A Pictorial History of American Airpower* (New York: Bramhall House, 1957), 206-209.

aluminum, Alcoa played an important role in supporting the US military during the Korean War and the Cold War era.

Aloca's growth in the post World War II era reflected that of the industry, and the company continued to be the leading producer of aluminum despite the emergence of competitors. Immediately after the war, the demand for aluminum dropped, and Alcoa responded by creating a variety of new aluminum products for consumers, including building materials. A whole new range of aluminum products emerged such as exterior siding materials, windows, doors, and commercial storefronts. Alcoa constructed a new headquarters building in Pittsburgh in 1953 with an exterior of pre-fabricated aluminum panels, and buildings with aluminum facades became widely accepted.[104] The greatest surge of Alcoa's postwar investment occurred between 1950 and 1956 due to the government-sponsored aluminum stockpile program, which provided a guaranteed market for the metal. During the 1950s, "the immediate need for aluminum for conventional war applications was pressing enough to strain Alcoa's capacity to serve its domestic markets."[105]

Between 1949 and 1958, Alcoa increased its primary capacity 2.7 times, while the industry overall increased 3.6 times. Alcoa's share of the market decreased somewhat due to the rise of its competitors; however the company continued to maintain its role as industry leader. In 1958, Alcoa held thirty-eight percent of the total U.S. capacity, compared to twenty-seven and twenty-four percent respectively for the Reynolds and Kaiser corporations.[106] Alcoa was particularly important to the economy of East Tennessee, especially Blount County, "in jobs, schools, economic advancements, and municipal additions. By 1960 Alcoa's investment in Blount County brought the county from eighty-fifth of Tennessee's ninety-five counties in assembled wealth to the top ten."[107] Alcoa also financially supported the construction of McGhee-Tyson Airport, which serves Knoxville and East Tennessee.

One aspect in which Alcoa differed from its new competitors was its continued involvement in producing its own energy. Other aluminum manufacturers purchased power for their plants from private energy companies. Alcoa continued to own and operate its power sources. The company considered electricity as an ingredient in aluminum and regarded the production of power as a long-term cost advantage.[108] To provide additional power to its system, NP&L built a number of small dams and powerhouses in the late 1940s and early 1950s.

Construction on the Queen's Creek plant by the NP&L began in 1947. An earth and rock dam and spillway was completed, and a powerhouse was built near the Nantahala Powerhouse. To provide more water for the Nantahala complex, NP&L had built two small dams at White Oak Creek and Dicks Creek in 1949, whose discharges diverted into the Nantahala tunnel. The Dicks Creek Dam was made of concrete and stood 12 feet high and 50 feet long. The dam at White Oak Creek was concrete, 110 feet long and 15 feet high.[109] A

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[104] Ibid., 250-251; Albrecht, ed., 80.

[105] Smith, 254.

[106] Ibid., 256.

[107] Tara Mitchell Mielnik, "Blount County," in *The Tennessee Encyclopedia of History and Culture*, Carroll Van West, ed. (Nashville: Rutledge Hill Press, 1998), 73.

[108] Ibid., 254-255.

[109] Aluminum Company of America (Alcoa), Alabama Power Company, Tennessee Valley Authority, and the

small diversion dam known as Diamond Valley Dam was also built in 1949, and directs water into Dicks Creek.

In 1949, construction began on the Tuckasegee Development, on the West Fork of the Tuckasegee River, 0.45 mile downstream from the Thorpe (Glenville) Powerhouse. Plans called for a concrete arch dam 58 feet high and 324 feet long; a 13-foot diameter tunnel; a powerhouse; and a transmission line to the Glenville Power House. In April of 1949 work was completed on the plant and it went into operation in May of 1950.

Construction also began in September of 1950 on the Cedar Cliff Hydroelectric Plant on the East Fork of the Tuckasegee River, 2.3 miles upstream from Tuckasegee, North Carolina. The plant contained an earth and rock fill dam 170 feet high and 580 feet long, a 15-foot diameter tunnel, and a powerhouse. The generator is a vertical turbine at 170 feet head. A 66 kv transmission line connected the plant to the Thorpe Powerhouse. The tunnel that was used for diversion during construction became a permanent power tunnel. Work on the plant was completed by 1952.[110] By 1955, NP&L had also constructed the Bear Creek, Wolf Creek, and the Tennessee Creek Developments to provide additional power to the Thorpe facility.

In 1957, NP&L purchased the Dillsboro and Sylva Electric Light Company. The plant, originally built in 1913, consisted of a concrete dam ten feet high and 230 feet long, and a wooden frame metal powerhouse with two generators that served around 2,200 customers in the towns of Dillsboro, Sylva, and Webster. This plant was badly damaged by a flood in 1940 which washed away most of the powerhouse. When NP&L acquired the plant, it was out of service. Company employees rehabilitated the equipment and increased the dam's height by two feet. The plant was put back into operation in January of 1958.[111]

During the 1960s, NP&L continued to be an important supplier of electric power in the region. In 1971, with customer growth making it impossible to meet demand, NP&L began purchasing power from the Tennessee Valley Authority. A new era at NP&L began in 1988 when Duke Power Company purchased NP&L from Alcoa. Duke then began upgrading the NP&L system, and in 1991 the NP&L system was connected to Duke's at Tuckasegee.[112]

In 1997, NP&L moved into new corporate headquarters in Franklin. By this time, the automation of its hydroelectric plants had been completed. In 1998, NP&L became a division of Duke Power. Today, Duke Power - Nantahala Area serves around 58,000 customers in six counties in southwestern North Carolina, and border sections of Tennessee, Georgia, and South Carolina.[113]

United States Army Corps of Engineers, *Alcoa's Hydroelectric Developments in the Smoky Mountains* (Pamphlet prepared in conjunction with the Sixth International Congress on Large Dams, New York City, 1958), 21.

[110]Alcoa, et. al., 24-25; *Thorpe Plant*, I-13-14.

[111]Barbara McRae, *The Dillsboro and Sylva Electric Light Company* (Franklin, NC: Nantahala Power & Light Company, n.d.), 4; *About NPL* (http://www.nantahalapower.com/aboutnpl.html, 1999), I-36-37; Nantahala Power and Light Company, *Nantahala Power and Light Company* (Franklin, NC: n.p., 1952), 8.

[112]*NP&L History* (http://www.nantahalapower.com/history.html, 1999), 2.

[113]*About NPL*, 6-7.

VI. HYDROELECTRIC POWER AND NATIONAL REGISTER ELIGIBILITY

1. Significance of Hydroelectric Power in North Carolina

Generally, hydroelectric power plants can be significant under NRHP criteria A and C. These facilities will most often have the potential to be significant under NRHP criterion A in the categories of Commerce, Military, Industry, and Social History. Under NRHP criterion C, hydroelectric power plants may be significant for their architectural or engineering design or engineering components. Hydroelectric power plants may also be significant under criterion C for their association with a master builder, architect, or engineer.

Criterion A - Significance in Military

Hydroelectric plants in North Carolina may be significant for their pivotal role in supplying power for important defense industries prior to 1955. The most obvious example of this role of hydroelectric power is the construction of the Nantahala and Thorpe (Glenville) projects from 1940 to 1942. These hydroelectric plants were built in direct response to concerns over the availability of aluminum production at the Alcoa facility near Maryville, Tennessee. Alcoa was the principal producer of aluminum which was a vital component in the military. Aluminum was used in the production of aircraft, shipbuilding, and other essential weapon systems.

The necessity for an increase in aluminum production at Alcoa was apparent by the late 1930s, and the Nantahala project was begun in response to this need. Following Pearl Harbor, America's need for aluminum greatly increased, and Alcoa built a new plant in 1942 to fulfill these demands. This requirement for additional electrical power for the Alcoa complex led to the construction of the Thorpe plant in 1942. The construction of the Nantahala and Thorpe Hydroelectric Plants are directly tied to the country's military efforts of World War II, rather than simply an increase in overall industrial production. Upon their completion, Alcoa described the electricity from these plants as going directly into bomber production at their plants. Additional hydroelectric plants in North Carolina may also be identified as significant in the country's defense prior to 1955.

Criterion A - Significance in Commerce and Industry

Hydroelectric power had an interrelated impact on the growth and development of commerce and industry in North Carolina. The availability of electrical power led to a dramatic increase in industrialization in the state, particularly in the textile, furniture, and tobacco industries. The development of these industries in turn, led to the creation of hundreds of related businesses supplying the goods and services of these industries to consumers.

The industrialization of America began with the advent of machines powered by steam and coal, but industry took a dramatic leap forward with the availability of affordable electric power from utilities. Prior to the widespread use of electricity, industries depended on complex systems powered by steam, coal, or small electrical motors for their production. The *Report on Manufacturing Industry in the United States at the Eleventh Census:1890*, reporting on the year 1889, stated that 208 out of 360 industries used stationary electric motors.[114] Even with more than half of America's industry creating products with the aid of the

[114] Richard B. DuBoff, "The Introduction of Electric Power in American Manufacturing," *Economic*

motors, many industries were limited by the power sources of these motors. Power, such as steam, adversely affected the size, location and design of factories and machines.[115] Before electric power, most factories required a prime mover such as a water wheel or steam engine. This source of power turned "line shafts" with pulleys and leather belts. The shafts were often three inches in diameter, suspended from the ceiling and ran the entire length of the building. Power was distributed to other floors via holes in the ceiling. Because these shafts were a fire hazard many factories opted to build expensive belt towers. The entire system worked continuously throughout the building no matter what machines were in use or disuse. If any problems occurred with the system, a full room of machines or the entire factory shut down until repairs could be made.[116] In addition, regular maintenance of the system was time consuming.[117]

At the turn of the century most factories depended on this costly and cumbersome power from steam or coal. Only four-percent of manufacturing power came from electricity.[118] However, by the 1920s, more than half of industry used electricity.[119] In 1920, manufacturing was the largest user of electricity in the United States economy.[120] In North Carolina, textile mills supplied with electric power grew from thirteen to three hundred in just twenty years.[121] The advent of electricity in manufacturing had a positive impact, however; many manufacturers continued to use electricity in the same way as they did coal and steam, as a direct-line system. Electricity truly became an asset to manufacturing when affordable electricity via utilities became more prevalent around 1910. Companies such as Southern (Duke) Power, Carolina Power & Light, and Alcoa were all major suppliers of hydroelectric power to North Carolina's industries during these years. In the book, *The Bright-Tobacco Industry 1860-1929*, the author directly credits Southern Power Company with North Carolina's tremendous industrial growth. "That James B. Duke's project in the development of hydroelectric power in the Carolinas aided in the remarkable growth of the southern textile industry is a well-known fact. Certainly the period of greatest expansion came after this prodigal outpouring of tobacco wealth into the formation of the Southern Power Company."[122]

Electricity spread quickly throughout North Carolina's industries because of the benefits in cost and efficiency. First, factories received more energy for their dollar with electricity. Steam generated a great deal of energy loss through condensation and inefficient belts and shafting. Within the state, cotton manufacturers saved five million dollars per year by not using the coal and boilers necessary for steam

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History Review, New Series Vol. 20, No. 3 (December 1967): 509.

115 Arthur G. Woolf, "Energy and Technology in American Manufacturing: 1900-1929," *Journal of Economic History* Vol. 42, No. 1 The Tasks of Economic History (March, 1982): 230.

116 Warren D. Devine, Jr., "From Shafts to Wires: Historical Perspective on Electrification," *Journal of Economic History* Vol. 43, No. 2 (June, 1983): 352

117 Devine, 352.

118 Woolf, 230.

119 Ibid., 230.

120 DuBoff, 510.

121 Nannie May Tilley, *The Bright-Tobacco Industry 1860-1929* (Chapel Hill: University of North Carolina Press, 1948), 639.

122 Ibid., 639.

plants.[123] Second, electricity resulted in more efficient machines. Individual machines could be shut off and motors could be directly incorporated into a machine or tool. Third, electricity meant that factories could greatly enhance mass production and batch processing. The layout of workspace could be efficient without the limitations of placing machines near belts and shafts.[124]

Electric power combined with North Carolina's improved transportation, mild climate, abundant labor, and proximity to raw materials, such as cotton, tobacco and lumber placed North Carolina in the lead for industrialization in the Southeast. By mid-century, it became the largest producer of cotton textiles, tobacco products, and wooden furniture in the country.[125] The state experienced dramatic increases in manufacturing, and labor and wages between 1900 and 1951. In 1900, the value of manufacturers was $95 million, but by 1951 it increased to $6.1 billion. Industrial laborers also increased from 70,750 to 402,631 during the same period. Wages increased from $1.4 million to $788 million.[126] Individual industries also experienced dramatic increases. The tobacco industry was valued at $16 million in 1900 and $1.2 billion in 1951. Textiles rose from $30 million to $2.6 billion during the same period.[127]

These increases would not have been possible with power derived from steam, coal or even direct-line electric motors. It was the advent of affordable power from a central location, such as Southern Power Company or Carolina Power & Light, that enabled North Carolina's factories to grow and become more efficient producers. In addition, electricity opened the door for new types of manufacturing to experience the benefits of industrialization. Electricity changed North Carolina's place in the southeast from a producer of raw goods to a leading industrial force.

An example of a hydroelectric plant's contribution to industry was the Badin Works in Stanly County. Developed in the early 1900s, the Narrows Hydroelectric Plant was built for the smelting of aluminum. Acquired by Alcoa, the dam and powerhouse were completed in 1917, and over the next decade this industry employed over one thousand men and women. The Narrows Dam and Power Plant Complex was listed on the NRHP in 1983 for its significance in the industry.

Criterion A - Significance in Social History

Hydroelectric plants in North Carolina gradually brought electric power into the cities and rural areas of the state. The widespread use and availability of electricity changed many aspects of everyday life. The impact of electricity on the social fabric of the South in general, and North Carolina in particular, has been the subject of increasing study in recent decades. The coming of electricity transformed many aspects of everyday life such as farm operations, food storage and preparation, and healthcare. Electricity's role in the urbanization of America is also significant. Because of the potential importance of hydroelectric power in social history, this category of significance is explored in more detail than the other categories in this study.

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[123]Ibid., 639.

[124]DuBoff, 511-513.

[125]Blackwell P. Robinson, ed., *The North Carolina Guide* (Chapel Hill: University of North Carolina Press, 1955), 98.

[126]Ibid., 98.

[127]Ibid., 98.

In 1910 more than half of the American population lived on farms, and only small towns and urbanized areas had been served by electricity.[128] Yet, the management of utility companies chose not to extend their lines out to these families because they did not feel it would be profitable. Farms were spread out and people were gradually leaving rural areas for the cities. Utilities believed there was no profit to be had by extending power lines into such hard to reach areas, for such a small customer base. Ten years later, the same thinking continued to prevail, placing rural America far behind its European counterparts. In Europe, more than two-thirds of German, French, Dutch and Scandinavian farmers were working with the aid of electricity.[129] In that same year, only 600,000 American farms were electrified, and the majority of those were in the northeast and far west.[130] As late as 1934, ninety-six percent of southern farms still did not experience the benefits of electricity.[131]

Most farmers expressed a willingness to incorporate electricity into their daily routines. One farmer whose house was near an electric line but not close enough to connect in, built a new foundation and moved his house.[132] Farmers, who could afford it, generated their own electricity with water motors, small private dams, and gasoline or kerosene powered systems.[133] These means of electricity were limited. They did not have the power to run machinery 24-hours a day or to electrify both the barn and home. In addition, farms capable of providing their own electrification were privileged and few.

The formation of the National Electric Light Association in 1910 was the first attempt to help the plight of farmers but little was done until the 1930s. It was the lean-times of the depression and the social and moral views of Franklin Roosevelt that helped focus attention on rural electrification. Roosevelt viewed farms, not only as the producers of goods, but also as the producers of America's moral center and the backbone of democracy.[134] That moral foundation was under siege, largely due to the Depression, America's farms were undergoing a transformation. Children, who once worked the farms with their parents, moved to the cities for greater job opportunities and a higher standard of living. Farm couples, ready to retire, chose to retire to the city in order to also reap the benefits of modern conveniences after a lifetime of backbreaking labor.

Roosevelt, and others, feared this flight from rural to urban communities and the possible negative changes it would bring to American society. In addition to his goal to assure the nation's moral future, Roosevelt felt it was important to provide everyone in the country with a minimal standard of living and rights.[135] In response, he created the Commission on Country Life to determine what could be done to curb the exodus from farms. The Commission concluded that the best way to encourage people to choose an agricultural

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[128]David E. Nye, *Electrifying America: Social Meanings of a New Technology, 1880-1940*. (Cambridge & London: MIT Press, 1991), 32.

[129]Ibid., 287.

[130]Ibid., 297.

[131]Gus Norwood, *Gift of the Rivers, Power for the People of the Southeast: A History of the Southeastern Power Administration* (Washington,: U.S. G.P.O., 1990), 7.

[132]Nye, 323.

[133]Ibid., 294-5.

[134]Ibid., 88.

[135]Ibid., 304.

lifestyle was by making rural life as attractive as urban life. And to do that meant offering the type of life people could find in the cities.[136]

Roosevelt took his second step in 1934 with the Tennessee Valley Authority Act, an experiment with which Roosevelt hoped to develop the rural Tennessee Valley, raise its standard of living, and provide electric power for seven states in the southeast. A year later, he created the Rural Electrification Act, designed to make electricity more accessible to the isolated and low-income rural areas. The REA offered low-interest loans to rural cooperatives, which would provide electric power at prices the farmers could afford.[137] In order to receive an REA high-line, interested residents needed only guarantee that at least three families per mile would use the line. A non-REA line could cost a family as much $2000, but an REA line with its cheaper cost and split bill between at least three families, might only cost each family as little as $333. This was still a sizable sum for most families so the REA also offered loan plans, not only for the line, but also for wiring their homes and farm buildings, and for buying appliances and equipment.[138] Just one example of the REA's success is evident in education. After five years of the REA 12,000 rural schools boasted electric power.[139]

Electricity on the farm was a major event that dramatically changed people's lives. In 1958, Paul Tidwell, manager of Merewether Lewis Electric cooperative, which served Middle Tennessee, remarked on how electricity impacted rural areas. "There has been a revolution in living standards of the city homes in the Tennessee Valley, but it's been nothing like the revolution in the rural home. There, 100 years of normal change and progress have been compressed into 25." In 1964, Aaron Jennings of Lincoln County, Tennessee remembered that, before electricity, babies were born by kerosene lamps. He would start his workday in the milking barn at 4 am with a lantern.[140] Women in Iowa remarked in a survey that the acquisition of electricity was the "most significant change in their lives" outdistancing even the impact of gasoline tractors.[141] In 1937, Alice Cole of Boone County Iowa said in "Wallace's Farmer," "electricity has completely changed our home."[142]

The most immediate result of affordable and obtainable electricity was simply the change created in a farm family's daily life and work routine. In the late 1930s the difference in lifestyles between rural and urban areas was dramatic. Farmers lived the same way as Americans did in the 18th and 19th centuries.[143] In the

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[136]Katherine Jellison, *Entitled to Power: Farm Women and Technology, 1913-1963*. (Chapel Hill & London: The University of North Carolina Press, 1993), 2-3.

[137]Russell Mills and Arun N. Toke with Susan Mills, *Energy, Economics, and the Environment*. (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1985), 367.

[138]Jellison, 99.

[139]Nye, 322.

[140]*Tennessean* (Nashville), 25 October 1958.

[141]Jellison, 111.

[142]Ibid., 18.

[143]Theodore Saloutos, *The American Farmer and the New Deal*. (Ames: The Iowa State University Press, 1982), 208.

Tennessee Valley only 1% of farm homes had indoor plumbing.[144] Union County, Tennessee had no electricity at all in 1926.[145] People hand-pumped water and heated it on wood or coal stoves. The average farmhouse used 40 gallons of water per day.[146] Just one cow required about 25 gallons of water a day. A United States Department of Agriculture report estimated that 10 hours per week was spent pumping and transporting water on rural farms.[147]

Electricity most notably benefited the farmer in time and labor saved. A Tennessee Valley study stated that electric lights gave the farmer an extra two to four hours of work a day.[148] For instance, it might take someone all day to pump enough water for a herd of cows as opposed to an electric pump that could provide 1,000 gallons a day.[149] Electricity cut milking time in half. Before electrification, milk was poured from a pail to a forty-quart can and kept in the icehouse. Ice had to be harvested in the winter and packed in sawdust for the summer. The equipment had to be cleaned with hand-pumped water that was first boiled in the kitchen. A half-hour each day was spent separating cream. After the introduction of electricity, a farmer cut his milking time by 50% with electric milking machines. The milk did not have to be hand transported but was pumped directly to tanks and then to trucks. Equipment was sterilized with electrically heated water.[150] Hand operated devices such as gristmills and feed cutters were replaced with motors. An electric clothes washer could save twenty, 8-hour workdays per annum over a washboard.[151] Electric motors replaced hand-operated machinery such as gristmills and feed cutters. Electric fences replaced barbed wire. Electric ranges replaced wood and coal stoves. Electricity permeated just about every task on the farm in the home.

In addition to a more efficient workday, electricity provided the farm family with improved health. Electricity meant the advent of indoor plumbing, which meant people bathed more frequently. The privy was often the cause of typhoid, dysentery and gastrointestinal disease. North Carolina's privies were a prime breading ground for hookworm, which created anemia and loss of energy and strength.[152] Electricity even changed the farmer's diet. During the state's long hot summers, rural families depended on foods such as salted fatback, cornmeal and molasses since they did not need to be kept cool. These foods lacked essential vitamins resulting in fatigue and a deadly disease called pellagra. A poor diet also affected pregnancies,

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[144] W. Bruce Wheeler, "Tennessee Valley Authority" in *The Tennessee Encyclopedia of History & Culture*, Carroll Van West, ed. (Nashville: Rutledge Hill Press, 1998), 958-962.

[145] Ibid., 958-962.

[146] Nye, 303.

[147] D. Clayton Brown, *Electricity for Rural America: the Fight for the REA*. (Westport, CT: Greenwood Press, 1941), xiii.

[148] Nye, 323.

[149] Ibid., 232-4.

[150] Ibid., 294.

[151] Ibid., 323-4.

[152] Brown, xiv.

causing stillbirths, deformities, low intelligence and premature babies.[153] Refrigeration improved the family diet, decreased the amount of waste, and decreased the possibility of disease.[154]

Electricity changed the look of the farm. In came power poles and out went many smaller support buildings. Indoor plumbing replaced privies. Refrigeration replaced smokehouses and springhouses. In addition, with irrigation systems, farm families could nurture green, grassy lawns and landscaping.

Electricity had an indirect effect on some rural communities. In areas where dams developed to create electricity, incomes and private industry greatly increased. The Tennessee Valley region is a good example. Between 1933 and 1951 the per capita income of the nation increased by 330%. For people living in the TVA regions it increased by 477%. Between 1933 and 1950, the national increase of employees in private industry was 88%. In the TVA regions it was 105%.[155]

Electricity may also have changed farm family's views on how they lived and how they desired to live. The REA and utility companies bombarded rural families, especially women, with advertisements touting the wonders of electricity and electric appliances. The REA considered women to be key components of their plan since women created the standard of living for their families.[156] Advertisements, pamphlets and posters educated women about labor saving devices that they may not really have considered a need for previously.

Originally rural areas were denied the benefits of electricity because of their low-profit potential. The fears created in the nation, by the Depression, changed people's perceptions and focus to the extent that the government stepped in to assure rural areas electrification. Electricity forever changed rural life both in very tangible ways such as work habits, increased health, view of the rural landscape, finances, and standard of living. Electricity impacted farming communities in less tangible ways as well, giving the farmer a sense of place in society, changing the purpose of farms from family homes to businesses, and changing the farmer's role from family provider to business man.

NP&L was one of many North Carolina electrical companies which helped to bring about this social change. After 1945, NP&L extended its power lines into the rural sections of the counties it served. This was made possible by the construction of hundreds of miles of transmission lines throughout the area, and by increasing power from its plants such as Mission, Bryson, Franklin, and Highlands. For example, in Jackson County there were 110 NP&L customers in 1945. By 1951, the number of customers had increased to 1,561 and many of these were in rural areas.[157] In August of 1952, NP&L completed transmission lines into the Big Cove Community of the Cherokee reservation. Because this community was so remote, the Cherokee Tribal Council agreed to clear a 40 foot right-of-way and erect the poles themselves. This finally resulted in electric service to the community which was "anxious to enjoy the conveniences made possible

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[153]Ibid., xiv-xv.

[154]Nye, 324.

[155]Victor C. Hobday, *Sparks at the Grassroots: Municipal Distribution of TVA Electricity in Tennessee.* (Knoxville: University of Tennessee Press, 1969), 36.

[156]Jellison, 100.

[157] *"Electric Power."* (Manuscript on file with the Franklin Duke Power Office, Franklin, N.C.), 5.

by electricity."[158] Through these and other projects, NP&L was able to serve 95% of area residents by 1952, and increase its customer base to 8,373.

Criterion C - Significance in Architecture

Hydroelectric plants in North Carolina may be significant for their architectural design. Architectural significance may be based on the design of a component such as the powerhouse or dam. Such properties may be particularly notable examples of an architectural style or possess notable detailing. Associated buildings and structures such as worker's dwellings or gatehouses may also collectively or individually possess architectural significance within an overall planned development.

Architectural significance may include properties which are recognized for their overall design or individual elements. Representative of such recognition is the Hiwassee Dam in Cherokee County, which was included in a National Trust study in 1988. The Hiwassee Dam was built in 1940 by the Tennessee Valley Authority on the Hiwassee River. The dam was designed in the Art Moderne style by Roland Wank, and it is considered an excellent example of the use of this style for a powerplant site.[159] Architectural significance was also identified as one of the criteria for listing the Narrows Dam and Power Plant Complex on the NRHP in 1983. Designed in the Spanish Revival style, the powerhouse was regarded as a notable example of this style in its adaptation for an industrial building.

Other powerhouses surveyed in the state have been identified as possessing similar design characteristics and detailing. Powerhouses built from the 1910s into the 1930s were generally built of brick construction with large multi-light steel windows. Most were built in rectangular forms with minimal architectural detailing. Others were built with design influences of the period including the Colonial Revival and Gothic Revival styles. Such powerhouses which retain integrity will likely be significant under criterion C as reflecting regional approaches to the design and construction of this property type. Using this standard, the Walters Hydroelectric Plant in Haywood County was identified as eligible for its architectural significance in 1995. Similarly the Franklin and Thorpe Powerhouses were also identified as potentially eligible in previous countywide surveys. The Franklin Powerhouse was designed with the influences of the Colonial Revival style in its arched windows and overall design, while the Thorpe Powerhouse displays Gothic arched windows in its design.

Architectural significance may also be associated with other property types such as associated dwellings or worker's housing. Such properties may qualify either individually or as an historic district. Representative of this approach is the determination of eligibility under criterion C for the Waterville Village at the Walters Hydroelectric Plant. This village is composed of eight residential buildings constructed in 1930 as part of the Walters complex. Other similar housing units are associated with other surveyed hydroelectric plants.

Criterion C - Significance in Engineering

Hydroelectric plants may be significant for their engineering design or internal components. A hydroelectric plant may be significant for an innovative overall plan and design, as illustrative of advances in technology, or for its construction design. An example of significance in engineering is the Walters Hydroelectric Plant on the Pigeon River in Haywood County. Built by the Carolina Power & Light Company in 1930, this plant

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[158] *"The Cherokee One Feather,"* Vol. VII, No. 29, July 17, 1974, 2.

[159] Donald C. Jackson, *Great American Bridges and Dams*, (Washington: Preservation Press, 1988), 181.

was identified in 1995 as significant in engineering for its overall design.[160] The dam's site posed a number of engineering challenges for its construction, and the complex is also distinguished as having one of the highest heads in the state. In addition to its determination of eligibility for the NRHP, this plant has been designated as a North Carolina Historic Civil Engineering Landmark.

In 1999, the Thorpe Dam was also identified as significant in engineering for its overall design.[161] This earth and rock dam was the first in the nation to utilize safety fuse plugs at its spillway entrance. Safety fuse plugs are essentially small earthen dams which are designed to fail progressively in case of a major flood. These devices helped to increase dam safety and prevent sudden flooding below the dam. Further review and research on additional hydroelectric plants in the state may identify additional properties which are significant for their engineering design.

Criterion C – Significance of a Notable Designer, Architect, or Engineer

Hydroelectric plants may be significant for their association with a notable designer, architect or engineer who developed plants on a local, state, or national level. No hydroelectric plants in North Carolina are currently listed on, or determined eligible for, the NRHP under this context. Further research and analysis of the state's hydroelectric plants may identify such properties under this criterion.

2. Hydroelectric Power Property Types and Registration Requirements

The period of significance for properties associated with the development of hydroelectric power in North Carolina is ca. 1900-1955. This period includes the emergence of hydroelectric technology, the appearance and growth of power companies, the role of hydroelectric plants in the industrial growth and social history of the region, and the contribution of hydroelectric plants to the military during World War II. The cutoff date of 1955 is used to include properties that are at least fifty years old by 2005, when the FERC re-licensing process is to be concluded for these seven hydroelectric facilities. Also, by the mid-1950s other forms of energy such as steam power and nuclear power came into favor over hydroelectric power.

Properties that are less than fifty years old must meet NRHP Criteria Consideration G, which requires that a property achieving significance within the last fifty years be of exceptional importance. This criteria helps to ensure sufficient time has passed to develop a historical perspective by which to evaluate the significance of a property. Properties associated with hydroelectric power that are less than fifty years old will be of exceptional importance if they have made an extraordinary contribution to the industrial or social development of the surrounding region or reflect an outstanding development in engineering or technology.

Within the context of the Development of Hydroelectric Power in North Carolina, ca. 1900-1955, are a number of identifiable and consistent property types. These property types are essential to the production of electric power, and include powerhouses, dams, pipelines or tunnels, penstocks, and gatehouses. Other associated property types may include worker's housing, support buildings and structures, and transmission lines.

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[160] Brockington and Associates, *Cultural Resources Management Plan for the Walters Hydroelectric Project*, 1995, p. 102.

[161] Mattson, Alexander & Associates, *Historic Architectural Resources Survey Report*, 1999, p. 12.

Registration requirements for these property types provide specific information that can be used to evaluate pre-1955 hydroelectric plants and their components. This evaluation includes a property's retention of integrity, and significance within the historic context. A property will have integrity if it retains a sufficient amount of physical characteristics from its period of significance. The seven aspects of integrity are: location, design, setting, materials, workmanship, feeling, and association. In order to be eligible for the NRHP, a property does not need to have all seven qualities present, but it does need to possess a sufficient amount of its historic physical character to convey an overall sense of time and place from its period of significance.

Essential physical features of an historic property are those that "define both *why* a property is significant and *when* it was significant," thus the relevance of each aspect of integrity depends upon the historic significance of a property.[162] Under criterion A, when a property is significant for its association with historical trends or events, integrity of design and workmanship are typically less important than those of setting, location, feeling, and association. For properties that are significant for their architectural style or notable engineering features (criterion C), however, aspects of design, workmanship, and materials are more relevant. Within the context of the Development of Hydroelectric Power in North Carolina, ca. 1900-1955, properties significant under criterion A must possess a sufficient degree of historic physical characteristics to reflect its character or appearance during its period of significance. It is the opinion of the North Carolina State Historic Preservation Office that the retention of specific design details and components, such as historic windows and doors, are not essential under this context, as long as the property conveys an overall sense of time and place. Aspects of setting, feeling, and association are essential in this conveyance.

Hydroelectric properties significant under criterion C must possess a stronger degree of architectural integrity. These properties must retain a substantial percentage of their historic design and detail, for it is these components that make the property historically significant. Alterations to the properties should be limited, historic materials should be evident, and defining historical features should be retained.

A. Property Type - Powerhouses ca. 1900 - 1955

Powerhouses are the buildings that contain the generators, turbines, and control equipment of hydroelectric systems. Powerhouses are typically of brick or reinforced concrete construction over a steel frame. A few examples will have concrete block or terra cotta tile cladding over steel frames. Gable or hipped roofs, some with ventilating clerestories, are found on early powerhouses, but those constructed from the 1910s on typically have flat parapet roofs. Crane clearances, which were required for dismantling and hoisting generators and turbines, were used to calculate minimum wall heights.

The architecture of powerhouses varies from simple utilitarian buildings to designs in popular styles of the pre-1955 period such as Colonial Revival, Spanish Revival, and Art Moderne. For example, the Franklin powerhouse, built in 1925, was designed with Colonial Revival influences including arched windows, keystones, and brick coursing. The 1941 Thorpe Powerhouse reflects Gothic Revival influences with rectangular brick spandrels and Gothic arched transoms above the windows.

It was routine for powerhouses to be built with expansion in mind. Foundations contained spaces for additional generating units, and temporary end walls enabled the structure to be extended as needed. Because of the large floor to ceiling heights required to install and move turbines and other equipment, most

[162] National Register Bulletin 15, "How to Apply the National Register Criteria for Evaluation," (Washington, DC: National Register of Historic Places, National Park Service, U.S. Department of the Interior, 1991), 46-48.

powerhouses were built with large expanses of wood or steel windows to bring natural light into the interior. This type of design is demonstrated in the Franklin, Mission, and Thorpe Powerhouses in western North Carolina. Rooms to house transformers are found in early plants. Powerhouses constructed after 1913, however, typically used outdoor transformers and switchyards to accommodate increased line voltages.

The main equipment within powerhouses are the turbines, generators, and switchboards that transform the power of moving water into electrical energy. The majority of hydroelectric facilities in the United States, especially those with high heads, have mixed flow or Francis-type turbines, which combine inward and axial flow. Early units are commonly enclosed in cylindrical plate iron cases called "boilermakers," and duplex or paired units have "camelback" cases. Multiplex runner units are common. In the 1920s, plate steel scroll cases became common. Low and moderate head plants often have spiral passages directly cast within the powerhouse substructure.[163]

Developed in the late 19th century, the Francis style turbine was manufactured in several patented varieties. Among the companies that sold this equipment were James Leffel of Springfield, Ohio, which offered the Hercules, Victor, and Samson turbines; and Dayton Globe Iron Works, whose line consisted of the American, New American, Standard New American, Special New American, and Improved New American. Other companies were Holyoke Machine Company; Stillwell-Bierce; J. & W. Jolly Company; and Ridson. Independent designers included Swain and John B. McCormick.

Stock pattern turbine designs were used in low and medium head installations in the 19th century, but the demands of larger 20th century high head plants called for custom designed units. Horizontal shaft multiple runner turbines were common around the turn of the century. Plants that were established in the late 1910s and on typically have vertical units that are attached to generators via large capacity vertical thrust bearings, which are often referred to as Kingsbury bearings. Beginning in 1929, low head installations began to use propeller or Kaplan type turbines.

Powerhouses that retain historic equipment include those at the Dillsboro and Bryson facilities. The Dillsboro Powerhouse contains a 1929 Francis turbine manufactured by the James Leffel Company and a 1940 Kaplan built by the S. Morgan Smith Company. The Bryson plant has two vertical Francis type turbines installed in 1929.

Early in hydroelectric development, most installations had stock horizontal shaft generators that produced sixty cycle, three-phase alternating current. With the shift to vertical shaft configurations in the early 20th century, "umbrella" settings came to be the norm in low and medium head installations. This configuration consists of "a thrust bearing mounted on top of, or immediately below, the generator shell, supplemented by one or more guide bearings between the generator and water turbine."[164] A constant supply of direct current (DC) electricity is supplied to the AC generators by an exciter, or DC generator, that is directly connected to the turbine shaft. Plants constructed after 1920 often have M-G sets or motor-generator units, which use electricity from the outside system to power an AC motor connected to a DC generator.[165]

To control the flow of water through the turbines, early hydroelectric plants used mechanical cylinder gates. During the first decade of the 20th century, the industry shifted to wicket gates, which have pivoting guide

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[163]Hay, 62, 82.

[164]Hay, 90.

[165]Ibid., 90-91.

vanes that both direct and control water flow. Around this same time oil hydraulic systems were coming into use to control speed. A variety of manufacturers produced these units or governors, including the Allis Chalmers and Pelton corporations. However, the Woodward Company of Rockford, Illinois, dominated the market and introduced electric flyball drives through the use of permanent magnet generators (PMG). As these allowed the governor to be located away from the waterwheel, Woodward introduced "cabinet" governor stands that could be located anywhere on the generator floor.

In addition to the turbines and generators, powerhouses also contained electrical switchboards to regulate the current and water flow. These early switchboards were generally manufactured by Westinghouse or General Electric and have proved to be durable. Although some of the original wiring and elements have been replaced, switchboards installed in the 1920s such as at Franklin and Bryson remain in operation.

Registration Requirements

Powerhouses will be significant under NRHP criterion A if they made a substantial contribution to the commercial or industrial development of a community or region. Powerhouses will also be significant under criterion A if they were part of the growth and development of community and rural electrification in the state before 1955. It is the opinion of the North Carolina State Historic Preservation Office that the retention of specific design details and components, such as historic windows and doors, while beneficial, are not essential under this context, as long as the property retains a sufficient degree of its historic appearance and character to convey an overall sense of time and place. Aspects of setting, feeling, and association are essential in this conveyance.

Powerhouses will be significant under NRHP criterion C if they are notable for their overall architectural design, or as exemplifying a particular national or regional style. Powerhouses will also be significant under criterion C for displaying innovative or technologically advanced engineering characteristics or components. Powerhouses significant under criterion C must retain a substantial percentage of their historic design and detailing, for it is these components that make the property historically significant. Alterations to the properties should be limited, historic materials should be evident, and defining historical features should be retained. Of particular importance to powerhouse designs are the large window bays.

To be considered eligible, powerhouses must retain various aspects of integrity. These aspects include:

- Location - A powerhouse must be located at its original site.
- Design - A powerhouse must retain the majority of elements of its design from its period of significance. This will include exterior materials and detailing. Of particular importance to powerhouse designs are the large window bays to illuminate the interior. These window bay openings must be retained with historic windows or windows that approximate the appearance of the historic windows. Doors of powerhouses should date to the property's historical period of significance or be similar in design to their historic character. The interior open floor space of a powerhouse must be retained with few added partition walls. Interiors must retain historic floor to ceiling heights.
- Setting - A powerhouse's historic physical setting must be intact. This will generally include a setting adjacent to a watercourse, or at the base of a reservoir.

Post-1955 buildings and structures adjacent to a powerhouse must be at a minimum and not disrupt the overall historic setting of the powerhouse.

- Materials - A powerhouse must retain the majority of its historic exterior and interior construction materials. This will include historic exterior siding or masonry, historic windows or appropriate replacement windows, historic doors or appropriate replacement doors, and historic decorative detailing. Interiors should retain the majority of historic floor, wall and ceiling surfaces. Powerhouse eligibility will be enhanced if the interior retains turbines, generators, or switchboards from its period of significance. However, if these elements have been replaced, a powerhouse will remain eligible if the other design attributes and materials are intact.

- Workmanship - A powerhouse must retain the qualities of workmanship which were imbued in its historic design and materials.

- Feeling - A powerhouses must retain a sense of time and place from its period of significance.

- Association - Powerhouses must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

B. Property Type – Dams ca. 1900 - 1955

Early hydroelectric plants often used existing dams for their projects. Dam construction in the 19th century included those made of masonry, earth, and timber. As hydroelectric power became a viable enterprise, dams were constructed solely for this purpose. Concrete and timber dams were also constructed in the late 19th century for use at hydroelectric plants. A few examples of timber crib dams were also built during the 1890s. Common dam designs include thin arch dams, which transfer thrusts to abutments. The use of steel in dam construction also came into play in the late 19th century, but it did not come into general use.

A number of hydroelectric facilities built in the early 20th century feature reinforced concrete slab and buttress dams. This design patented by Frederick Ambursen distributes the weight of the water across an inclined upstream face. The design calls for a row of triangular buttresses that support cast-in-place reinforced concrete slabs, and typically has a curved sloping downstream spillway that carries water from the crest. This design created a "shell-dam" with a hollow core between the buttresses. Some power companies who used this design elected to install the facility's powerhouse inside the dam's hollow interior rather than build a separate structure.[166]

Another common dam design is a multiple arch dam created by John S. Eastwood. This design features thin concrete cylinder arches set at an angle and joined at their edges. The arches rest on triangular buttresses. An example of a multiple arch dam is that at the Bryson facility. Built in 1924, this concrete dam has four multiple arches. Hydraulic fill earth dams were developed around the turn of the century. These dams require high pressure streams of water to wash fill from hillsides. The fill is then carried via sluices to the dam site. Semi-hydraulic dams used dump cars that ran on parallel elevated trestles to carry the fill from pits

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[166] Ibid., 48-50.

to the dam site.[167] Rock fill dams are strong but also require an impermeable sheathing on their upstream faces. A variety of materials such as rammed earth, stone in mortar, reinforced concrete, or planks can be used for this process. The Thorpe Dam, constructed in 1941, is an example of an earth and rock fill dam. The dam is 150' in height and 900' in length.

Dams will generally have a number of associated components such as concrete spillways or sluiceways, tainter gates, and gatehouses. Concrete spillways or sluiceways provide channels for the water to come through or over the dam. The tainter or radial gate, is one of the most widely used types of gates on dams. Tainter gates control the flow of water in a spillway by being raised or lowered through a winch system. Winches are usually motor driven although smaller dams may be operated by hand. Tainter gates are usually of steel and pivot on trunions set within the sides of the spillway.

Gatehouses refer to buildings which contain the winches and machinery for the tainter gates, or those built to control the intake gates for tunnels and pipelines. Gatehouses associated with tainter gates are usually small buildings of frame and metal panels, built on top of the dams themselves, such as those at the Bryson and Mission facilities. These gatehouses contain the control equipment for the tainter gates below. Gatehouses to control water intake are generally larger, and may be of concrete, or frame. These gatehouses accommodate large steel gates, and are located on dams or edges of reservoirs to control water flow into the tunnels or waterpipes.

Registration Requirements

Dams will be significant under NRHP criterion A if they made a substantial contribution to the commercial or industrial development of a community or region. Dams will also be significant under criterion A if they were part of the growth and development of community and rural electrification in the state before 1955. It is the opinion of the North Carolina State Historic Preservation Office that dams with replacement materials such as gunite may still be eligible under criterion A as long as the property retains a sufficient degree of its historic appearance and character to convey an overall sense of time and place. This will include retention of the dam's historic configuration and setting. Gunite is similar in composition and color to concrete, and in the opinion of the North Carolina State Historic Preservation Office, does not alter the appearance of dams to such a degree as to render them ineligible.

Dams will be significant under NRHP criterion C if they are notable for their design elements, or exemplify a particular national or regional architectural style. Dams will also be significant under criterion C for displaying innovative or technologically advanced engineering characteristics or components. Dams significant under criterion C must retain a substantial degree of the historic physical elements that make it a notable architectural or engineering property.

To be considered eligible, dams must retain various aspects of integrity. These aspects include:

- Location - A dam must be located at its original site.
- Design - A dam must retain the majority of its historic construction elements. Concrete, brick, stone, or earthen dams should retain their historic appearance and configuration. This will include the retention of historic

[167]Ibid., 52-54.

spillways or sluiceways, and historic or appropriate replacement tainter gates.

- Setting - A dam's historic physical setting must be intact. A dam should not be concealed or obscured by substantial buildings and structures constructed past its period of significance.

- Materials - A dam should retain and exhibit its historic construction materials. Dams will still retain integrity of materials if in-kind replacement materials are used. This would include earth and rock for earth and rock dams, and concrete to match the original for concrete dams. Replacement materials that do not imitate the historic material, or where there is a substantial loss of historic fabric, will result in a loss of integrity. The use of gunite, a mixture of cement and sand, is a common modern replacement material for concrete dams and is an acceptable material for dams significant under criterion A.

- Workmanship - A dam must retain the qualities of workmanship which were imbued in its historic design and materials.

- Feeling - Dams must retain a sense of time and place from its period of significance.

- Association - Dams must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

C. Property Type - Flumes, Tunnels, and Canals ca. 1900 – 1955

Some hydroelectric systems make use of flumes, canals, or tunnels to transport water from reservoirs to powerhouses. Early systems used streamlined versions of typical water irrigation systems. Timber flumes are commonly found in the West and consist of wooden boxes laid across trestles or sleepers. Semicircular sheet metal flumes appeared in the early 20th century. Reinforced concrete flumes, although used occasionally, were not generally used. Tunnels are typically found in mountainous areas, and cut through or beneath ridges and mountains. Early 20th century tunnels were originally plank lined. They were later lined with concrete. The Thorpe Hydroelectric Plant has three tunnels that connect the dam to the powerhouse. The tunnels average over 4,000 feet and cut through Shoal, Pilot, and Bell Coney Mountain to furnish water to feed into the powerhouse's penstocks.

Flumes, tunnels, and canals will be significant under NRHP criterion A if they made a substantial contribution to the commercial or industrial development of a community or region. They will also be significant under criterion A if they were part of the growth and development of community and rural electrification in the state before 1955. These structures will be significant under NRHP criterion C if they are notable for their design elements, or exemplify a particular national or regional architectural style. They will also be significant under criterion C for displaying innovative or technologically advanced engineering characteristics or components. It is likely that these structures will be eligible as contributing elements within an overall hydroelectric plant as opposed to individual characteristics.

To be considered eligible, flumes, tunnels, and canals must retain various aspects of integrity. These aspects include:

- Location - These structures must be located at their original site.
- Design - These structures must retain the majority of their historic construction elements.
- Setting - These structures' historic physical setting must be intact. They should not be concealed or obscured by substantial buildings and structures constructed past their period of significance.
- Materials - These structures must retain and exhibit their historic construction materials. They will still retain integrity of materials if in-kind replacement materials are used.
- Workmanship - These structures must retain the qualities of workmanship which were imbued in their historic design and materials.
- Feeling - These structures must retain a sense of time and place from their period of significance.
- Association - These structures must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

D. Property Type - Pipelines and Penstocks ca. 1900 – 1955

Pipelines and penstocks transfer water to the turbines. Pipelines are defined as "pressure conduits that run from a dam or the foot of a canal to the surge tank or standpipe."[168] Pipelines are connected to turbine cases by penstocks. Penstocks typically have steep slopes and are able to withstand high pressures. Pipelines and penstocks are often confused, and it is not uncommon for the entire system to be referred to as a penstock. Throughout the late 19th century wood stave pipelines were used in hydroelectric facilities to carry water along gentle slopes. These were typically two to eight feet in diameter. Plate steel penstocks then delivered the high head water to the turbines. It was found that rivets in the penstocks weakened the steel plate and caused internal surface friction, so welded steel versions became the norm. A few pipelines and penstocks were constructed of precast or cast-in-place reinforced concrete; however, the material could not withstand pressure without seepage and so was not widely used.[169]

Associated with pipelines and penstocks are surge tanks. Surge tanks are venting devices that provide relief of pressure in long conduit systems. Early surge tanks were simply large, tall steel standpipes that acted as safety valves during intense surges. In 1911, the differential surge tank was introduced. This piece of equipment contains a riser that is similar in diameter to the pipeline and that is enclosed by a much larger diameter tank. It features ports midway up the riser that help prevent oscillations within the tank and conduit. Surge tanks are commonly situated on legs that raise them to the same height as the forebay.[170]

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[168]Ibid., 57.

[169]Ibid., 57-58.

[170]Ibid., 58-59.

Hydroelectric plans built in western North Carolina feature the extensive use of steel pipelines. Plants such as Nantahala and Thorpe employ the use of miles of pipelines to direct water to their powerhouses. These pipelines are generally elevated several feet off the ground, and are supported by poured concrete piers or footings.

Pipelines and penstocks will be significant under NRHP criterion A if they are components within an overall hydroelectric plant which made substantial contributions to the commercial or industrial development of a community or region. They will also be significant under criterion A if they are components within a hydroelectric plant which contributed to the growth and development of community and rural electrification in the state before 1955. These structures will be significant under NRHP criterion C if they are notable for their design elements. They may also be significant under criterion C for displaying innovative or technologically advanced engineering characteristics or components.

To be considered eligible, pipelines and penstocks must retain various aspects of integrity. These aspects include:

- Location - These structures must be located at their original site.
- Design - These structures must retain the majority of their historic construction elements.
- Setting - These structures' historic physical setting must be intact. They should not be concealed or obscured by substantial buildings and structures constructed past their period of significance.
- Materials - These structures must retain and exhibit their historic construction materials. They will still retain integrity of materials if in-kind replacement materials are used.
- Workmanship - These structures must retain the qualities of workmanship which were imbued in their historic design and materials.
- Feeling - These structures must retain a sense of time and place from their period of significance.
- Association - These structures must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

E. Property Type – Dwellings ca. 1900 – 1955

To operate and maintain hydroelectric plants, a number of workers had to be consistently on-site within each twenty-four hour period. For remote sites, this often required the construction of dwellings to accommodate plant operators and their families. Such dwellings were built near powerhouses and dams. These dwellings were generally built to reflect popular residential styles of the period, and often these dwellings were built in similar plans for economy of construction and maintenance. These "workers villages" were also designed with playgrounds for children, and automobile garages or storage buildings. Worker's housing that is known to exist include the groupings of dwellings at the Waterville, Nantahala, and Thorpe facilities.

Dwellings, either individually or collectively, will be significant under NRHP criterion A if they are components within an overall hydroelectric plant that made substantial contributions to the commercial or industrial development of a community or region. They will also be significant under criterion A if they are components within a hydroelectric plant that contributed to the growth and development of community and rural electrification in the state before 1955.

Dwellings will be significant under NRHP criterion C if they are notable for their design elements, exemplify a national or regional architectural style, or display the characteristics of an intact planned community in association with a hydroelectric complex. Dwellings significant under criterion C will retain a high degree of their historic materials and architectural detailing.

To be considered eligible, dwellings must retain various aspects of integrity. These aspects include:

- Location - A dwelling, or grouping of dwellings, must be at the site related to its period of significance.
- Design - Integrity will be based on those elements which embody a particular style or form such as arrangement of rooms, height, fenestration, porch location and dimensions, chimney placement, decorative embellishment, and the location of wings or additions. A dwelling, or grouping of dwellings, must retain basic design features from the period of significance.
- Setting - A dwelling, or grouping of dwellings, must retain the physical environment from the period of significance. For hydroelectric plants, dwellings must retain their historic spatial relationship with other properties in the complex.
- Workmanship - The workmanship of a dwelling, or grouping of dwellings, must remain evident from the period of significance. This would include retention of the majority of historic exterior features such as decorative millwork, porch columns, window and door treatments, and siding materials.
- Materials - A dwelling, or grouping of dwellings, must retain the majority of historic materials such as porch columns, exterior siding materials, and fenestration. If all of these materials have been replaced the dwelling will no longer retain integrity.
- Feeling - A dwelling, or grouping of dwellings, must retain the sense of time and place from the period of significance. Dwellings must retain those physical features that convey their historic character.
- Association - A dwelling, or grouping of dwellings, must retain association with the physical elements, and overall qualities that imparts historic character.

<u>F. Property Type - Support Buildings and Structures ca. 1900 – 1955</u>
This property type refers to small ancillary buildings and structures which support the overall operations at a hydroelectric plant. These buildings and structures can include storage facilities, garages, and pumphouses. Others may contain electrical generators or transformers. These buildings are generally of concrete or frame construction, and may be located adjacent to dams or powerhouses. These buildings will generally not be of individual significance, but have the potential to be contributing to a district or overall complex.

To be considered eligible, support buildings and structures must retain various aspects of integrity. These aspects include:

- Location - These buildings and structures must be located at their original site.
- Design - These buildings and structures must retain the majority of their historic construction elements.
- Setting - These buildings and structures' historic physical setting must be intact. They should not be concealed or obscured by substantial buildings and structures constructed past their period of significance.
- Materials - These buildings and structures must retain and exhibit their historic construction materials. They will still retain integrity of materials if in-kind replacement materials are used.
- Workmanship - These buildings and structures must retain the qualities of workmanship which were imbued in their historic design and materials.
- Feeling - These buildings and structures must retain a sense of time and place from their period of significance.
- Association - These structures must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

G. Property Type - Transmission Lines ca. 1900 – 1955

Transmission lines refer to the support structures and electric wires for the transmission of electricity over distances. In the early years of hydroelectric development the earliest poles were of wood and they carried copper wiring in various voltages. After World War II, most of these early wooden poles were replaced with either new wood poles or metal poles. Rewiring also was widespread after 1945. This study did not identify any extant transmission line components associated with the NP&L erected prior to 1955. Given the changing technology of electrical power over the past fifty years, it is unlikely that any pre-1955 transmission line elements remain in use in the state. While this property type has the potential to be relevant in the future, it does not fit into the established context of hydroelectric power in the state to 1955.

VII. NATIONAL REGISTER ASSESSMENTS OF SEVEN HYDROELECTRIC PROJECTS OF THE NANTAHALA POWER & LIGHT COMPANY

In June of 2001, an historical and architectural survey was conducted of seven hydroelectric projects associated with the growth and development of the Alcoa Company and its subsidiary, the Nantahala Power and Light Company in North Carolina (NP&L). Nantahala Power & Light, a Division of Duke Power, is the current FERC licensee for the seven projects. Duke Power, a Division of Duke Energy Corporation, commissioned this evaluation in support of its efforts to re-license these facilities. These plants are described and evaluated in chronological order of their construction.

1. Dillsboro Hydroelectric Project

Historical Overview

C.J. Harris constructed the original plant at this location in 1913 on the Tuckasegee River in Jackson County. It replaced a small hydro plant that Harris had built on Scott's Creek ca. 1908 to provide power to his Blue Ridge Locust Pin Factory. Harris, along with a partner, developed the Dillsboro and Sylva Electric Company to serve his building supply company in Sylva and a few commercial customers in the same town. The company continued to grow and began selling power to Sylva residents. By 1927, increased demand for power forced the company to build a larger dam on the Tuckasegee River[171].

In 1940, a flood washed away most of the powerhouse and damaged the dam. The company repaired the plant within two weeks, while purchasing power from NP&L in the interim.[172] In 1957, NP&L purchased the physical properties of the Dillsboro and Sylva Electric Light Company. Upon acquisition, the plant consisted of a concrete dam ten feet high and 230 feet long, a wooden frame metal powerhouse, and two generators that served around 2,200 customers in the towns of Dillsboro, Sylva, and Webster. When NP&L acquired the plant, it was out of service. Company employees rebuilt the powerhouse, rehabilitated the equipment, and increased the height of the dam by two feet. The plant was put back into operation in January of 1958.[173] The plant has continued to provide electricity for NP&L to the present.

Description

The Dillsboro Hydroelectric Project consists of a powerhouse and dam on the Tuckasegee River. The building has an exterior of corrugated steel added in 1957, a poured concrete foundation, and a metal gable roof. Windows are ca. 1970, one-over-one aluminum sash design. The main entrance has a ca. 1940, five-panel door. Over the door is a shed roof frame and metal canopy. On the north facade are two original stone piers with added poured concrete in between plus some remnants of the original stone spillway. At the eaves are exposed rafters. The power plant has an interior brick chimney. In the eaves are rectangular louvered vents.

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[171] McRae, 1-2.

[172] Ibid., 3.

[173] Ibid., 4; NP&L n.d., I-36-37, 41; NP&L 1952, 8.

The interior of the Dillsboro Powerhouse has wood floors, walls of corrugated steel and exposed framing, and a poured concrete foundation. There is an office area with a wood stove and flue. Leading to this office is a ca. 1940, five-panel door. The interior has an exposed wood truss support system.

The interior retains a switchboard manufactured by Westinghouse and installed in 1940 following the flood. An original turbine was salvaged from the powerhouse after the 1940 flood and placed back into operation. This is a Type-Z Francis turbine installed in 1929, and manufactured by James Leffel & Company. The other turbine is a Smith-Kaplan turbine installed in 1940 following the flood, and manufactured by the S. Morgan Smith Company. The interior also has one vacant turbine pit.

The dam impounds a reservoir which contains 15 acres when full. This linear dam is of stone and concrete, and the height of the dam was raised to twelve feet in 1958. On the south end of the dam is a concrete spillway with two steel tainter gates.

National Register Assessment

In consultation with the North Carolina State Historic Preservation Office, it is determined that the Dillsboro Hydroelectric Project meets NRHP criterion A. Under criterion A, the plant is representative of the early development of hydroelectric power in North Carolina. The plant was constructed to provide power to a local factory and commercial enterprises. By the mid-1950s, the plant supplied power to over 2,000 customers in the towns of Dillsboro, Sylva, and Webster. The plant is significant in the category of Commerce and Industry as well as Social History as part of the overall influence of electricity in the growth and development of industry and the transformation of North Carolina communities in the early- to mid-20th century.

The Dillsboro Powerhouse and Dam have both been modified from their original designs; however these modifications do not detract from the plant's overall sense of time and place, which reflect its early- to mid-20th century period of significance. The Dillsboro Powerhouse was rebuilt in 1940 and has post-1955 exterior siding and windows. However, the powerhouse retains its historic configuration, and much of its historic interior remains intact including turbines from its period of significance. The Dillsboro Dam was constructed in 1927. The height of the dam was raised two feet in 1958. This modification does not substantially alter the appearance of the dam, which overall retains its sense of its historic time and place. The historic setting of the Dillsboro Hydroelectric Project remains intact and the complex as a whole retains a sufficient degree of its historical appearance and character to convey its historical significance.

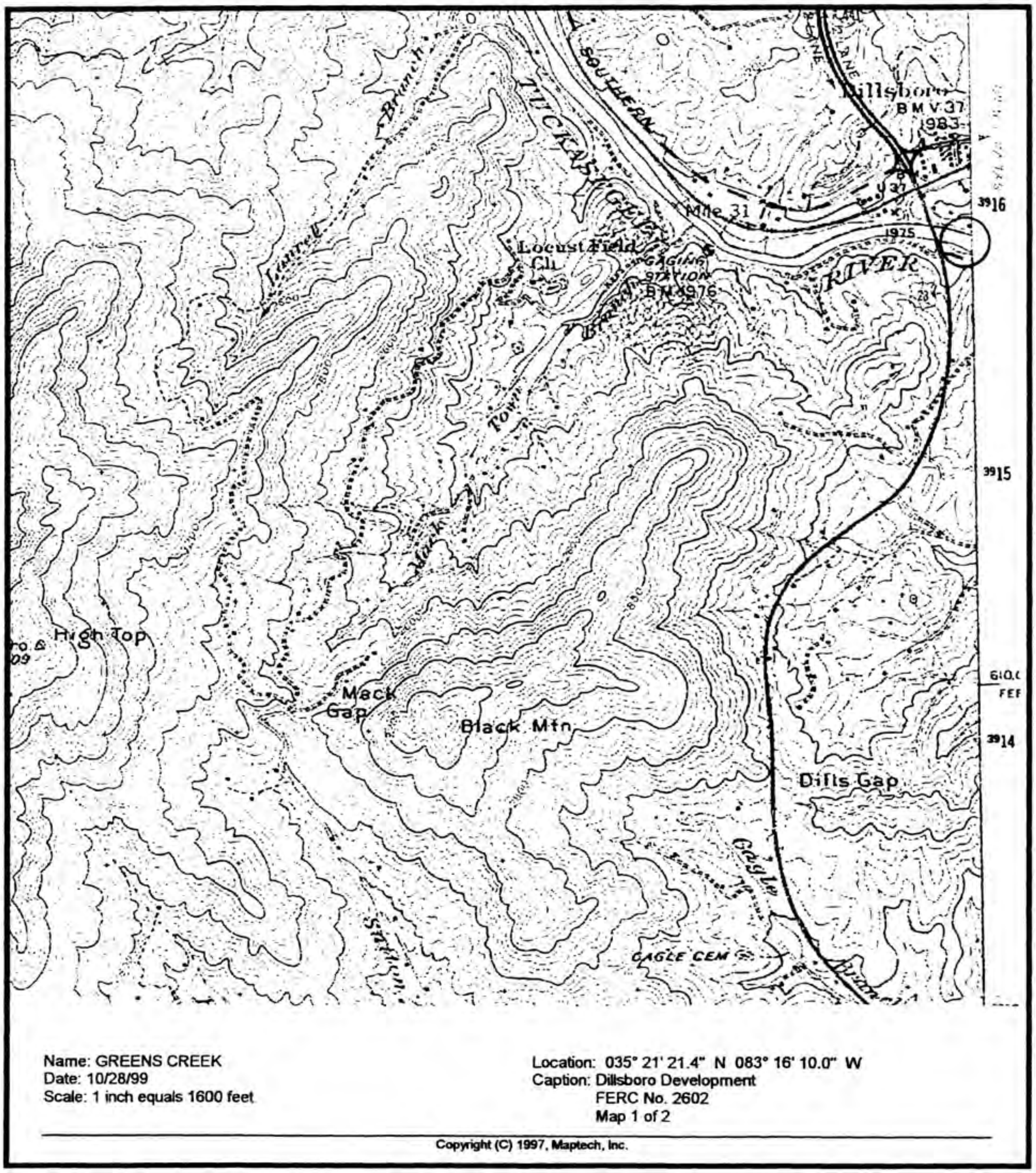

Figure No. 3. Location of the Dillsboro Hydroelectric Project, Map 1 of 2.

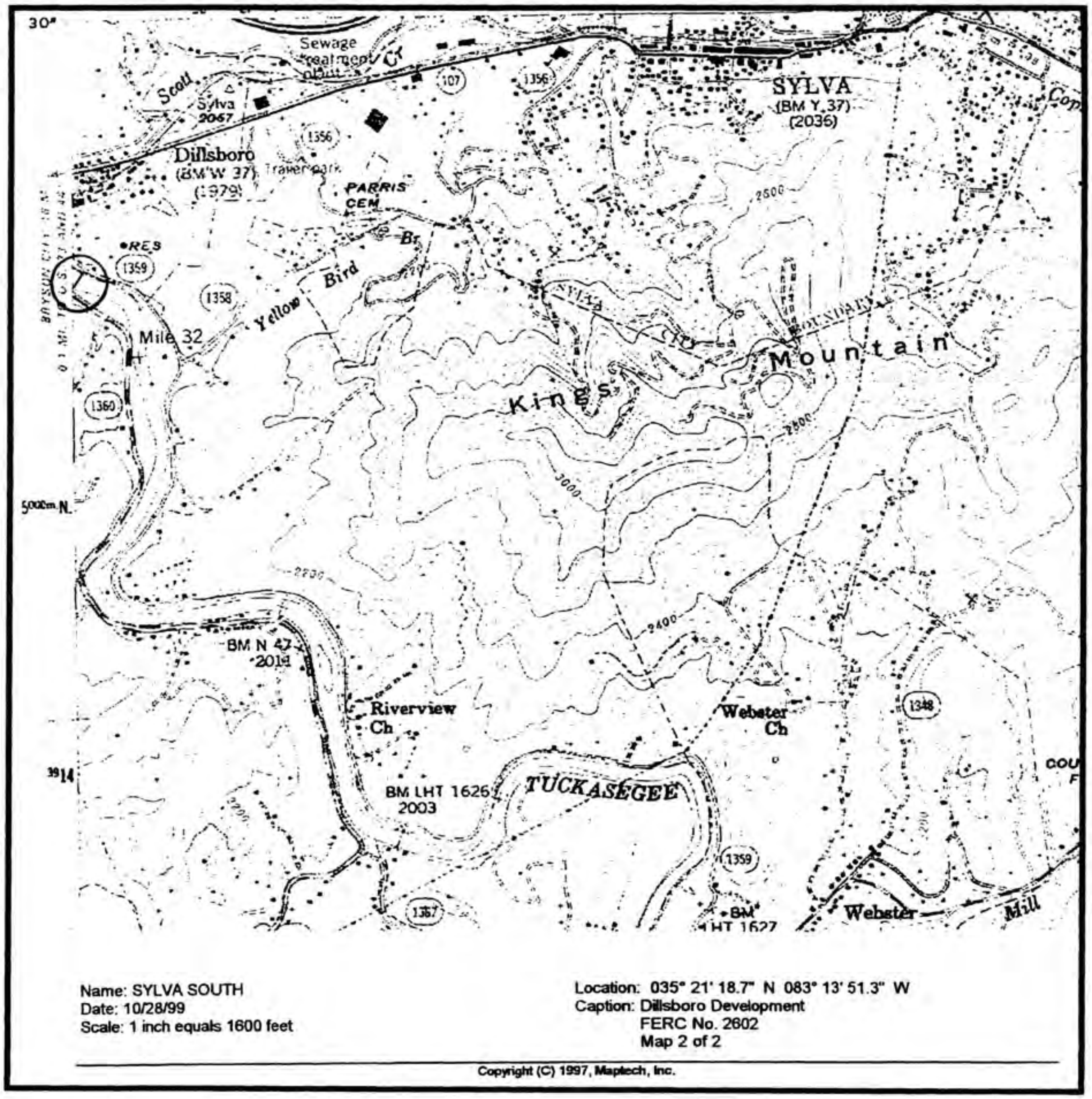

Figure No. 4. Location of the Dillsboro Hydroelectric Project, Map 2 of 2.

Dillsboro Dam and Powerhouse

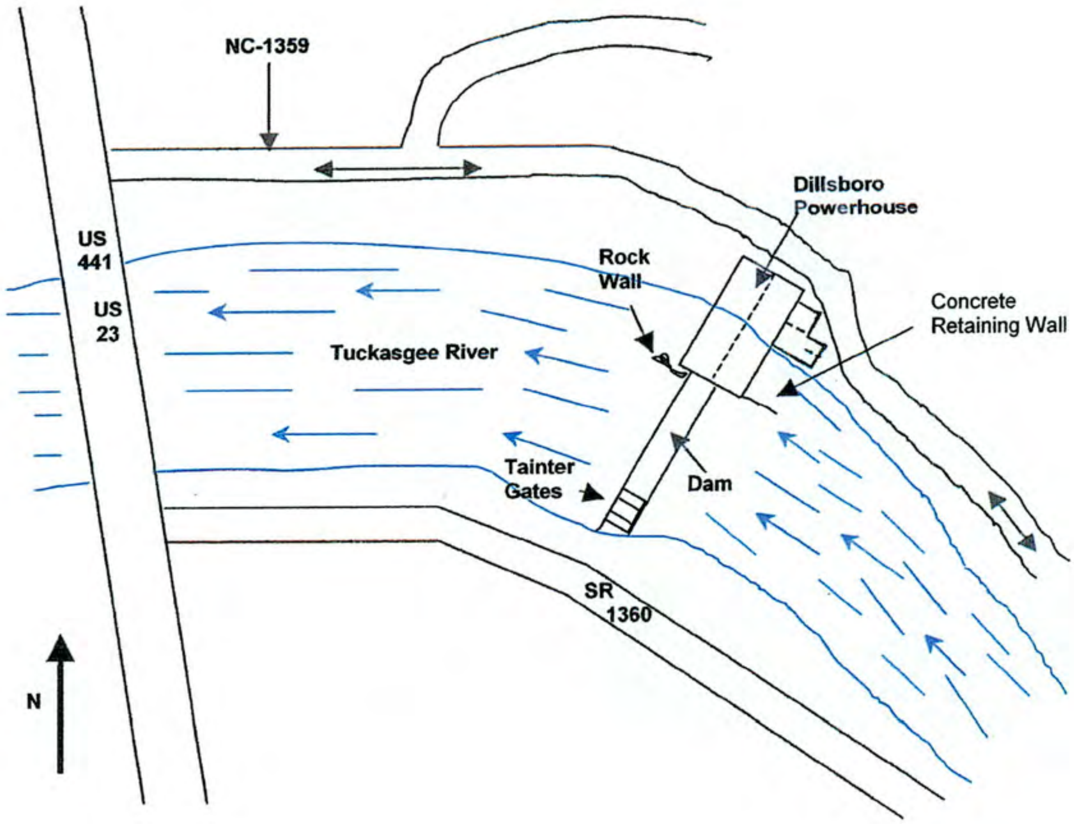

Figure No. 5. Dillsboro Dam and Powerhouse Site Plan.

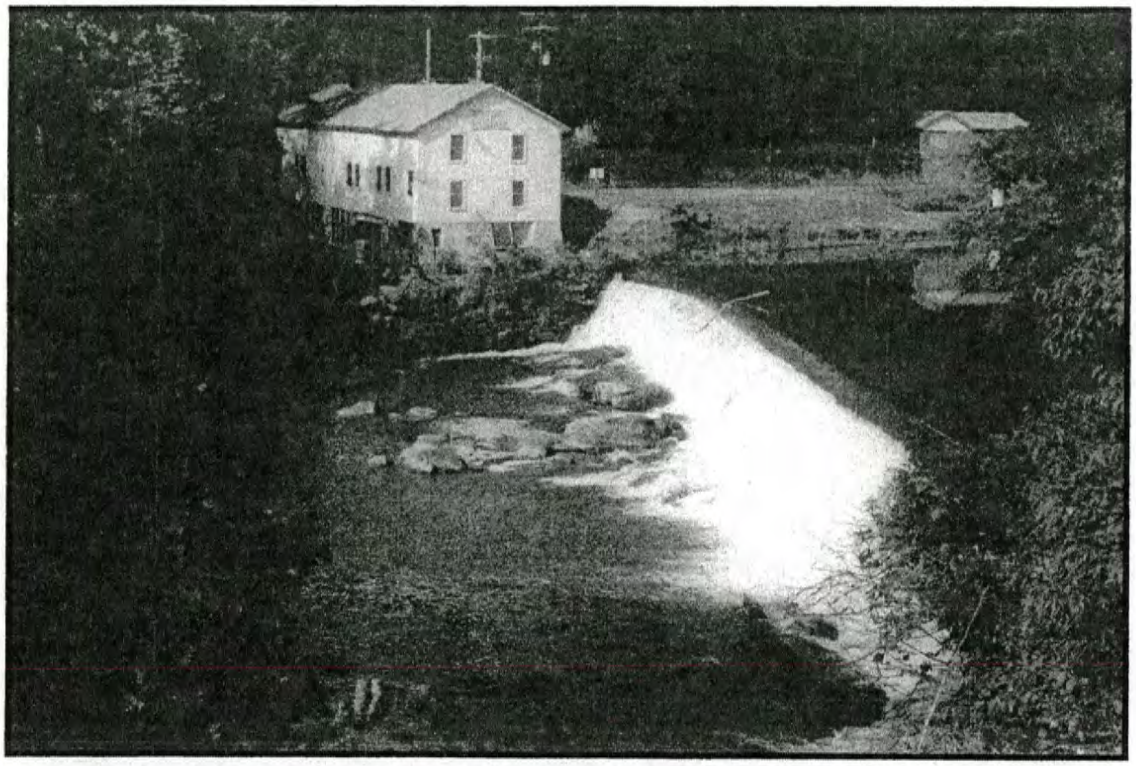

Figure No. 6. The Dillsboro Powerhouse and Dam.

Figure No. 7. The Dillsboro Powerhouse, south and west facades.

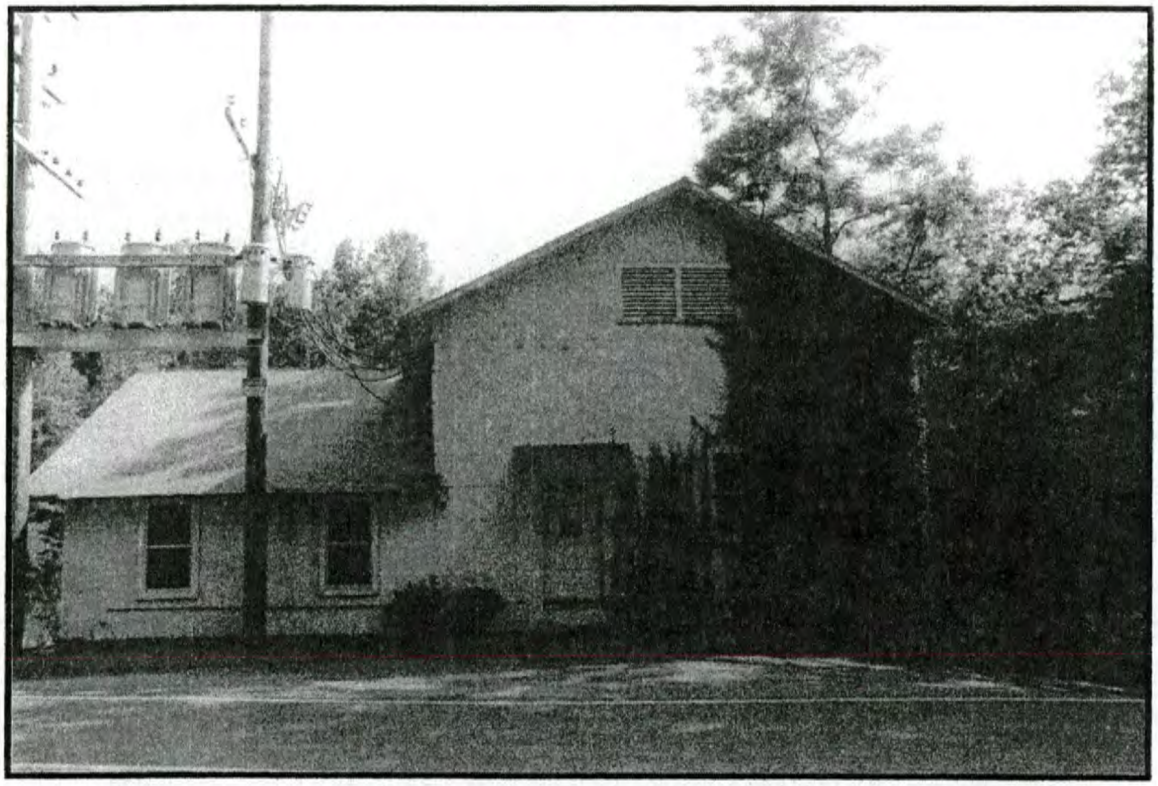

Figure No. 8. The Dillsboro Powerhouse, north facade.

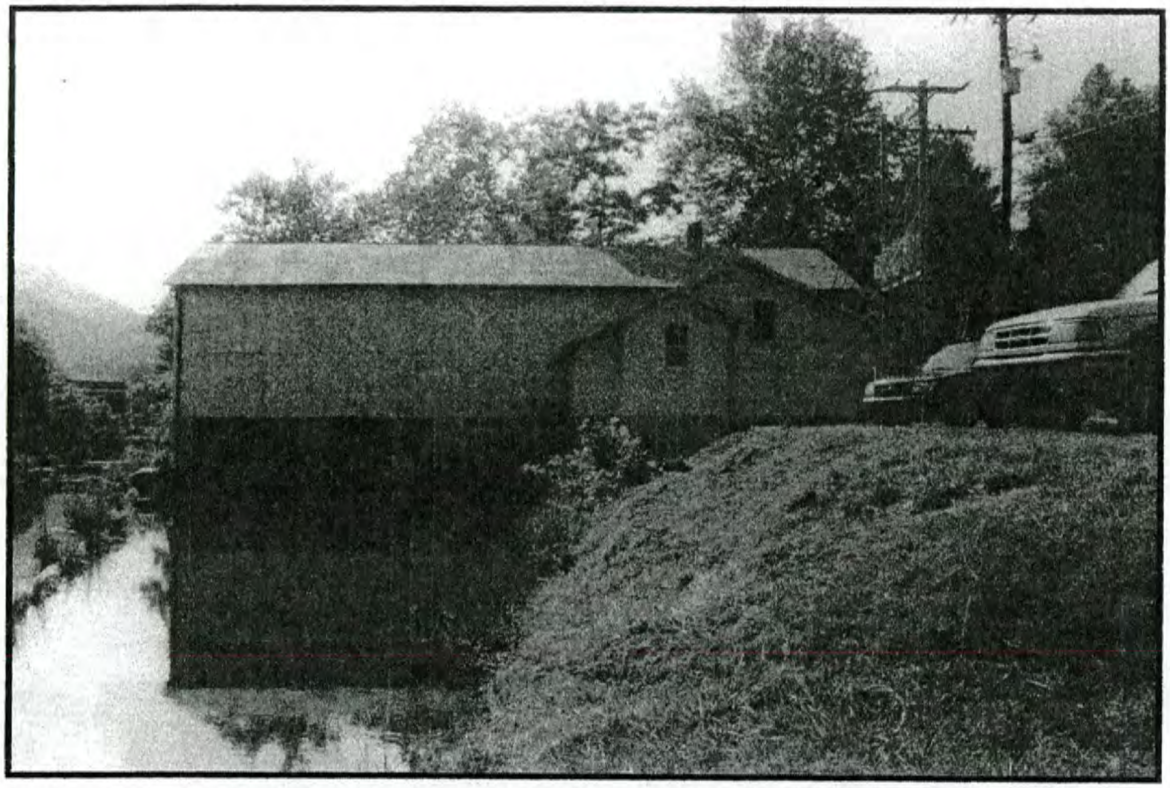

Figure No.9. The Dillsboro Powerhouse, east facade.

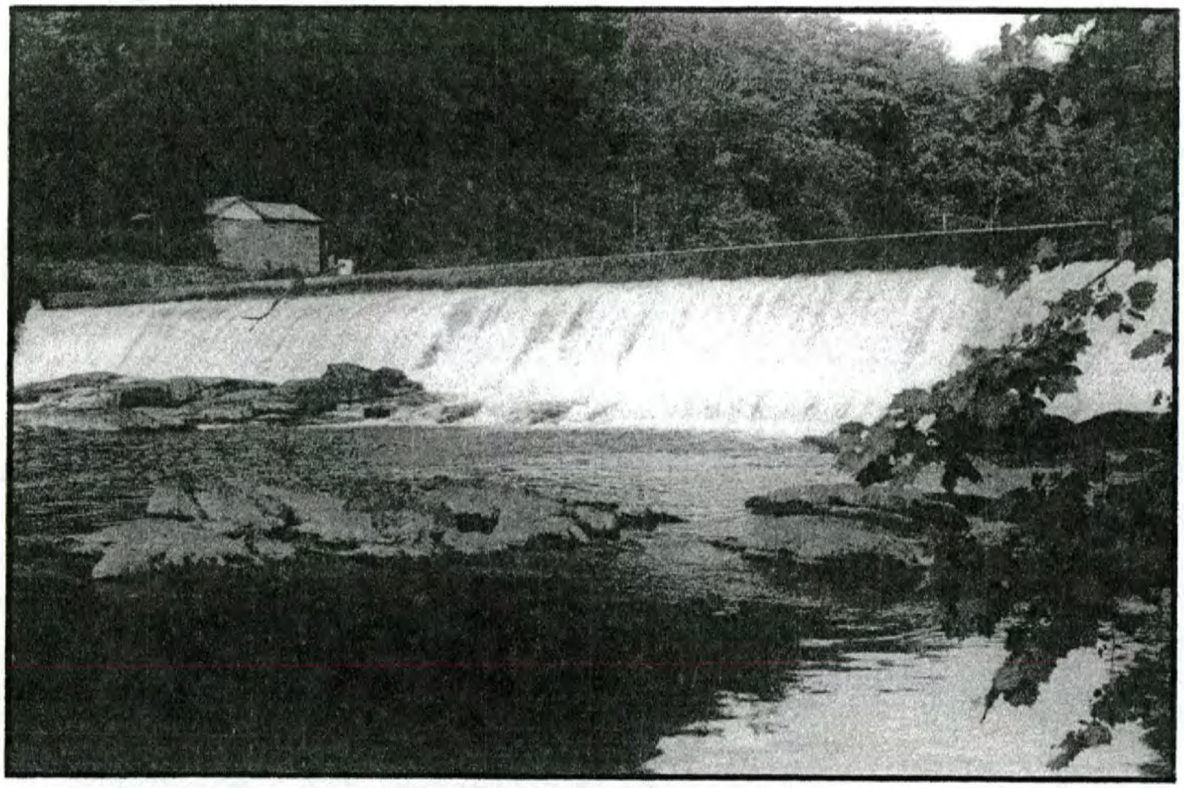

Figure No. 10. The Dillsboro Dam.

2. Bryson Hydroelectric Project

Historical Overview

The Bryson Dam and Powerhouse were constructed in 1924 on the Oconaluftee River in Swain County. Built by the Bryson City government, the Bryson plant provided power to several hundred residents and businesses of the community for several decades. NP&L purchased the Bryson City electric power system in 1942. The plant consisted of a multiple-arch type concrete dam, 241 feet long and 34 feet high, and a brick powerhouse that contains two hydroelectric units of 700 hp capacity each; a 6.6 mile, 12 kw transmission line running from the Bryson Plant to Cherokee, North Carolina; and a distribution system in the Town of Bryson City to Substation Bryson City. At the time of its acquisition in 1942, 704 customers received power from this system.[174]

In 1943, NP&L converted the plant to semi-automatic operation, reducing the operating force from four to one. This new equipment consisted of float-operated devices constructed in the NP&L shop to operate two tainter gates while varying the load on the units according to the streamflow. The remainder of the installed equipment consisted of overcurrent, bearing temperature, and oil pressure relays and field breakers utilized to provide automatic protection to the units.[175]

In 1986, the Bryson Dam and Powerhouse were both extensively remodeled. Over the years the dam had lost large sections of its original concrete due to exposure to the elements and the freeze-thaw cycle. In order to repair the dam, the original spalled concrete was chipped down to the firm concrete, and then a new surface of gunite was applied. Gunite is a surface which is built up through a dry mixture of cement and sand through a hose under air pressure, which is then mixed with water at the nozzle. The result is a rough textured concrete rather than the smooth concrete of the original surface. For the Bryson Dam, a wire mesh was applied to the original surface and two to four inches of gunite was added. Concurrent with the work on the dam, the powerhouse was remodeled through the enclosure of the majority of original windows with wood and stucco panels.

Description

The Bryson Powerhouse was built in a rectangular plan, and constructed of six-course common bond brick, which was sandblasted in 1986. The building's original doors were removed and replaced with frame vertical board doors with diagonal bracing in 1986. The window openings were covered with stucco panels in 1986, but retain original brick sills. At the roofline is a corbelled brick cornice. The powerhouse has a concrete foundation with the penstocks divided by concrete piers. On the north facade are transformers enclosed within a plywood and metal fence.

The interior of the Bryson Powerhouse has a poured concrete floor, exposed brick walls, and a ceiling of exposed rafters and roof decking. The interior is composed of open floor space except for an original corner office. This office has wood partition walls, two, two-over-two wood sash windows, a wood ceiling, and an original five-panel wood door. The window openings were covered in 1986 with panels of stucco, but the original windows remain beneath. These are exposed on the interior and are paired twenty-four light steel awning design with eight-light paired transoms. Over the main entrance are paired sixteen-light windows

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[174]NP&L n.d., I-7.

[175]Ibid., I-8.

and paired eight-light transoms. On the east facade of the powerhouse are the steel headgates for the penstocks, and gate winches.

The building has an original switchboard manufactured by General Electric. The building contains two Vertical Francis turbines both of which produce 700 horsepower. The original turbine installed in 1925 was manufactured by S. Morgan Smith, and a second turbine manufactured by James Leffel & Co. was installed in 1929. Both generators were manufactured by General Electric.

The dam impounds Lake Ela, which has a capacity of 38 acres when full. The dam is of concrete with four multiple arches, and an exterior surface of gunite added in 1986. On top of the dam is a corrugated metal gatehouse containing the winch for the two steel tainter gates. This gatehouse has a metal shed roof and an exterior of 1986 corrugated steel.

National Register Assessment

In consultation with the North Carolina State Historic Preservation Office, it is the determination that the Bryson Hydroelectric Project meets NRHP criterion A. Under criterion A, the plant is significant for its role in the development of electrical power in western North Carolina. Constructed in 1924, the plant was one of the earliest in western North Carolina to bring electricity to a municipality. It served several hundred residents and businesses in the Bryson City community and contributed to changes in the lifestyles of area residents through the introduction of electrical power. The plant continued to serve the surrounding community after being acquired by NP&L in 1942.

The Bryson Powerhouse was modified in 1986 through the enclosure of original window openings with wood and stucco panels and the replacement of original doors. At this same time, the Bryson Dam was modified through the application of a gunite surface. The alterations to the Bryson Powerhouse and Dam do not substantially alter the appearance of the structures as to render them ineligible for the NRHP. The powerhouse's interior retains its design from its period of significance, including original turbines and switchboard. These components reflect the historic operations of the plant and represent the development of electrical power in the area. The historic physical setting surrounding the Bryson Powerhouse and Dam remains intact, and the complex as a whole retains sufficient historical character to convey an overall sense of time and place of its period of significance.

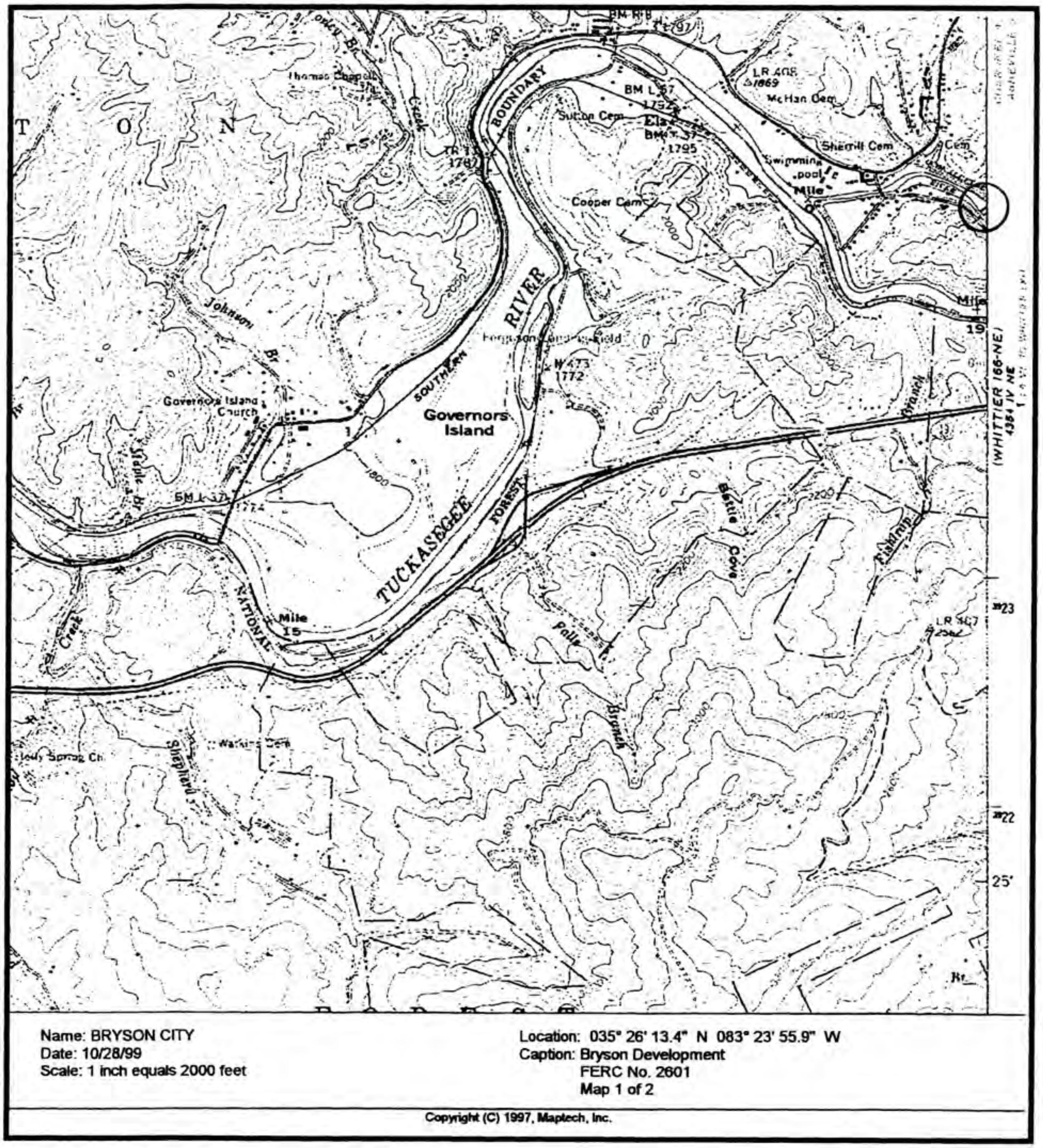

Figure No. 11. Location of the Bryson Hydroelectric Project, Map 1 of 2.

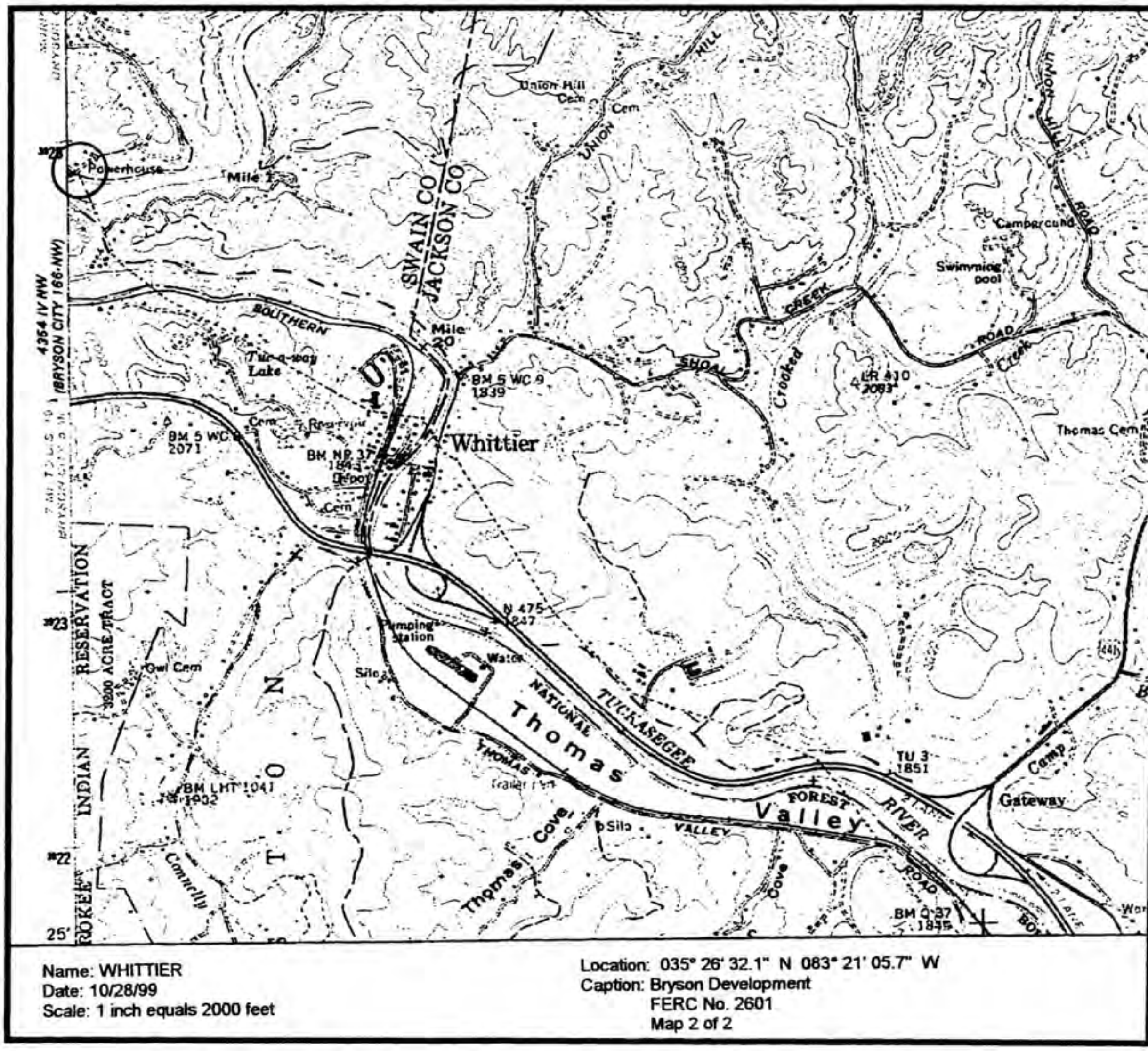

Figure No. 12. Location of the Bryson Hydroelectric Project, Map 2 of 2.

BRYSON DAM AND POWERHOUSE SITE PLAN

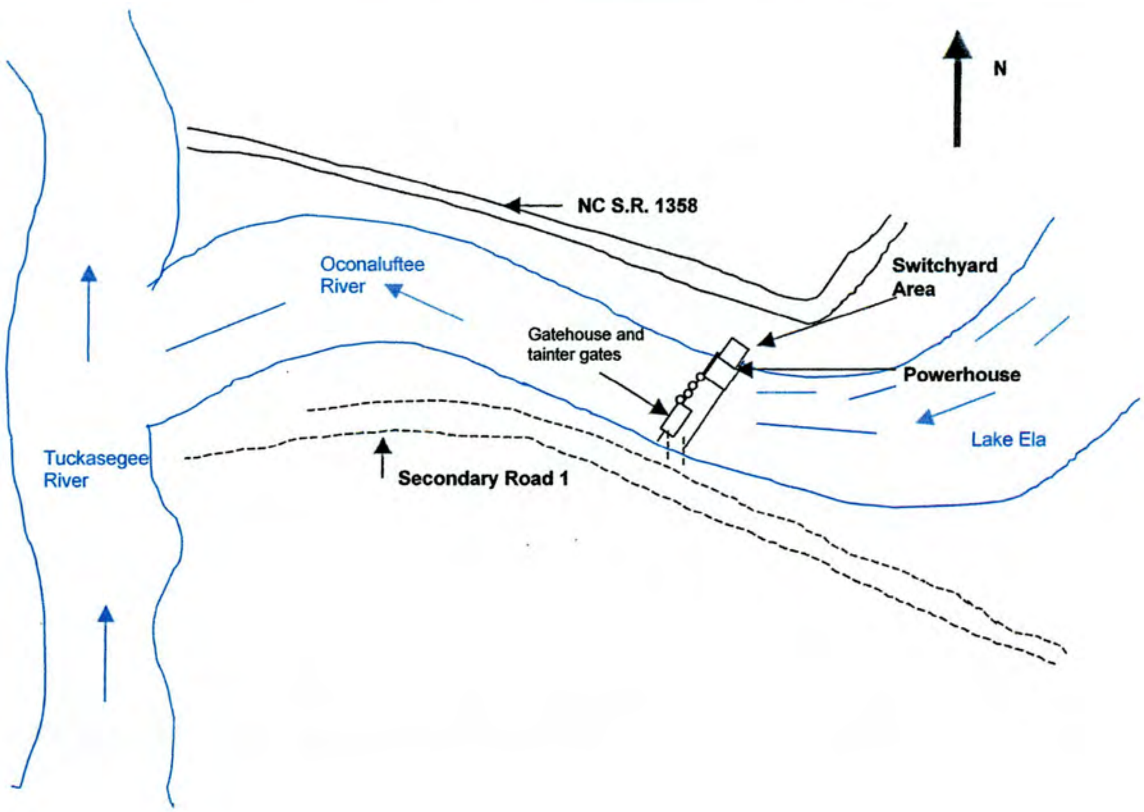

Figure No. 13. Bryson Powerhouse and Dam Site Plan.

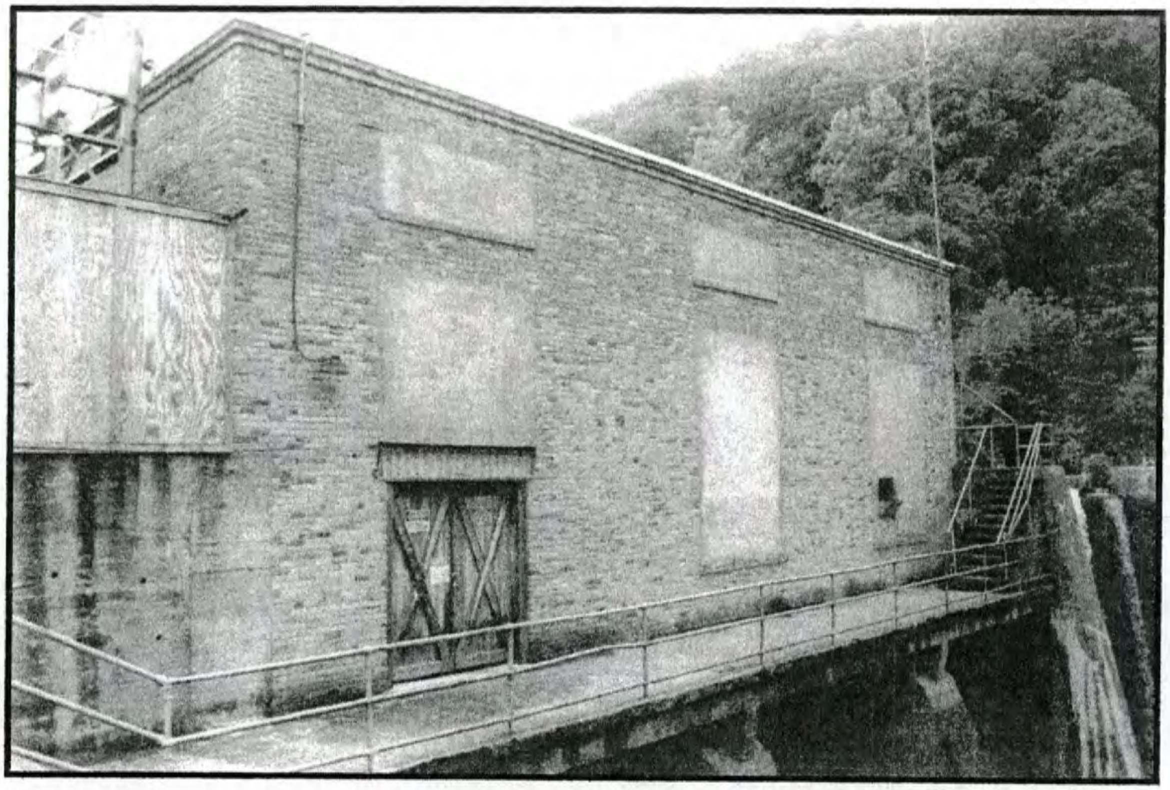

Figure No. 14. The Bryson Powerhouse, west facade.

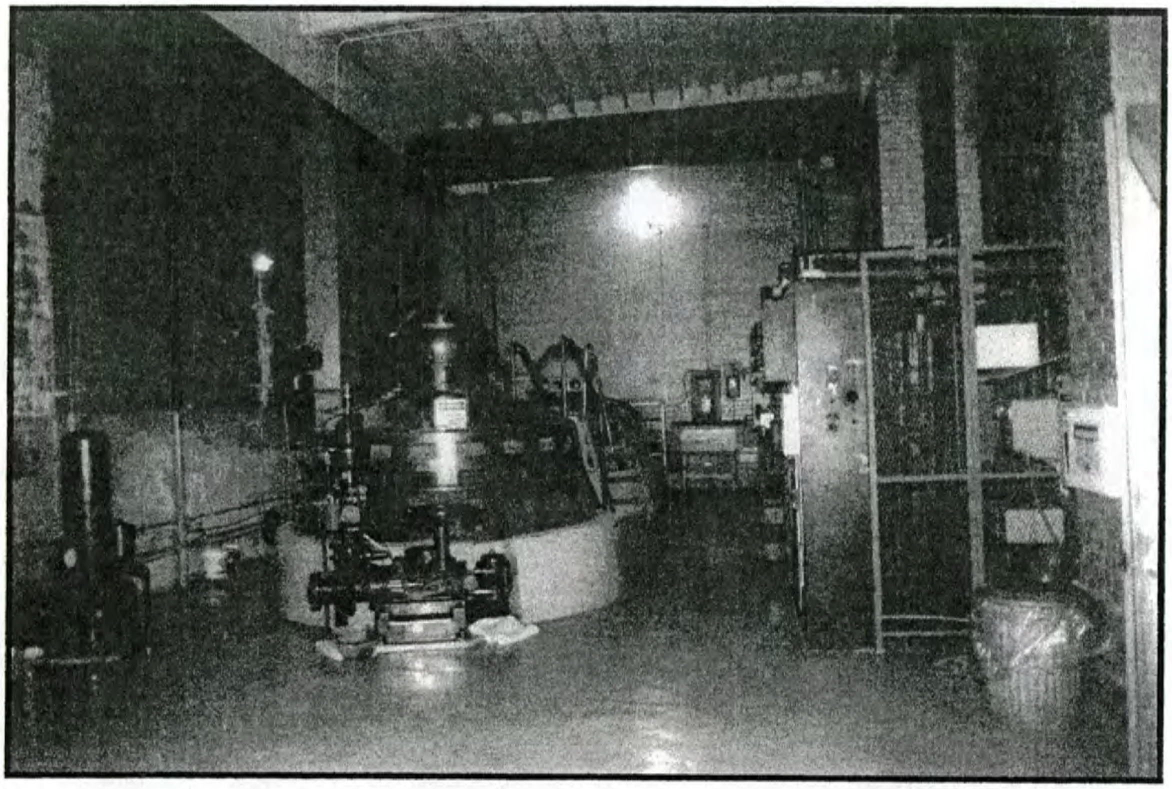

Figure No. 16. The Bryson Powerhouse, interior view and turbines.

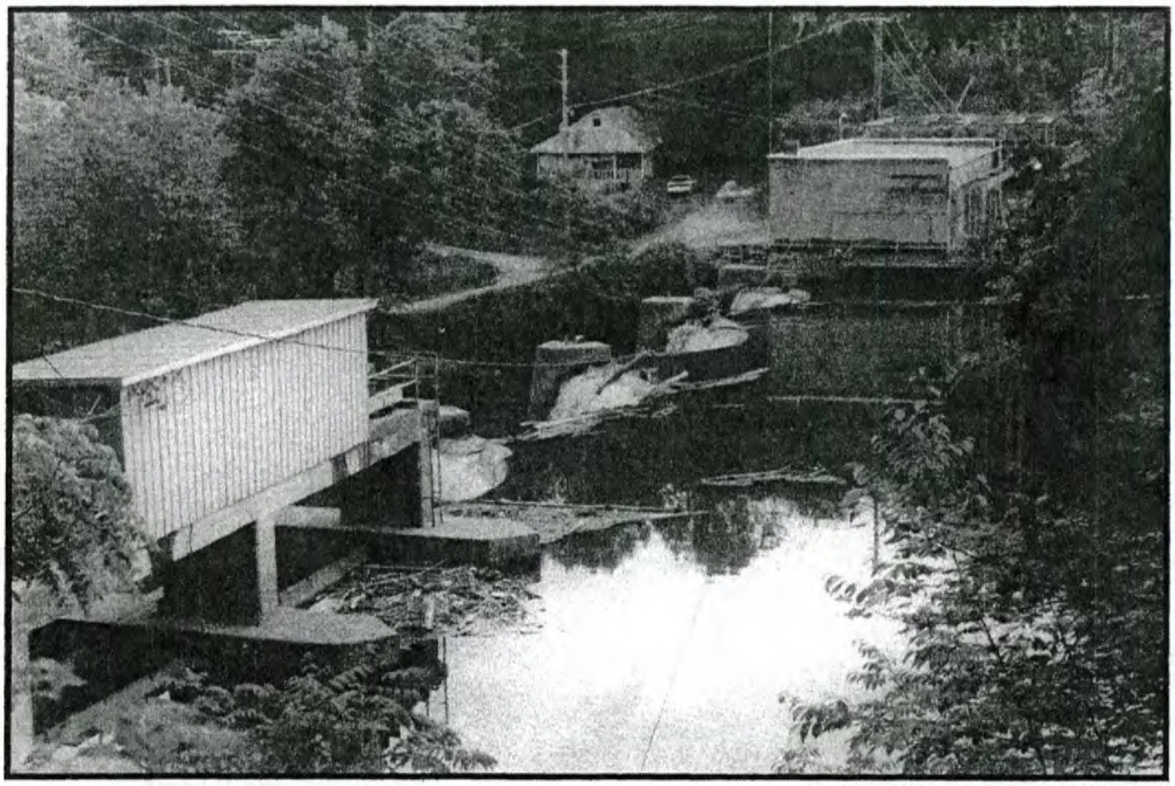

Figure No. 17. The Bryson Powerhouse, south facade, and Dam and gatehouse.

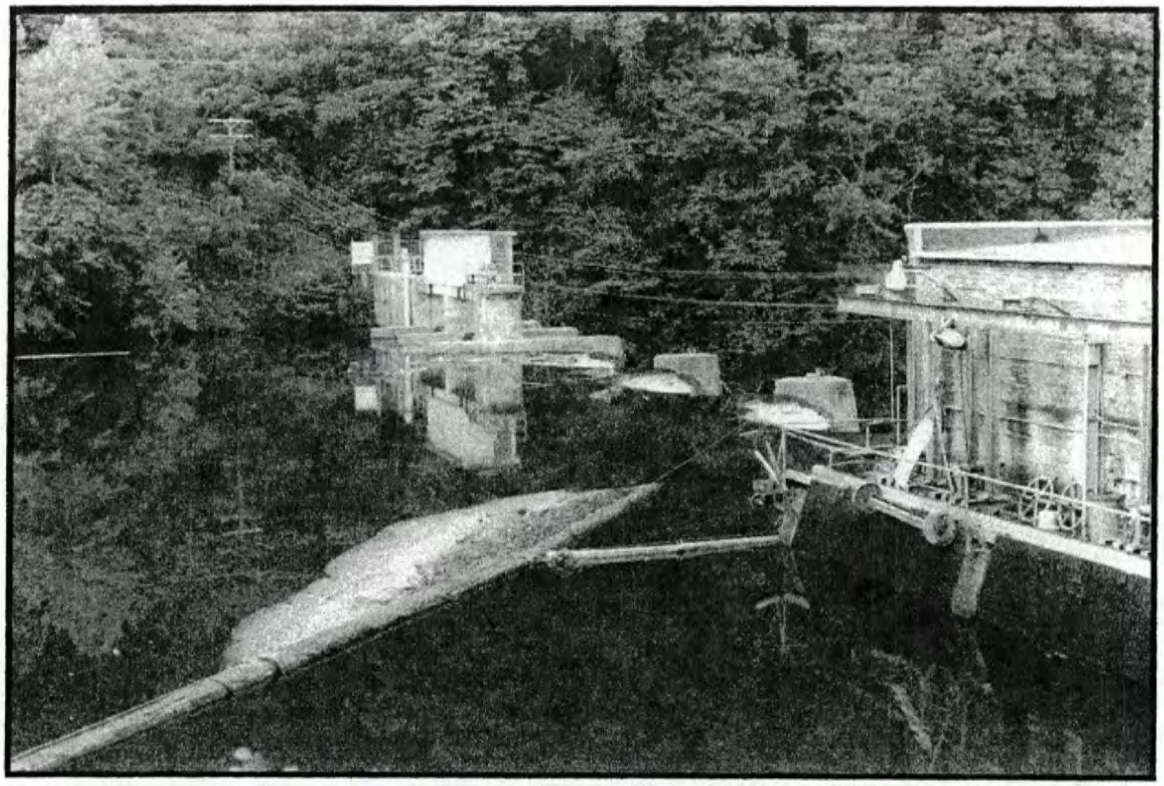

Figure No. 18. The Bryson Dam and gatehouse, view from above.

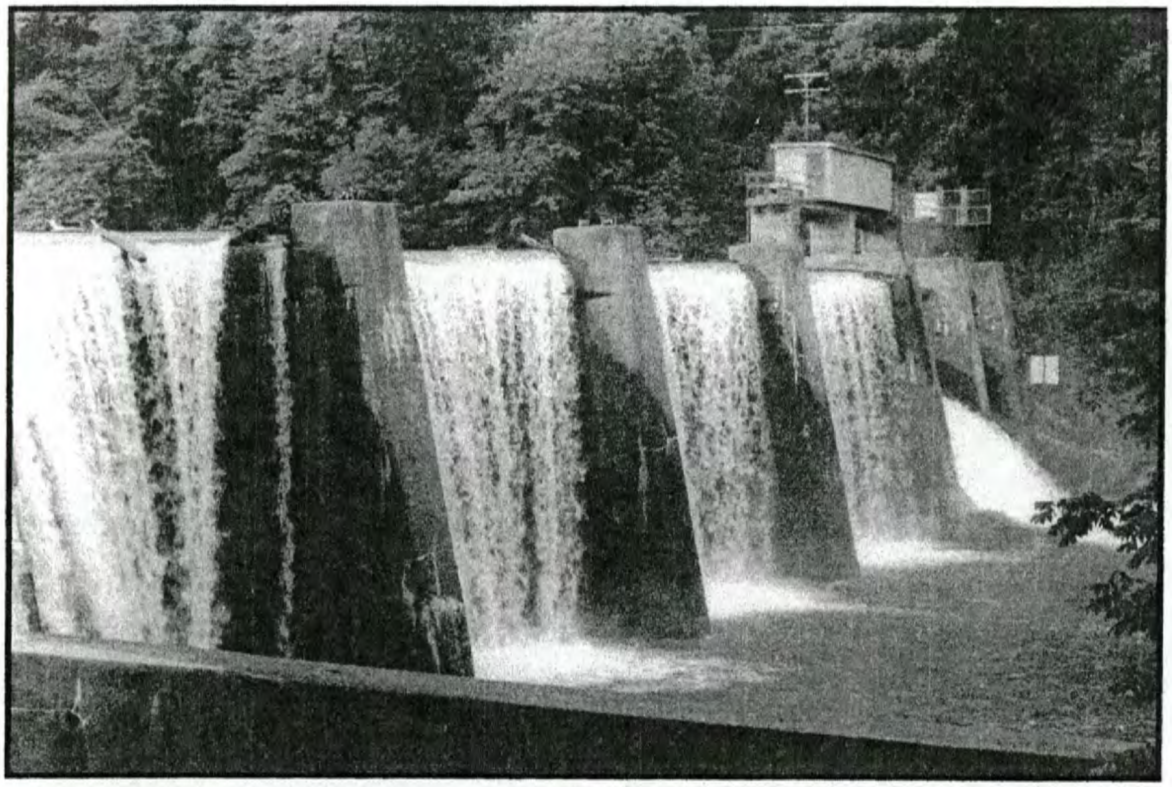

Figure No. 19. The Bryson Dam, view from below.

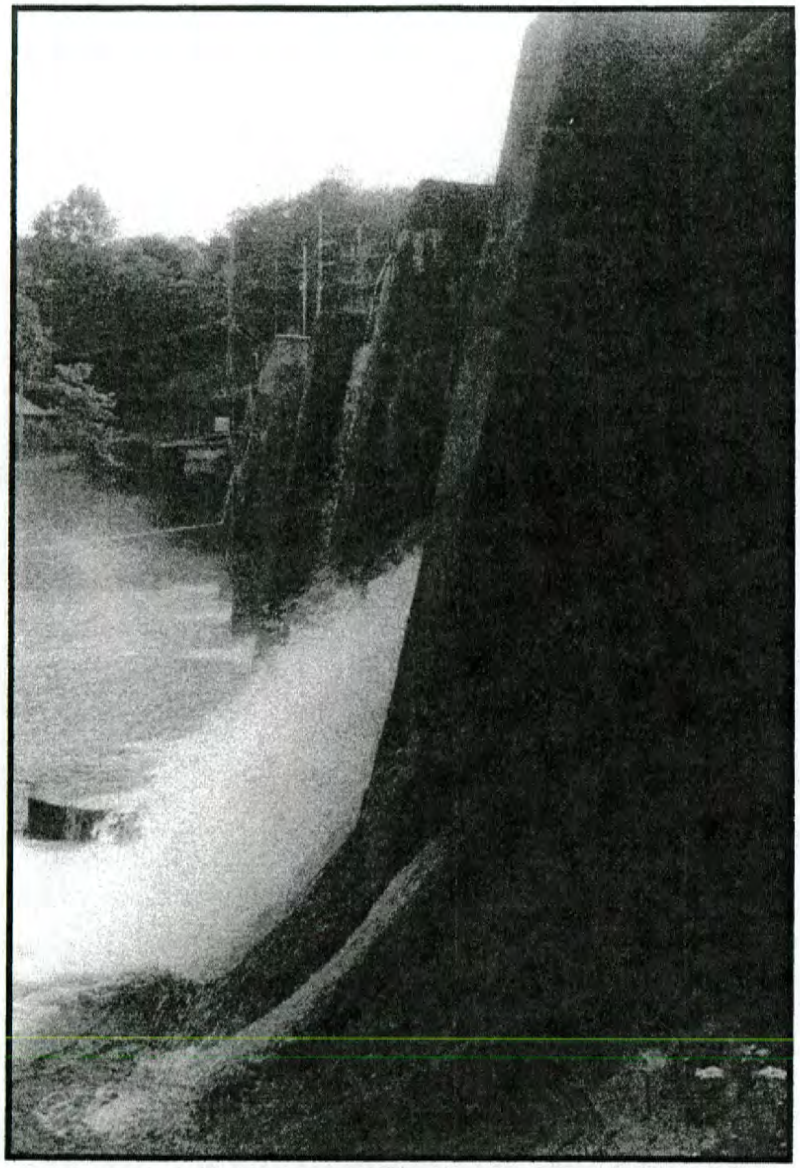

Figure No. 20. Detail of the Bryson Dam showing added gunite surface.

3. Mission Hydroelectric Project

Historical Overview

The Mission Hydroelectric Project was built in 1924 on the Hiwassee River in Clay County to serve the electrical customers in the town of Andrews. Financed by the town, the dam and powerhouse were built by Ludlow Engineers of Winston-Salem. Both of the turbine units in the powerhouse were placed on-line in December of 1924. The Mission plant proved a drain on the town's financial resources, and after the stock market crash in October, Mayor John Christy sold the plant to NP&L in 1929. Upon its acquisition by NP&L, the Mission plant consisted of the dam, powerhouse, two turbines with a 930 horsepower capacity, and a 12-mile, 22 KV transmission line. There were 345 customers connected to the system at the time of its acquisition.

In 1943, NP&L added a third turbine unit. NP&L converted the plant to semi-automatic operation in March of 1947, reducing the operating force from four men to one. The conversion equipment was similar to that installed at the Franklin Plant. Three tainter gates had fixed hoists for automatic operation and one gate was equipped to operate mechanically in case of failure of the electrical equipment. Since the 1940s, the Mission Plant has continued to be part of the operations of NP&L.

Description

The Mission Powerhouse is a rectangular plan brick building completed in 1924. The building rests on a poured concrete foundation, and has an exterior of brick Flemish bond. On the main (west) facade are three bays of original paired steel windows. The windows have thirty lights in the upper panels and forty lights in the lower panel. The panels are separated by steel muntin bars, and the windows are divided by brick pilaster strips. The windows rest on poured concrete sills. Above the windows are recessed panels with sailor brick coursing. At the roofline is a corbelled brick cornice and concrete coping. At the southeast corner of the building is an entrance with an original two-panel wood door.

On the south facade of the powerhouse are three windows in the thirty-over-forty configuration. On the east facade are three windows with a thirty-light window over the pedestrian door. On the east facade is the one-story office wing, which has both thirty-five-light and fifteen-light original steel hinged windows. Many of the original glass lights have been replaced with metal sheets. On the north facade, the pedestrian entrance has an original steel door. The equipment bay has a ca. 1980 overhead track steel door. Adjacent to this door is an original fifteen-light window. Above the entrances is a thirty-light, eighteen-light, eighteen-light, eighteen-light, and thirty-light continuous window divided by steel muntin bars.

The interior has a poured concrete floor, exposed brick walls, and a steel truss support system and wood decking at the ceiling. Along the east and west walls of the building are six original light fixtures. These light fixtures are of steel and are stamped "Glow Chicago." In the northeast corner of the building is a small office and bathroom area. This area is subdivided by a brick and poured concrete wall. Leading into the office is an original two-panel wood door. Doors into the shower and bathroom areas are original four-panel wood design. The office has an original hanging light fixture from the ceiling.

The interior has three turbines, two of which were installed in 1924, and the third was added in 1943. All three are Vertical Francis turbines manufactured by the S. Morgan Smith Company. Adjacent to the turbines are three General Electric AC & DC generators. The original switchboard, manufactured by General Electric also remains intact.

The Mission Dam impounds a reservoir which contains 47 acres at full capacity. The dam is of poured concrete. Approximately 4,000 cubic yards of concrete were added to the dam bays located behind the powerhouse in 1998. Gunite was applied to the entire surface of the dam in the early 1990s. The dam has seven original steel tainter gates of steel which measure 16' in width and 14' in height. The gatehouse on the dam is of ca. 1970, corrugated steel and wood panels.

National Register Assessment

In the opinion of the Consultant, the Mission Hydroelectric Project meets NRHP criteria A and C. Under criterion A, the powerhouse and dam are representative of the early development of hydroelectric power in western North Carolina. The plant was built to provide power to the Town of Andrews, which built its own transmission line and distribution system. The town's streetlights were powered by the plant along with an initial 345 customers. The plant was acquired from the town by NP&L in 1929 which extended power to Robbinsville and the Marble and Topton communities. By the late 1940s, over a thousand customers were served by the Mission plant. The powerhouse and dam are significant in the category of Social History as part of the overall influence of electricity in the transformation of North Carolina communities and rural areas in the early- to mid-20th century. The Mission Dam has been altered through the addition of gunite to the surface; however, this exterior surface does not render the property ineligible as contributing to the overall sense of time and place of the hydroelectric complex, and the dam retains a sufficient degree of its historic character and appearance to convey its period of significance.

The Mission Powerhouse is also significant under criterion C for its architectural design. The powerhouse is representative of the municipal and corporate designs for this type of industrial building in the region. Of brick construction, this building was designed in a rectangular plan with large multi-light steel windows for interior illumination. The building has simple exterior brick detailing with influences of the Colonial Revival style in its brick coursing and pilaster strips. The building retains much of its original exterior and interior features, and its high degree of integrity meets registration requirements for this property type.

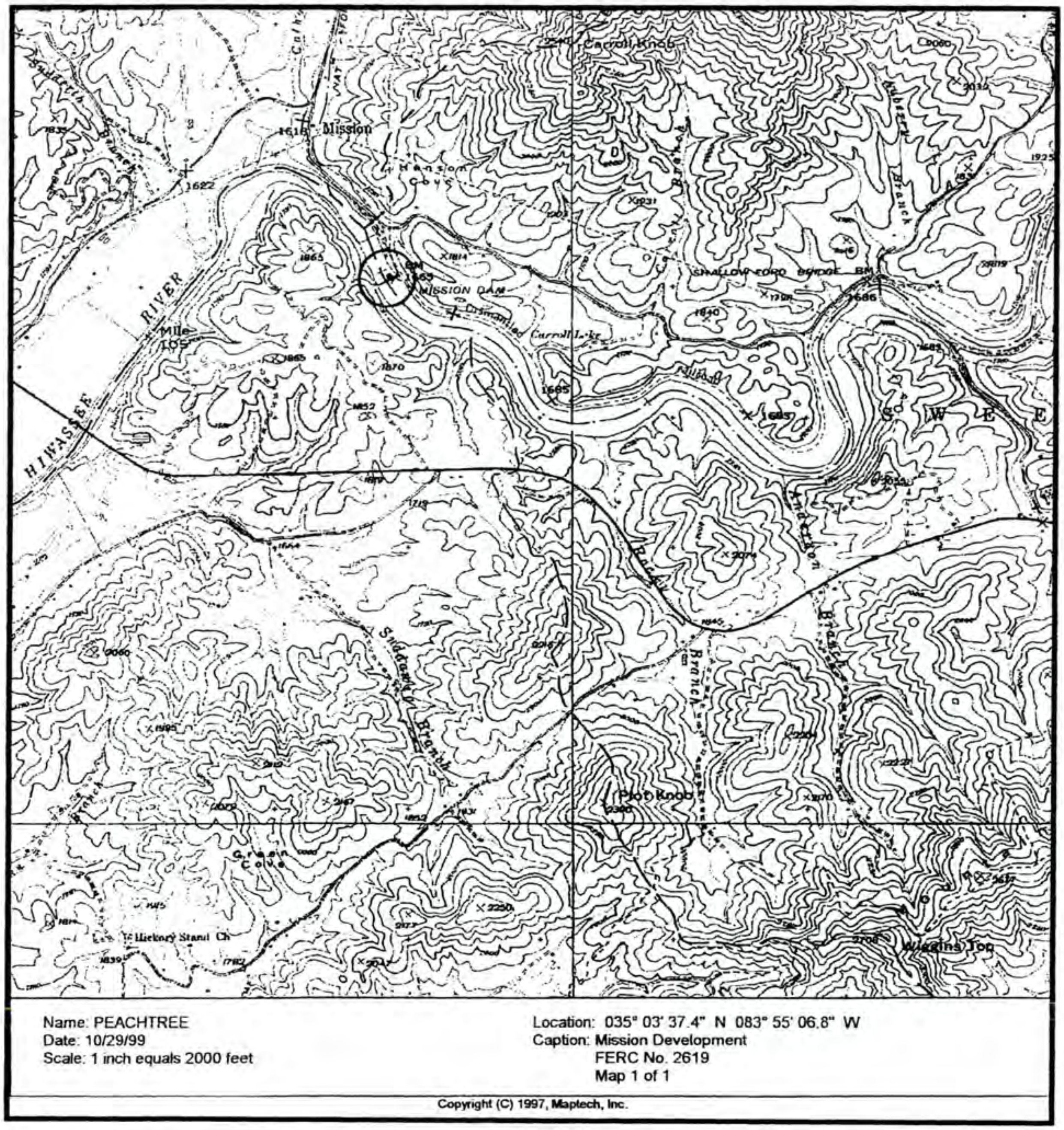

Figure No. 21. Location of the Mission Hydroelectric Project, Map 1 of 1.

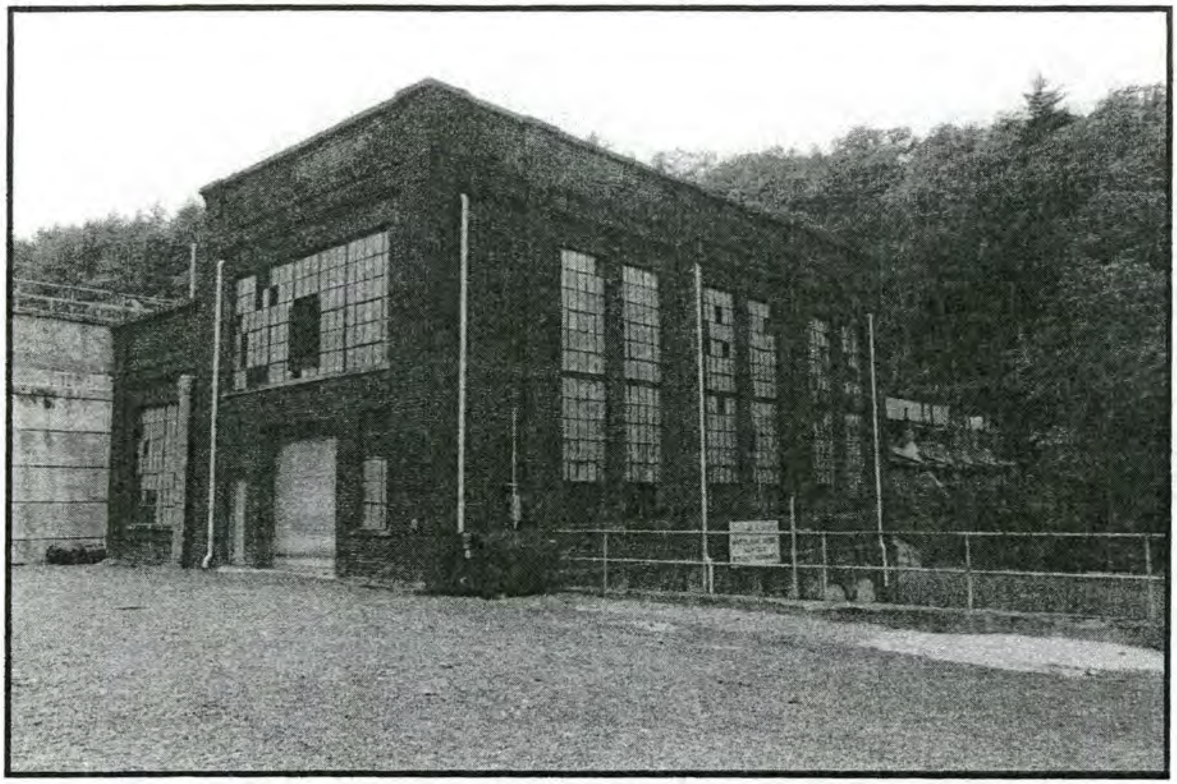

Figure No. 22. The Mission Powerhouse, west and north facades.

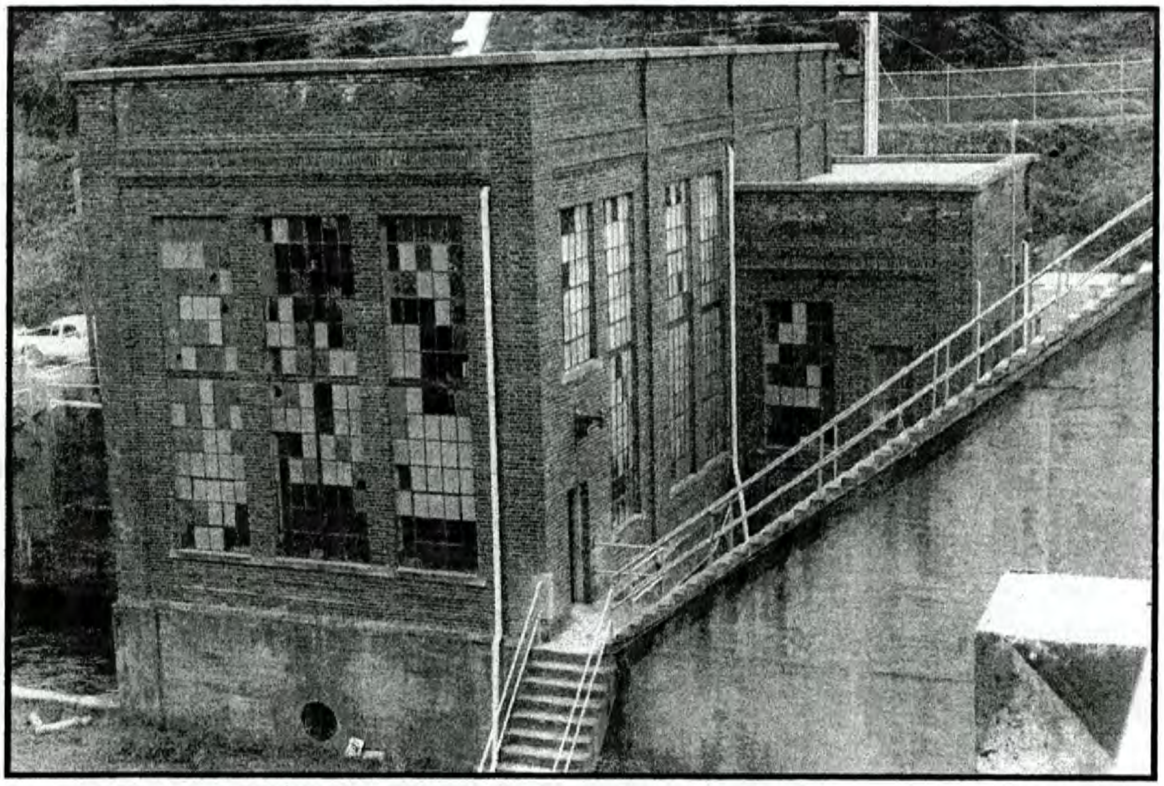

Figure No. 23. The Mission Powerhouse, south and east facades.

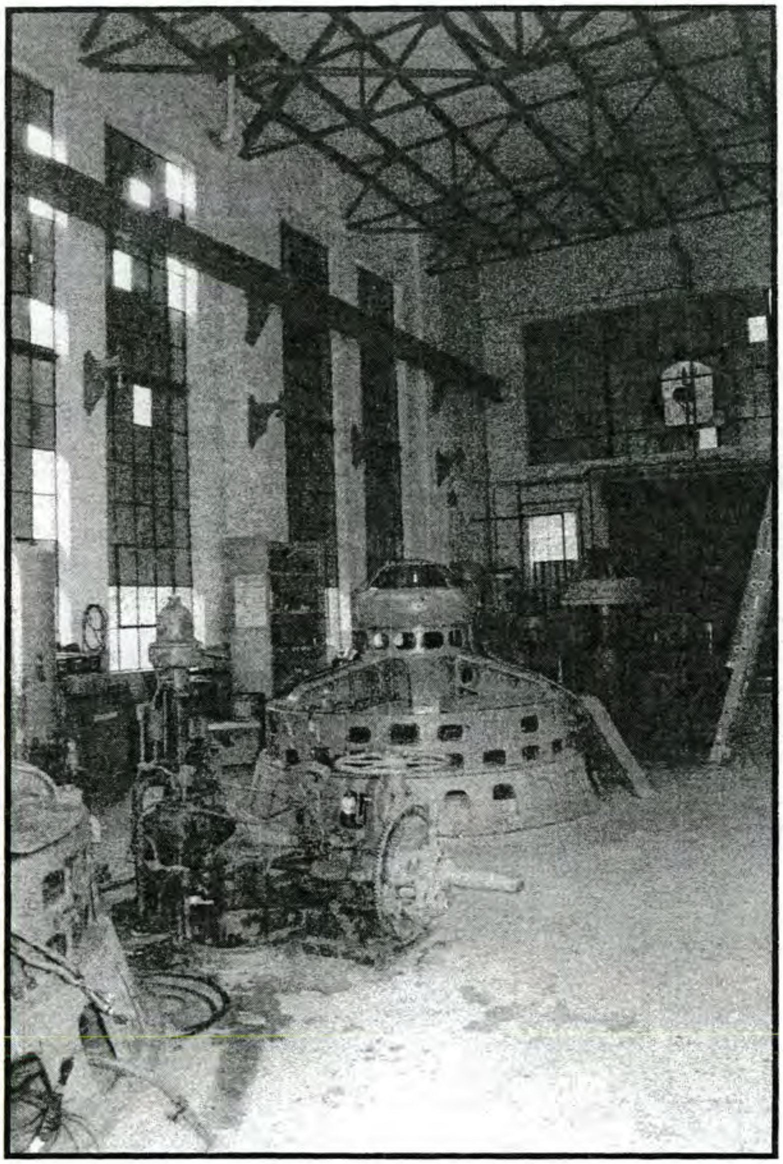

Figure No. 24. Interior view of the Mission Powerhouse and original turbines.

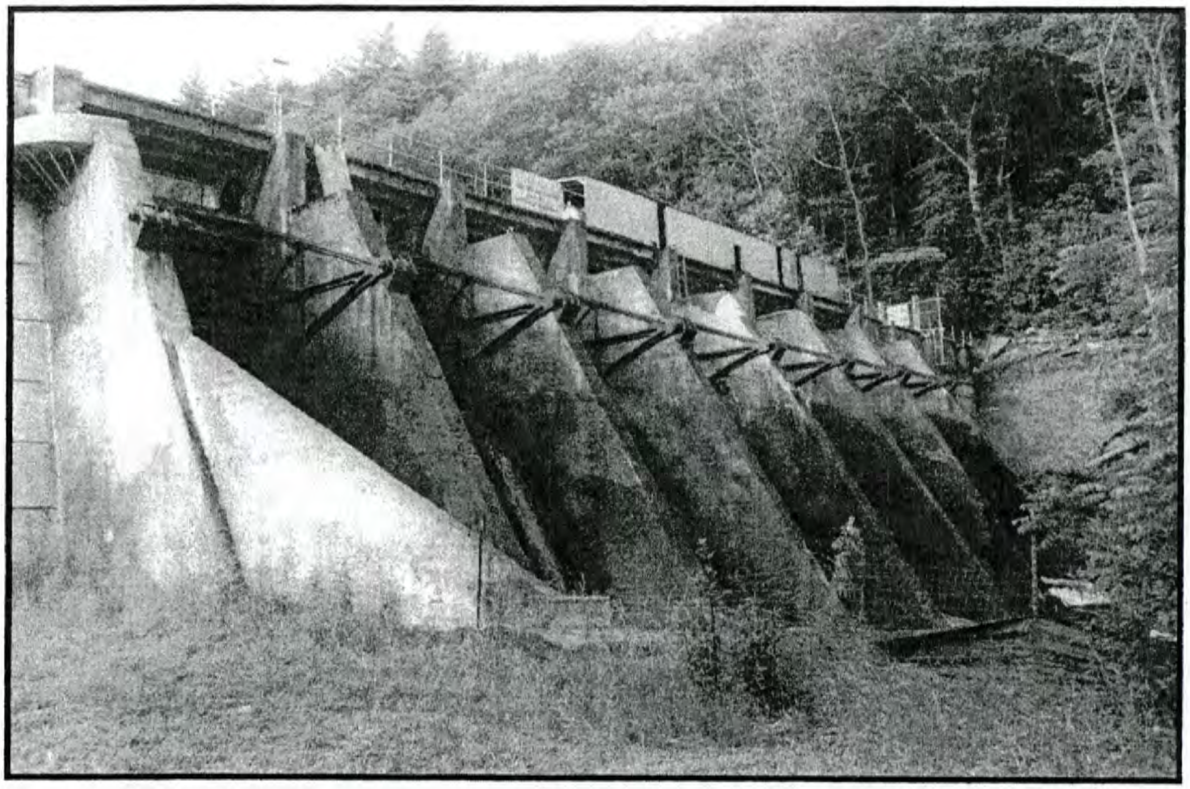

Figure No. 25. The Mission Dam, view from below.

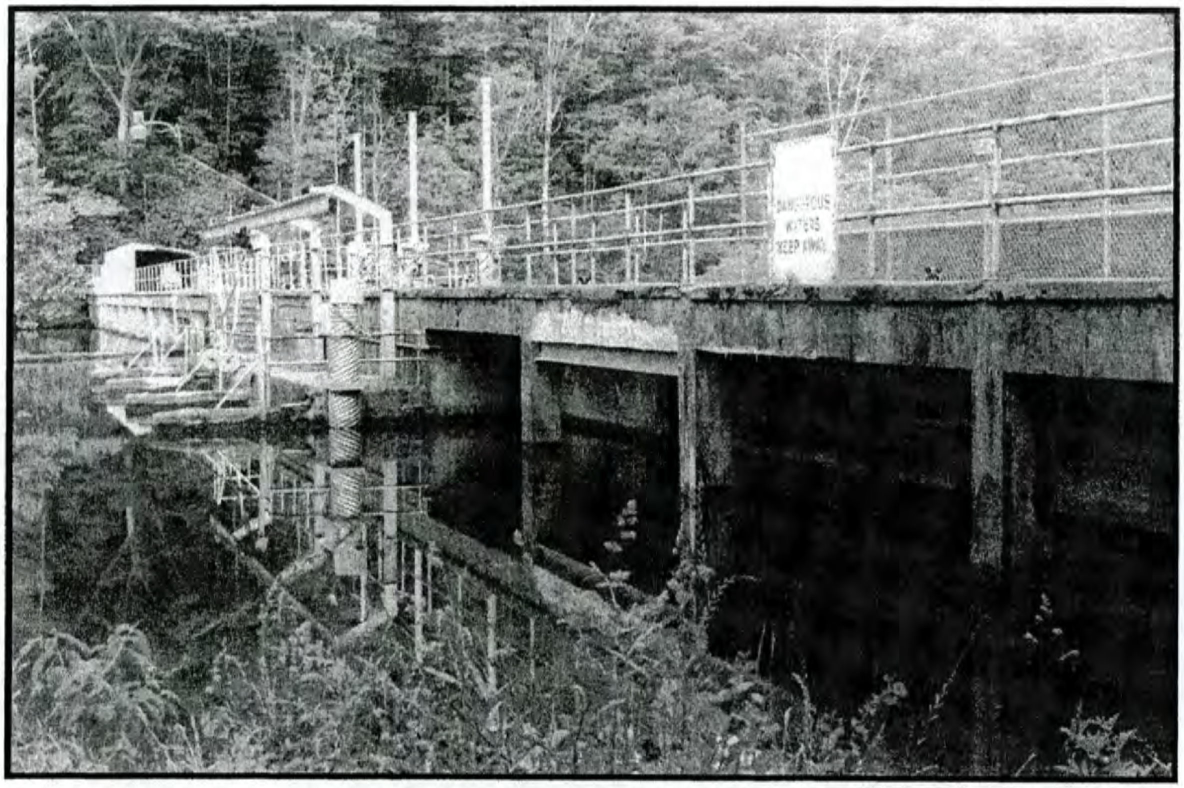

Figure No. 26. The Mission Dam, view from above.

4. Franklin Hydroelectric Project

Historical Overview

Electricity was first generated in Macon County in 1908 when Henry O. Cozad built a small plant on Cartoogechaye Creek in conjunction with his roller mill. This small plant was later supplemented by a kerosene generator and for several years supplied all the available power in the Town of Franklin. Cozad and his associates incorporated the Franklin Light and Power Company in December of 1909. In 1923, the Lake Emory Company organized to build a power plant on Rabbit Creek. It soon became evident to those involved that the creek would be too small to generate enough power for local needs. Following these failures, the Franklin Town Board then selected a site on the Little Tennessee River, and authorized $300,000 in bonds for the acquisition of property and construction of a new hydroelectric plant. Robert and Company of Atlanta, Georgia was hired to design and build the plant. By November of 1925, the dam and powerhouse were completed, and Franklin Mayor S.H. Lyle Jr. officially turned on the plant providing power to the community.[176]

By the time of the Depression, the town had sold the facility to Northwest Carolina Utilities, who let the plant fall into disrepair. In 1933, Northwest Carolina let the plant revert back to the town. In May of that year, the management of the plant was taken over by NP&L, and in November of 1933 the company bought the plant from the town. At that time, company president J.E.S. Thorpe promised the residents of Franklin that an additional 3,000 horsepower would be added to the facility by adding the plant to NP&L's main line.[177]

Upon its acquisition, the plant consisted of a concrete gravity type dam, 447 feet long and 25 feet high, a brick powerhouse containing two hydroelectric units, and an 11.3-mile transmission line from the power plant to Franklin. At the time of purchase the plant provided power to 307 customers. By 1945, the plant had been converted to semi-automatic operation, reducing the operating force from four men to one. Since the 1940s, the plant has provided continuous electricity to NP&L.

Description

The Franklin Powerhouse is of brick construction and was built in a rectangular plan. The building has a poured concrete foundation, concrete roof, and an exterior of five-course common bond wire brick (manufactured by the Norwood Brick Co., of Charlotte). On the main (west) facade is a central entrance with original paired six-panel hinged doors. The door surround has soldier and sailor brick coursing and corner concrete shoulders. Above the entrance is an original glass and metal light fixture. Above the light fixture is a rectangular concrete panel inscribed "Franklin, N.C. Power Plant." This panel is outlined in soldier course brick. There are four windows on this facade, and these are original thirty-five-light steel design with inset six-light hinged windows. Above the windows is a concrete transom bar with concrete shoulders, and an arched multi-light steel transom. The transom is outlined with two courses of soldier course brick, and at the top of the arches are concrete keystones. All windows have poured concrete sills. Above the windows is a belt course of corbelled brick and alternating stretcher brick. Above this belt course is a concrete cornice. At the roofline metal coping has been added over the original concrete coping.

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[176]McRae 1987, 75.

[177]Ibid., 76.

On the south and north facades are similar steel and hinged windows. The window opening on the north facade has been enclosed with concrete block and a large exhaust fan. On the north facade is an entrance with a ca. 1970 solid wood door. On the east facade are two, thirty-five-light windows. This facade has a small brick wing cantilevered over the powerhouse spillway. This wing has original six-light steel hinged windows. Over the wing are two, eight-light steel hinged windows with concrete sills, multi-light transoms, and brick arches with concrete keystones.

The interior of the powerhouse has an original concrete floor, exposed brick walls, and a ceiling of poured concrete. On the west wall is a ca. 1940 frame office with wood walls and a three-vertical light and three-panel door. Windows of this office are single-light fixed design. The building has an original Westinghouse switchboard and two vertical propeller turbines. Both of these turbines were manufactured by James Leffel & Co., and installed by NP&L in 1942. The generators are original and were manufactured by Westinghouse. Attached to the upper walls is a steel track and crane. One turbine opening in the floor is unused.

The dam impounds Lake Emory, which contains 174 acres when at full capacity. The dam is of concrete, and has six steel tainter gates separated by concrete piers. In the early 1990s the original concrete dam surface was covered with wire mesh and a new surface of gunite. On top of the dam is a ca. 1985 frame and metal gatehouse which contains the winches for raising and lowering the tainter gates.

National Register Assessment

In 1994, the Franklin Powerhouse was deemed to be potentially eligible for the NRHP under criteria A and C. This assessment was made as part of a countywide survey of Macon County when the powerhouse was placed on a Study List. The Consultant concurs with this assessment. The Franklin Powerhouse is significant under criterion A in the category of Social History. The plant was one of the earliest in western North Carolina to bring electricity to a municipality, with several hundred customers being served soon after it was placed in operation in 1925. The plant was acquired by NP&L in 1933, which continued to serve and expand its operations in the City of Franklin. The plant contributed to changes in the lifestyles of area residents through the introduction of electrical power. As an intricate component of the Franklin Hydroelectric Project, the Franklin Dam contributed to the social changes that the plant brought to the region. The dam has a 1990s gunite exterior, which does not render the property ineligible as contributing to the complex's overall sense of time and place, and the Franklin Dam is also eligible for the NRHP under criterion A.

The Franklin Powerhouse is also eligible under criterion C for its architectural design. The building was designed with Colonial Revival influences in its arched windows, keystones, and brick coursing. The design is typical of similar powerhouses built by municipalities and corporations in North Carolina during the early 20th century. The building has not been significantly altered and retains sufficient integrity to meet registration requirements for this property type.

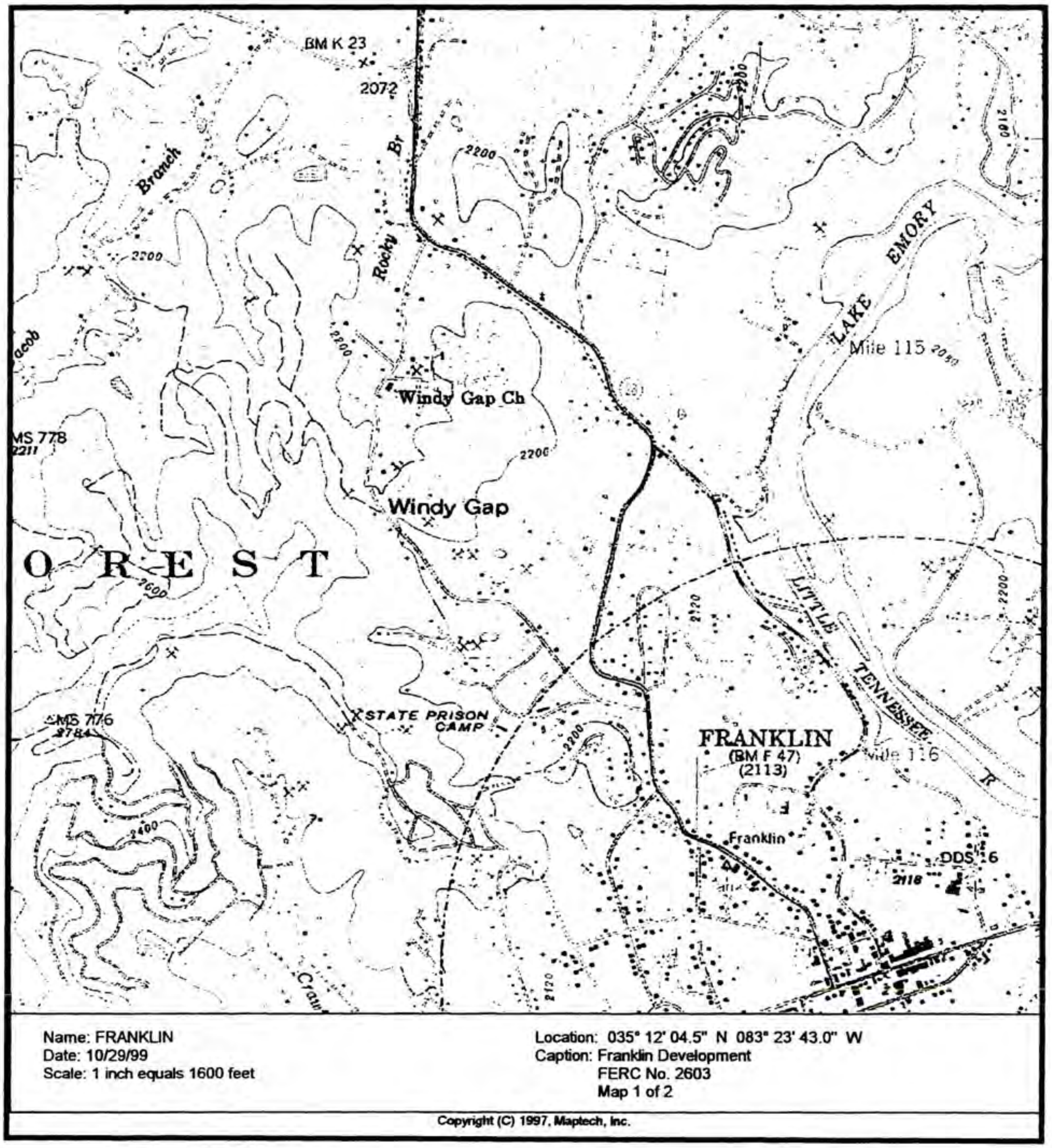

Figure No. 27. Location of the Franklin Hydroelectric Project, Map 1 of 2.

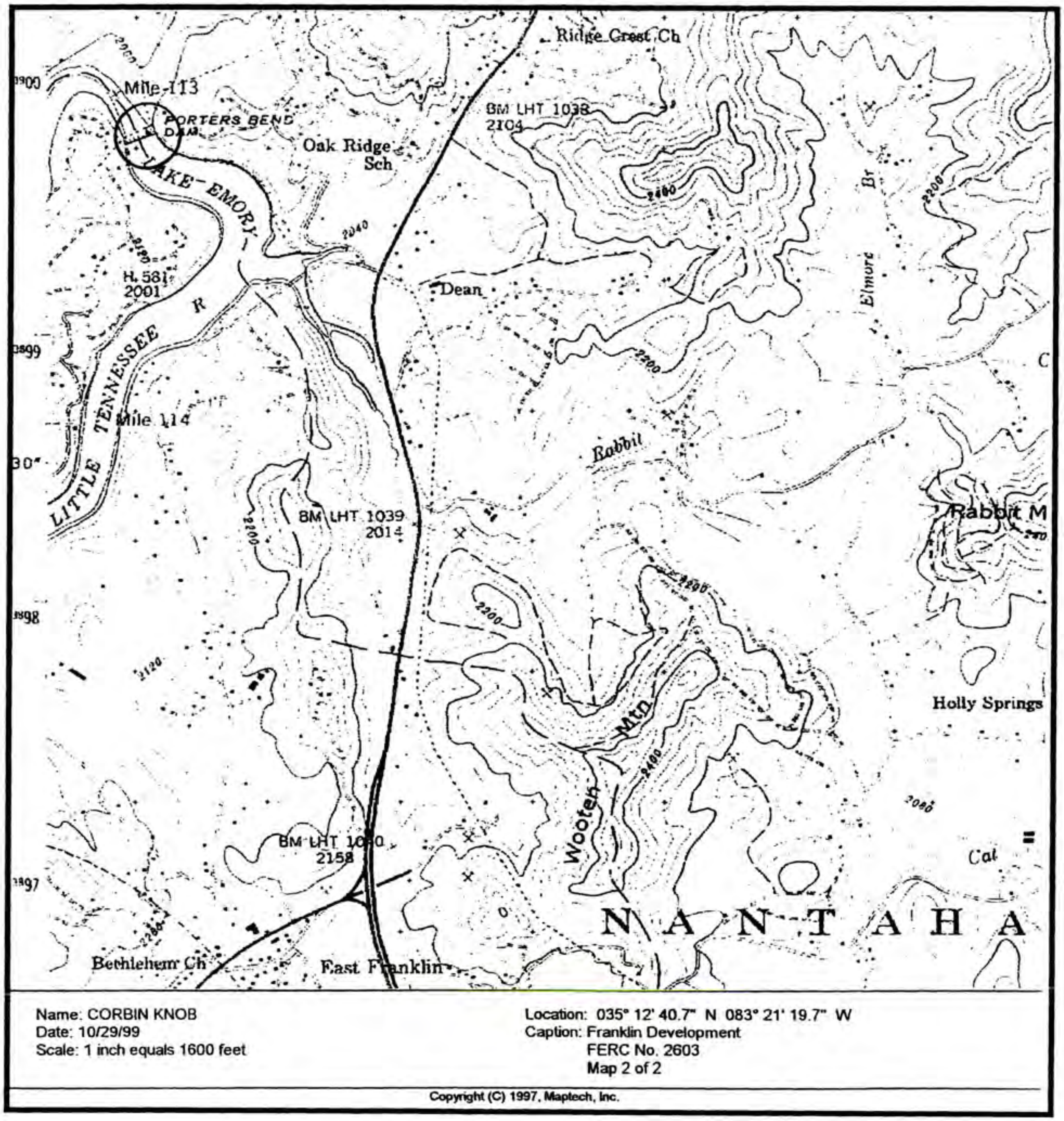

Figure No. 28. Location of the Franklin Hydroelectric Project, Map 2 of 2.

FRANKLIN DAM AND POWERHOUSE SITE PLAN

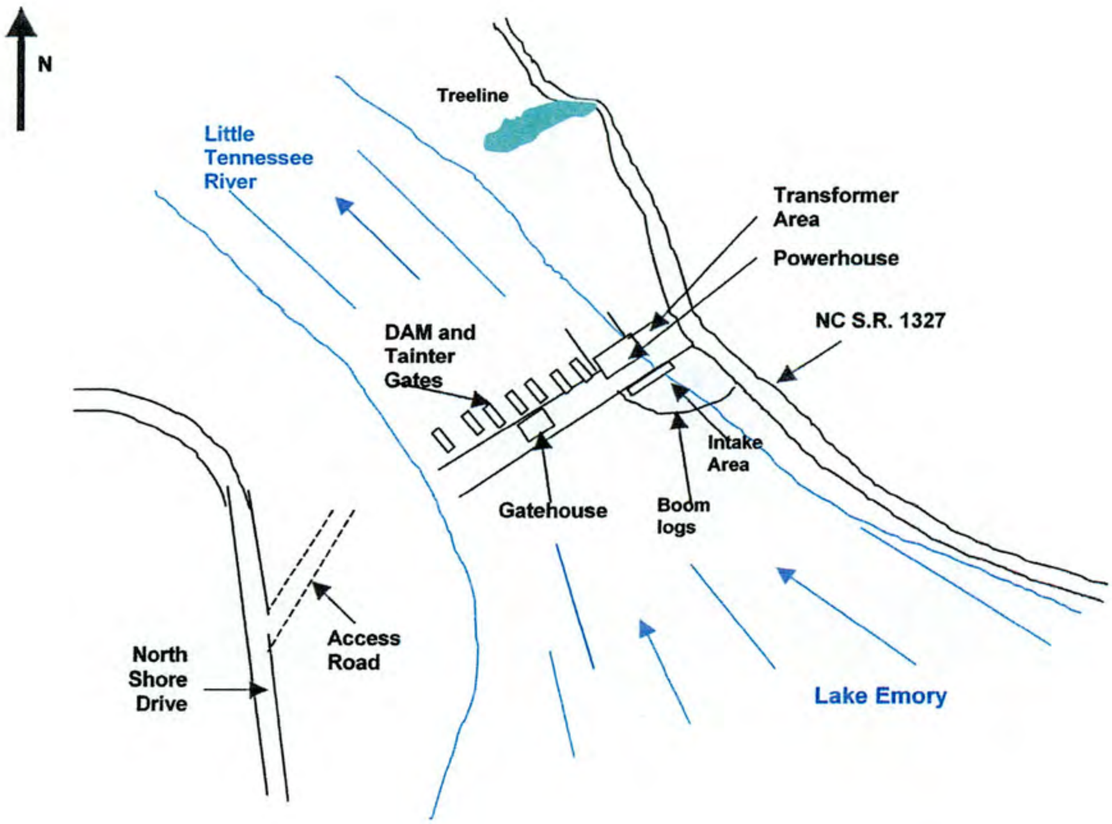

Figure No. 29. Franklin Dam and Powerhouse Site Plan.

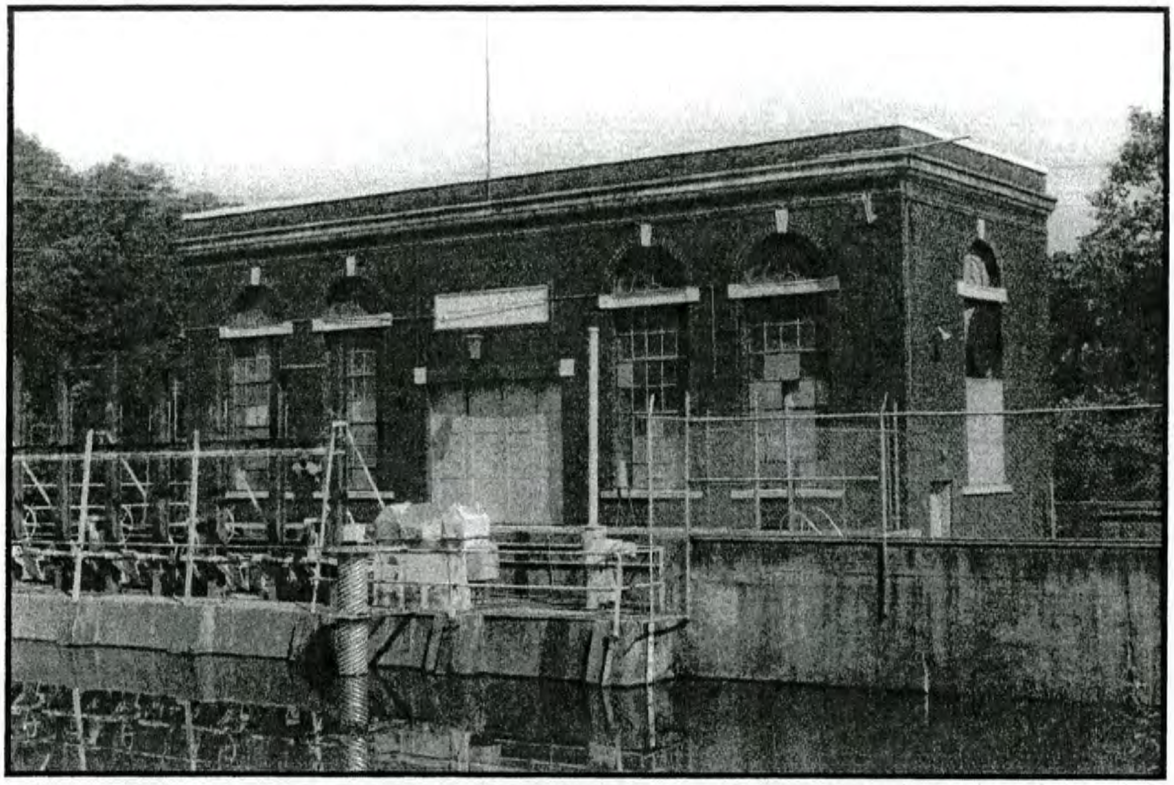

Figure No. 30. The Franklin Powerhouse, west and south facades.

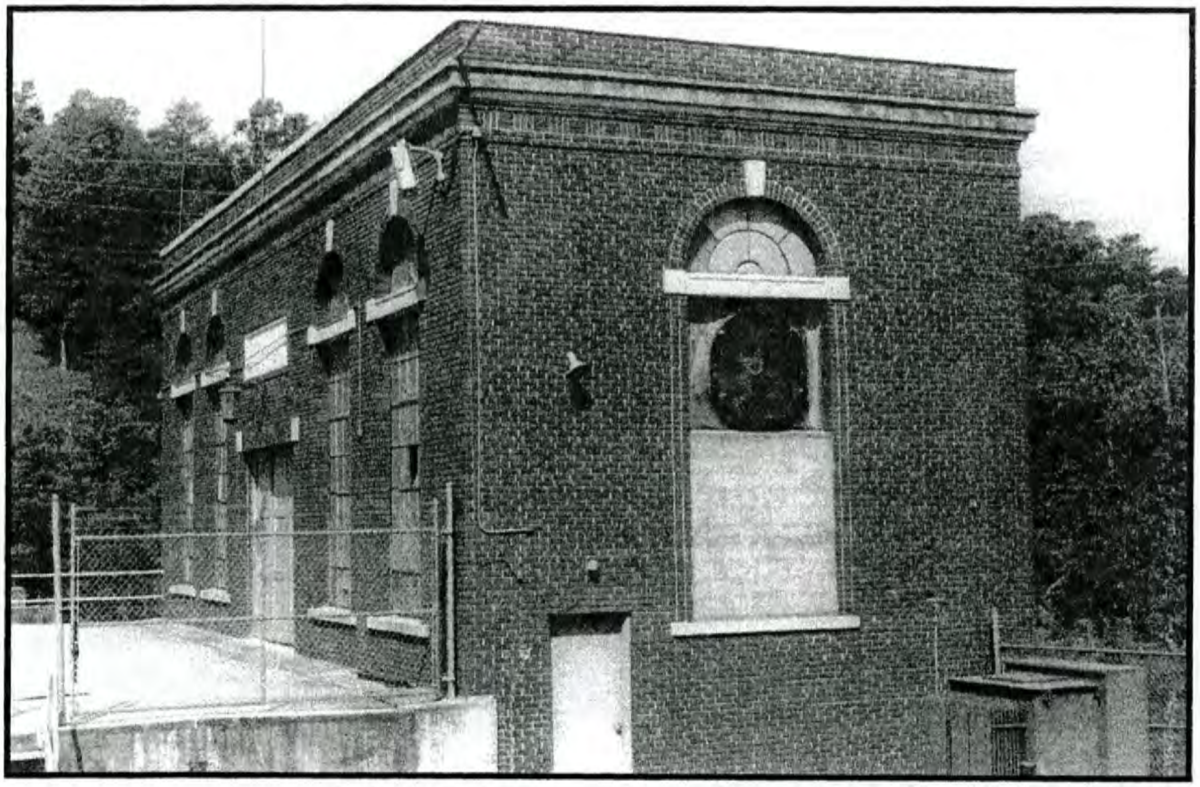

Figure No. 31. The Franklin Powerhouse, west and south facades.

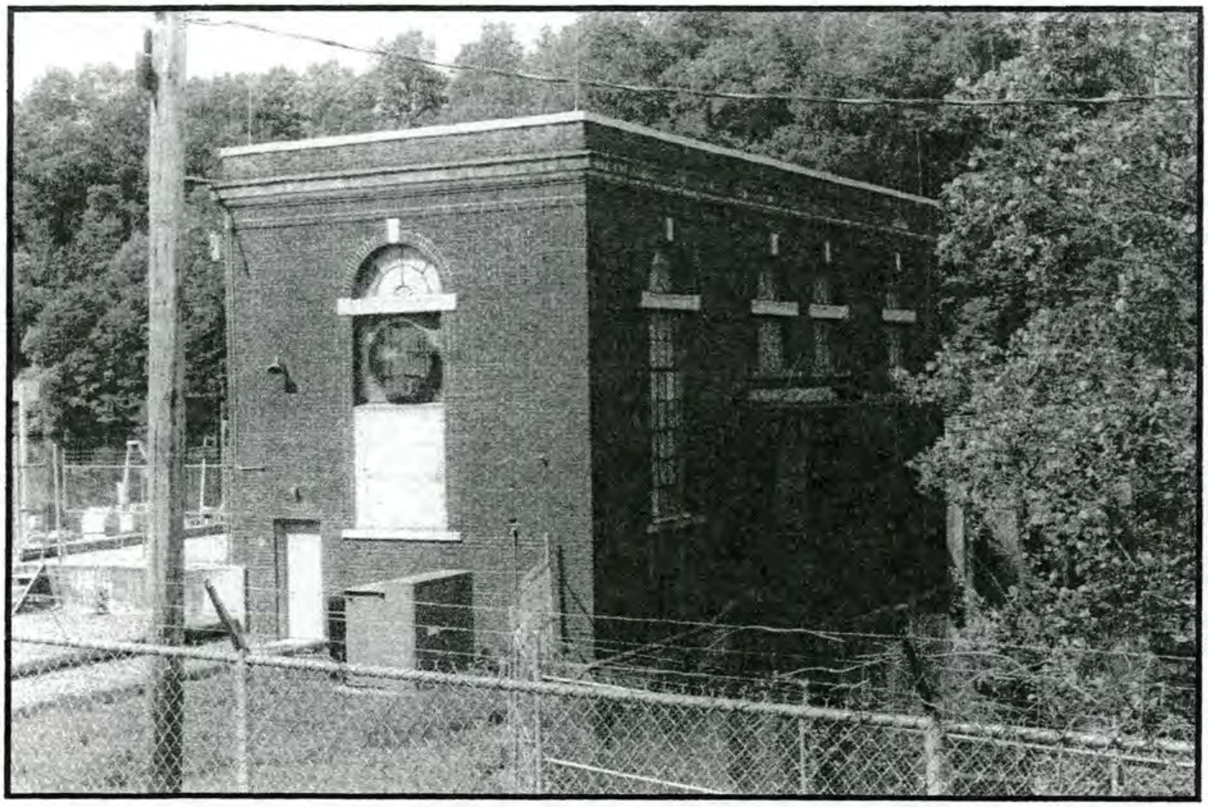

Figure No. 32. The Franklin Powerhouse, south and east facades.

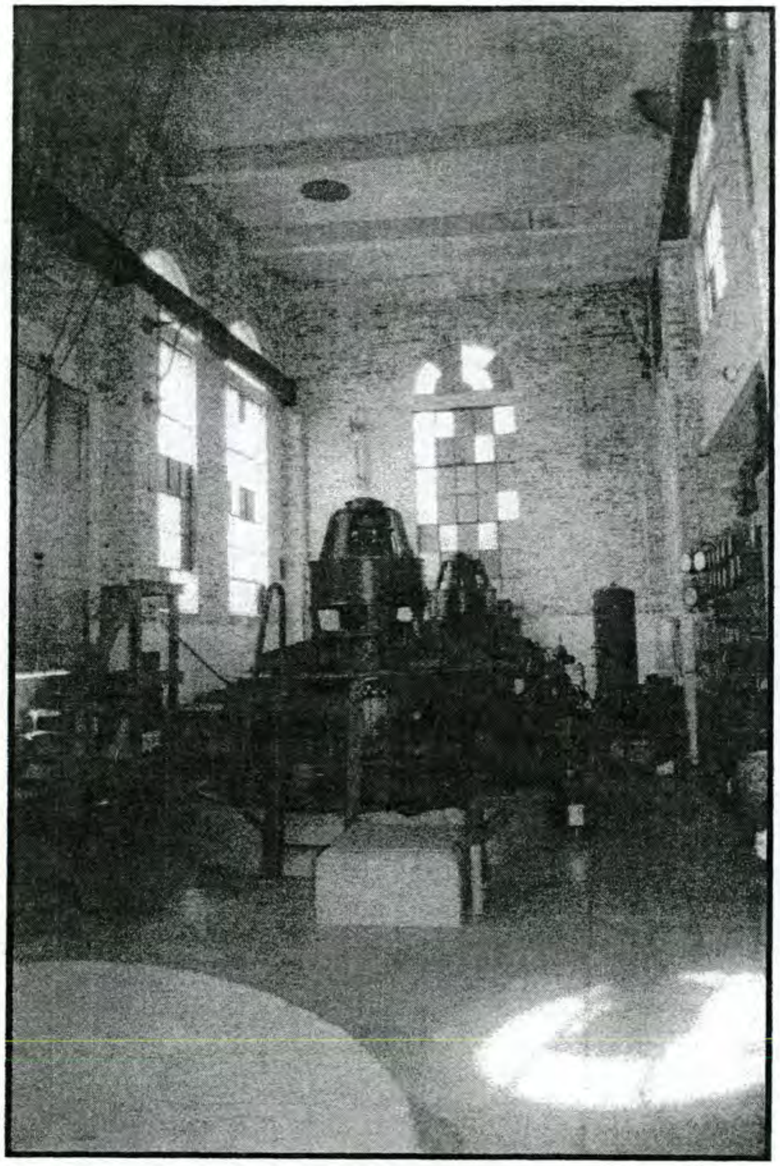

Figure No. 33. Interior view of the Franklin Powerhouse and original turbines.

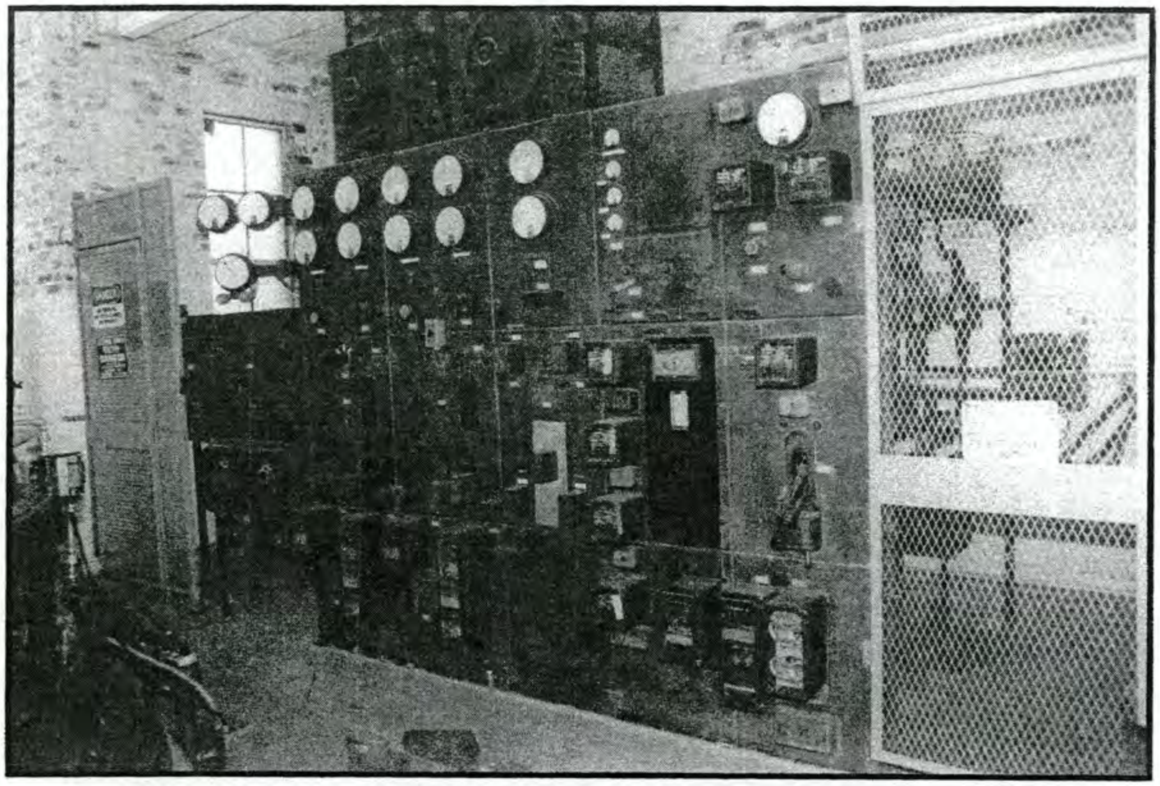

Figure No. 34. The Franklin Powerhouse, original switchboard.

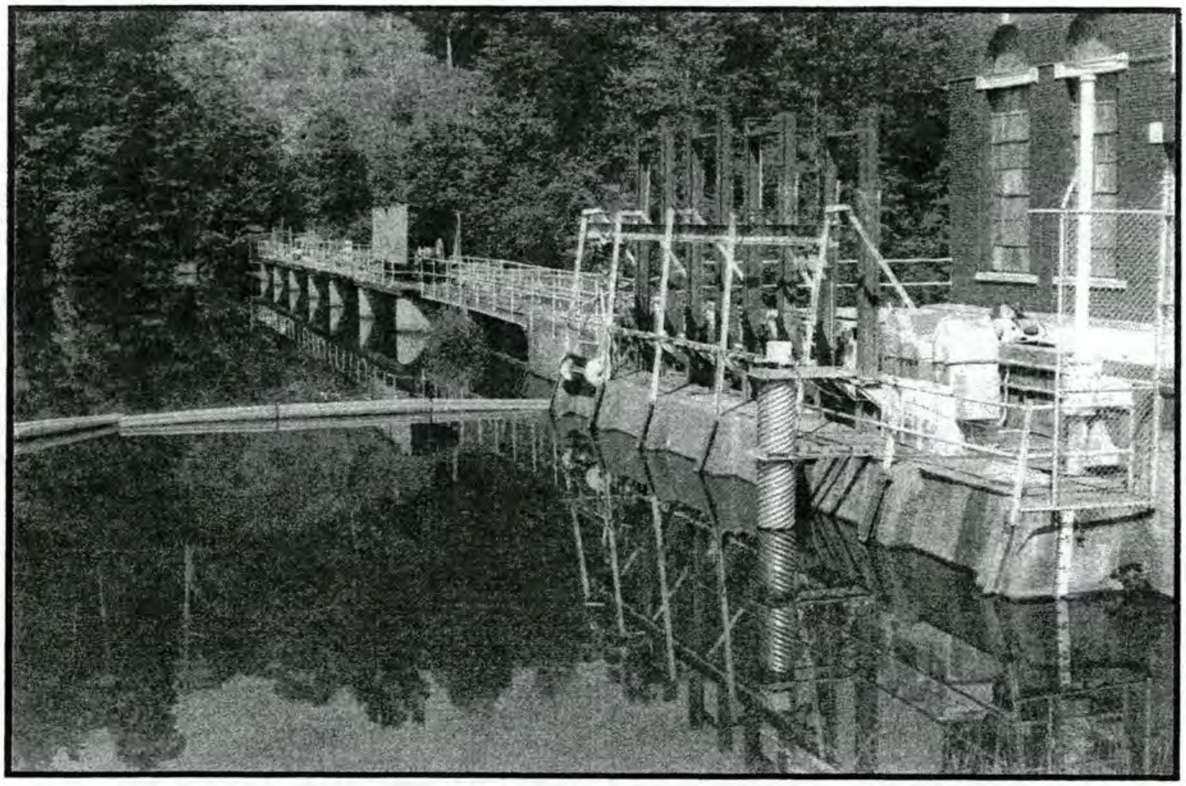

Figure No. 35. The Franklin Dam, view from above.

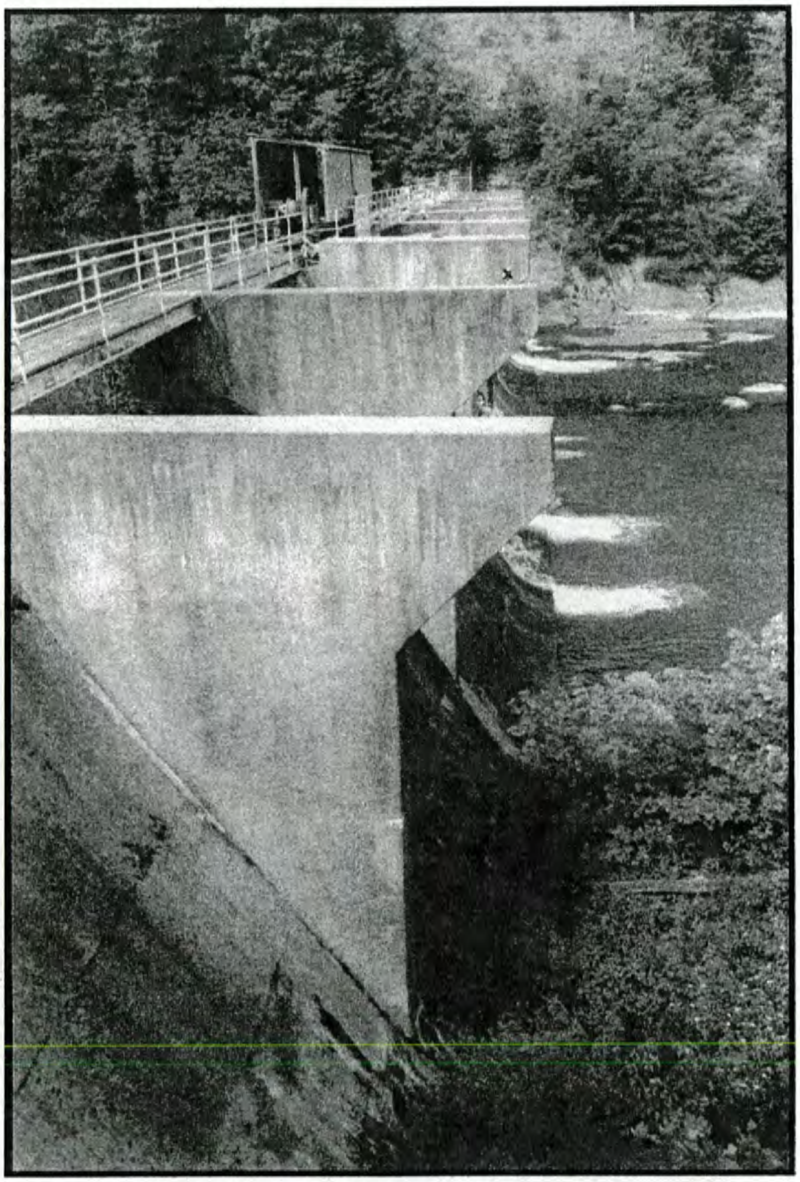

Figure No. 36. The Franklin Dam, view from below.

5. West Fork Hydroelectric Project

Historical Overview

The West Fork Hydroelectric Project has two components - the Thorpe Hydroelectric Plant built in 1941 and the Tuckasegee Hydroelectric Plant completed in 1950. The Thorpe Hydroelectric Plant is located on the West Fork of the Tuckasegee River in Jackson County. The land that the Thorpe Plant would be built on had been in the possession of NP&L for several years. The company eventually planned to develop it, but prior to 1939 there were no industrial or residential demands that would justify the expense of construction. But with the outbreak of World War II, the demand for aluminum from America's allies had skyrocketed. The country's aluminum producers could not keep up with the demand so in June of 1940, the North Carolina Utilities Commission gave permission for the construction of the Glenville (the name was later changed to Thorpe) and the Nantahala hydroelectric projects.[178] By the end of the month, Morrison-Knudson of Boise, Idaho, the construction contractor for the project, had begun hiring laborers. About 1,500 men, both locals and workers brought in by the contractor, worked around the clock for around sixteen months to finish the project, working on the powerhouse, dam, and tunnels simultaneously.[179]

The dam proved to be an economic boon for families in the area still feeling the effects of the Depression. In addition to providing a large part of the workforce, the project provided economic benefits to those locals not directly involved in construction activities. The community of Tuckasegee, located near the location of the powerhouse, became the site of the work camp. Locals boarded the workers and provided necessary services to these men. In East Laporte, the existing rail line to Sylva, previously used to supply a lumber mill, was used to transport materials and equipment for construction. At the reservoir site, a garage was built to fuel and service the project vehicles and machinery.[180]

The massive Glenville project employed innovative construction techniques in an effort to get the plant into operation in record time. Original plans called for one long tunnel to be drilled from the dam to downriver at a site where the present Tuckasegee plant is located. In an effort to speed the work up, engineers decided to build three tunnels and three sections of steel pipe. All three sections were built at one time, with crews drilling each section through solid rock. Each crew per shift built around ten feet per day and when each of the tunnels was drilled through, all three were right on target with its other half.[181]

To clear the bed for the reservoir, the contractor used cattle to haul the logs. While workers drilled the diversion tunnel, a flume diverted the water. Once the tunnel was completed, workers removed the flume and finished the dam. This earth and rock structure was 150 feet high, 1,310 feet long, and 830 feet thick at the base. By February of 1941 the work had been completed.[182].

When the dam was dedicated on October 13, 1941, its 1,462-acre lake was full. Three and one-half miles of tunnel and pipeline at the intake at the reservoir carried water to the powerhouse, 1,200 feet below the lake.

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[178]NP&L n.d., 1.

[179]Ibid., 3.

[180]Ibid.

[181]Ibid.

[182]Ibid., 4-5.

An important feature of the power plant is the head (the vertical distance in elevation from intake to turbine), which is 1,169 feet. At the time of construction, it was the highest head of any hydro plant east of the Rockies and made it possible to produce more power with less water.

The brick powerhouse was described as "a stately building in a rare setting of surrounding hills." The turbine, the largest of its kind in North America at the time of completion, is a twin-runner, horizontal Pelton. The generator turns at 257 rpm and produces 120 million kilowatt hours of electricity per year. For the first time in a hydro development, the contractor put six "fuse plugs" into the dam at the spillway for safety. These plugs made of earth and sandy material lie across the rock spillway and are separated by concrete piers. Engineers designed these plugs to fail progressively in the case of overtopping by waters of the lake. These plugs then become inexpensive emergency floodways that can easily replaced if washed out. These plugs proved their worth two months after construction began when the worst flood in Tuckasegee history occurred. The dam held although power was knocked out on some of the lines to the site.[183]

In 1951, NP&L officials renamed the Glenville plant in honor of John Edward Stirling Thorpe. Thorpe became president of NP&L in 1929, led the company through the war years and supervised the construction of the two largest NP&L developments. In 1997, the plant became automated with operations transferred to the Nantahala Operations Center in Franklin, North Carolina. The Thorpe plant presently generates enough electricity to supply power to 12,500 households per year.

The Tuckasegee Hydroelectric Plant is located in Jackson County. In 1949, construction began on the Tuckasegee Hydroelectric Plant, on the West Fork of the Tuckasegee River, 0.45 mile downstream from the Thorpe Powerhouse. This development included the construction of a concrete arch dam, tunnel, powerhouse, and a transmission line to the Thorpe Powerhouse. In April of 1949 work was completed on the plant and it went into operation in May of 1950. The plant is remotely operated by workers at the Thorpe Powerhouse.

Description

The Thorpe Hydroelectric Plant consists of a dam and associated saddle dam, powerhouse, two gatehouses, and three tunnels and pipelines. These properties were inventoried in 1992 by representatives of the North Carolina Department of Cultural Resources. The Thorpe Dam was given survey number JK-382, while the powerhouse was given survey number JK-396. Nine associated Bungalow style dwellings built for the dam operators and their families are located adjacent to the Thorpe Powerhouse, but are outside of the project boundary. This worker's housing complex was surveyed and given the survey number JK-397. The Thorpe Powerhouse is a rectangular plan, two-story, Gothic Revival influenced brick building. The building rests on a poured concrete foundation and has an exterior of five-course common bond wire brick. Windows are original twenty-four-over-twenty-four fixed steel design. Dividing each window bay is a brick pilaster. Below each window is a concrete sill and rectangular brick spandrel. Above the windows are rectangular brick spandrels and a Gothic arched transom of original glass and steel. At the roofline is a crenelated parapet wall of glazed terra cotta. At each brick pilaster are terra cotta pilaster strips below the roofline.

At the rear (east) facade is a one-story wing with a flat roof. This wing has original fifteen-light steel awning windows and concrete sills. On the north facade of this wing is an original solid steel door. At the east facade of the main section is an original two-panel steel door with wire mesh panels. On the north façade is

[183] Alcoa, et al. 1958, 18; NP&L n.d., 5.

an original steel track door. To the north of the powerhouse is a ca. 1960 corrugated metal storage building resting on a concrete block foundation. This building has double doors of frame construction.

The interior of the powerhouse has a poured concrete floor, exposed brick walls, and a ceiling of steel beams supporting a poured concrete slab roof. Connecting the main floor and basement level are original steel stairs. The building has a terrazzo floor on the first floor level, and a concrete floor in the basement. Interior doors are original two-panel design and single-light glass and steel design. The first and second floors are supported by rectangular concrete columns.

The building contains an original Allis-Chalmers Horizontal Impulse (Pelton Wheel) turbine, made in Milwaukee in 1940. There is also an original Allis-Chalmers AC generator with a capacity of 21,600 kw. The original switchboard is located in a partitioned room with a dropped acoustical tile ceiling and linoleum floor. This original switchboard was manufactured by Westinghouse. A second switchboard added after 1960 is also located on the first floor, and was manufactured by the Russ Electric Co.

The Thorpe Dam is of earth and rock fill, and has a height of 150' and length of 900'. The dam impounds a reservoir containing 1,462 acres at full capacity. A small saddle dam with a height of 122' and length of 410' also helps to impound a tributary for the main dam. The Thorpe Dam has a two-lane, paved road built across the top (State Route 1157). The dam's spillway has two manually operated steel tainter gates, both of which are 12' in length and 25' in width. Associated with the dam are six safety fuse plugs of earth which are designed to fail in sequence in the event of a major flood.

On top of the dam is a two-story gatehouse of poured concrete. This gatehouse contains a large steel gate which operates the dam's bypass or diversion unit. The building has original paired two-panel steel doors. Windows are original fixed twelve-light steel design, and are presently covered with metal panels. The building has a flat roof of poured concrete, walls, and floor. On the second story are also paired two-panel steel doors. To the east of the dam is a similar poured concrete gatehouse which contains a large steel gate. This gate controls the intake into the tunnel and pipe system feeding the powerhouse.

Connecting the dam to the powerhouse are three tunnels and two pipelines. These tunnels are: Tunnel # 1 under Shoal Mountain, which has a length of 3,627'; Tunnel # 2 under Pilot Mountain, which has a length of 4,591', and; Tunnel # 3 under Bell Coney Mountain, which has a length of 4,803'. Along with the tunnels are two steel pipelines along Shoal Creek and Trout Creek totaling over 2,400' in length. These steel pipelines are supported by poured concrete piers. Together, these tunnels and pipelines furnish the water to feed into the powerhouse's penstocks.

To the west of the Thorpe Powerhouse are nine dwellings and associated ancillary buildings remaining from the original company village built in 1940. These dwellings are located outside of the project boundary of the West Fork hydroelectric project. These dwellings were built in standardized plans, and are presently vacant and in fair to poor condition. The dwellings are one-story in height, of frame construction, and were built in gable front plans with Bungalow influences. The dwellings have poured concrete foundations, asbestos shingle siding, and gable roofs of asphalt shingles. The houses have two interior and exterior wall brick flues. The main facades have original gable porches with square Doric influenced wood columns and railings with square balusters. Original front doors are six-light and two-panel glass and wood design. In the gables are louvered vents. The rear facades of the houses have shed roof porches with square wood posts. The rear doors are original six-light and two-panel glass and wood design.

The houses were built with a living room, dining room, kitchen, bath, and two or three bedrooms. Numbers 8, 19, 36 and 50 each have the extra third bedroom. The interiors have original wood floors, wall board walls and ceilings, and original two-panel doors. The houses were originally heated by stoves. The baths have been remodeled but retain original curved tubs. Most kitchens retain their original sink and cabinets.

The nine dwellings are grouped together in two separate areas. Along Dexter Road, just west of the powerhouse are six dwellings. One of these has been extensively altered with a large ca. 1970 lateral wing, while another has been gutted by fire. Associated with this grouping of dwellings are three original, two-car garages. These garages are of corrugated steel and wood construction, with a shed frame roof with exposed rafters and double doors of corrugated steel. To the west of this complex are three additional dwellings grouped together facing State Route 107. Associated with these dwellings is a single-bay corrugated metal garage, and a three-bay corrugated metal garage. An original one-story frame storage building is also located within this complex.

The Tuckasegee Hydroelectric Plant consists of a powerhouse and dam on the West Fork of the Tuckasegee River. The powerhouse is a two-story, poured concrete building. This building has a corrugated steel panel roof. The building's entrance has an original two-panel steel door. This door is set within a larger hinged steel door. The building has no other fenestration. The interior of the powerhouse has poured concrete walls, floors, and a section of the upper wall is of steel panels. The interior retains an original vertical Francis turbine manufactured by the S. Morgan Smith Company.

The Tuckasegee Dam impounds a reservoir, known locally as Little Glenville, which contains 7.9 acres at full capacity. The concrete arch dam was built in an oval shape with steel panels on top of the concrete. The dam is 61' in height and 324' in length. The dam has a concrete spillway and steel panel sluice gates. Connecting the dam to the powerhouse is a 13-foot diameter steel penstock and a tunnel which is 3,246' in length.

National Register Assessment

In 1994, the Thorpe Powerhouse and the adjacent worker's housing were deemed potentially eligible for the NRHP, and placed on the Study List following a survey of Macon County. These properties were considered eligible under criterion A and C for their historical and architectural significance. In addition, the Thorpe Dam Complex Historic District was determined eligible for the NRHP in 1999. This complex includes the dam and associated gatehouses. The Consultant concurs with both these assessments. In the opinion of the Consultant, the Thorpe Hydroelectric Plant has significance under criterion A in the categories of Military and Engineering, and under C for the architectural significance of the powerhouse and adjacent worker's housing. The plant is not eligible in the category of Social History because almost all of its electricity prior to 1955 was sent to the Alcoa plant in Maryville, Tennessee, rather than to residential or commercial customers in western North Carolina. Power to local customers from this plant was not provided in any appreciable quantities until the 1960s.

At the beginning of World War II, it became apparent that America's ability to meet the projected need for aluminum for the war effort was insufficient. In response, the nation's largest producer of aluminum, Alcoa, made plans to increase production and build a new plant at its facility in Blount County, Tennessee. The aluminum smelting process requires an enormous amount of electrical power, and both the Thorpe and Nantahala plants were built to help supply this need. The Thorpe plant was completed and placed into operation in 1941, with Nantahala placed in operation in 1942. Both of these hydroelectric plants provided the necessary electricity to help power the Alcoa facility in Tennessee which made aluminum for aircraft. The significance of these two hydroelectric plants was noted in the February issue of *Engineering News-Record*, in the article "More Power for Bomber Production." The article states that the immediate goal of these plants was to produce electricity for the manufacture of bombers, and that the annual electricity produced each year by these plants could build 1,230 B-17 "Flying Fortress" bombers.[184] Alcoa was one of America's essential industries during World War II, and both the Thorpe and Nantahala plants contributed to its success.

The Thorpe Dam is also significant in the category of Engineering for its overall design. This earth and rock dam was the first in the nation to utilize safety fuse plugs at its spillway entrance. Safety fuse plugs are essentially small earthen dams which are designed to fail progressively in case of a major flood. These devices helped to increase dam safety and prevent sudden flooding below the dam. The dam and its associated buildings retain sufficient integrity to meet registration requirements for this property type.

The Thorpe Powerhouse is a notable example of an electrical powerhouse of its period. Designed with the influence of the Gothic Revival style, the building is similar of other powerhouses in the region. It was built in a rectangular plan with large, multi-light steel windows, and open floor space on the interior. The building retains much of its original interior and exterior detailing, and possesses sufficient integrity to meet registration requirements for this property type. The Thorpe worker's housing also retains sufficient integrity to meet registration requirements for this property type.

In addition to the powerhouse, worker's housing, and dam complex, it is also the opinion of the Consultant that the water pipelines and tunnels connecting the powerhouse and dam also meet registration requirements for the NRHP. These structures were integral to the operation of the complex, and their construction enabled the plant to have such a high head and large electrical generating capacity. The steel pipeline and tunnel appear much as they did when they were built, and retain integrity of their original design.

In consultation with the North Carolina State Historic Preservation Office, it is the determination that the Tuckasegee Hydroelectric Plant meets NRHP criterion A. Under criterion A, the plant is significant in the categories of Industry and Military. The Tuckasegee plant was completed in 1950 to provide additional power to support the operations of the Aloca aluminum plant in Blount County, Tennessee. In the post World War II era, Alcoa was a leading company in the aluminum industry, and as the principal industry in the region, had a substantial impact on the growth and development of East Tennessee. Alcoa also played an important role in the U.S. military's preparedness during the Korean Conflict and the Cold War as a substantial supplier of the government's aluminum stockpile for aircraft production. The Tuckasegee plant supported this effort as a contributor to Alcoa's power supply. The Tuckasegee plant is not eligible under the context of Social History as it was not until the 1960s that power from the Tuckasegee Hydroelectric Plant was used to supply electricity for regional residential and commercial customers.

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184 *Engineering News-Record*, February 26, 1942, 56.

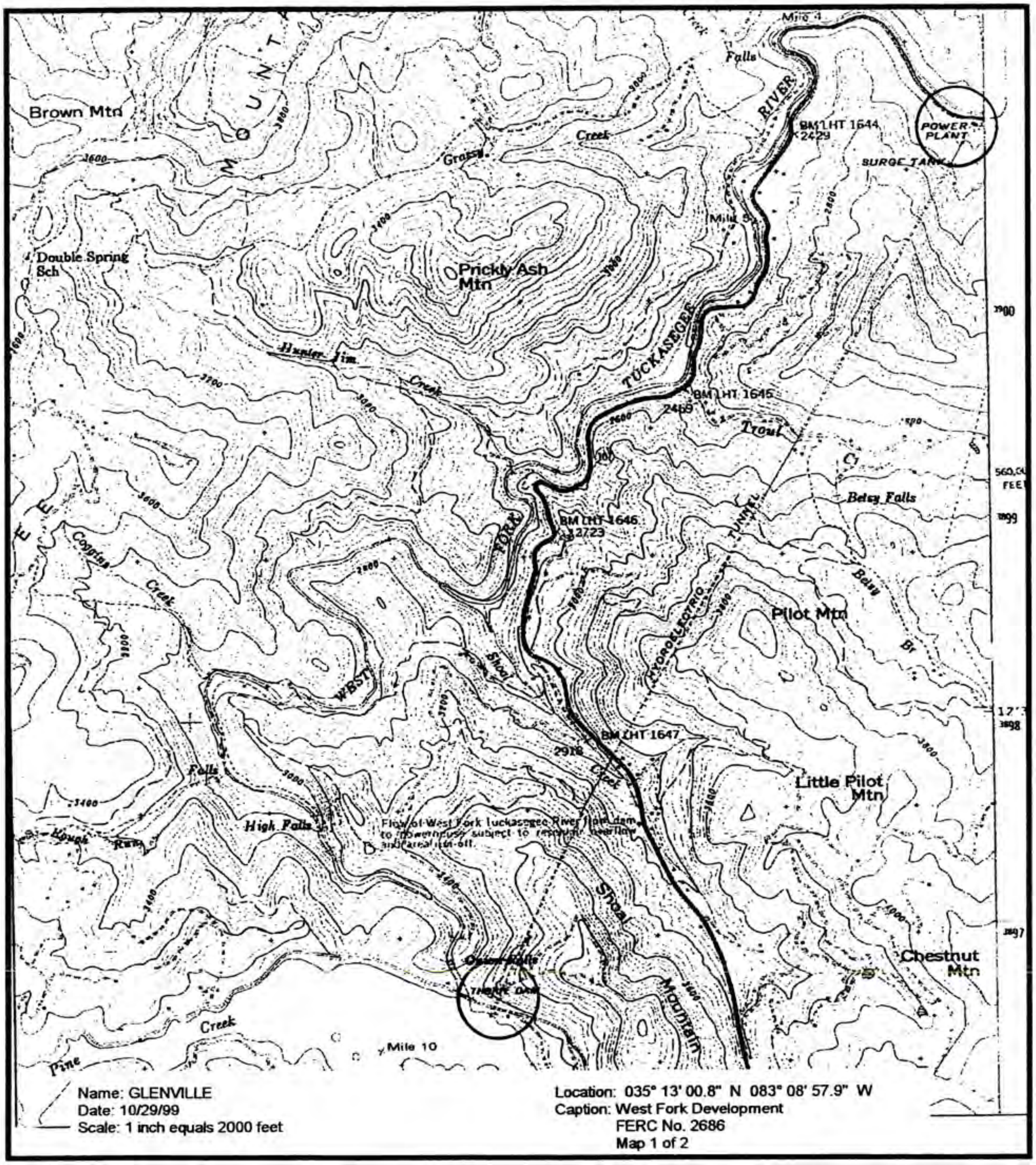


Figure No. 37. Location of the West Fork Hydroelectric Project, Map 1 of 3.

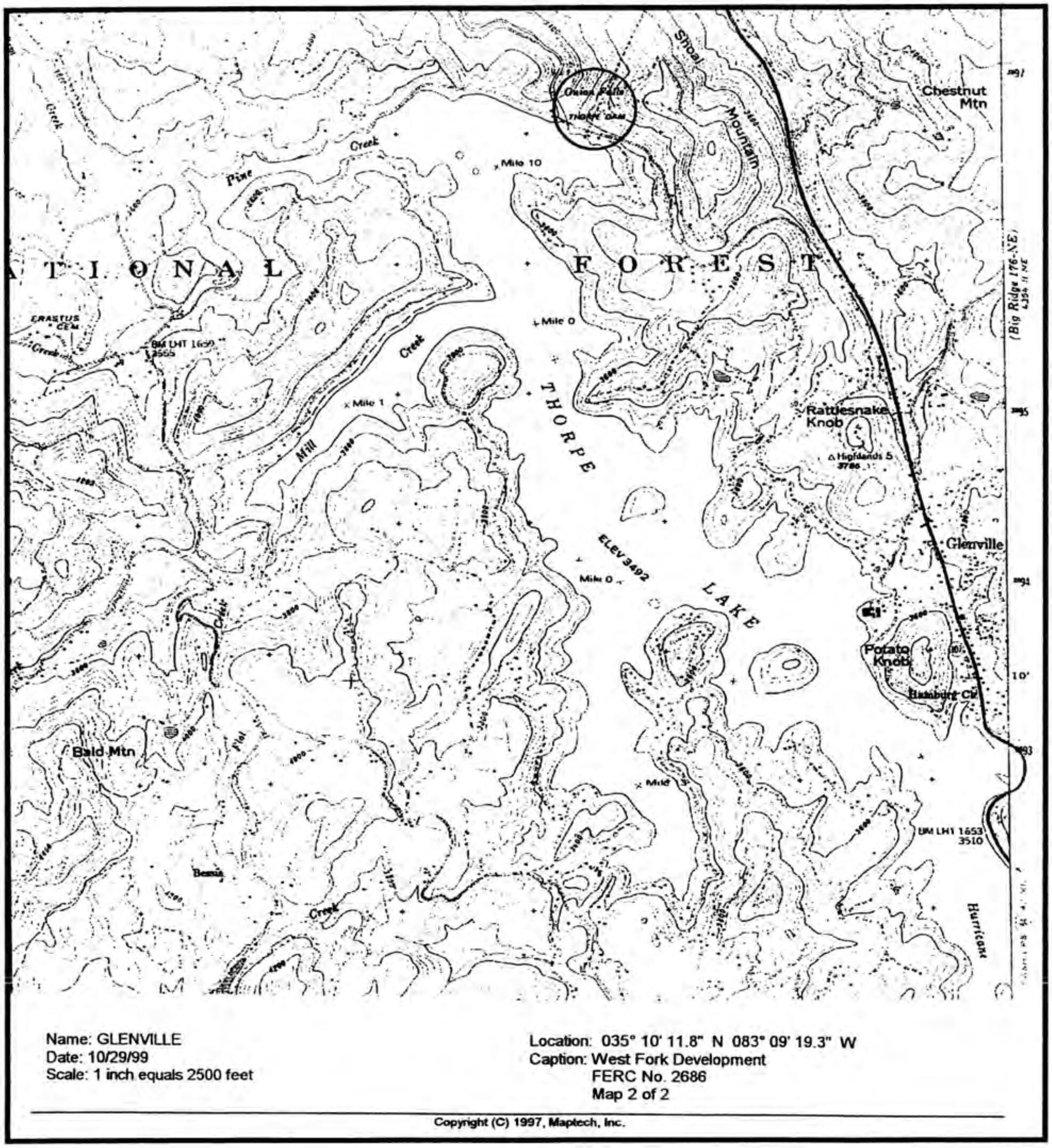


Figure No. 38. Location of the West Fork Hydroelectric Project, Map 2 of 3.

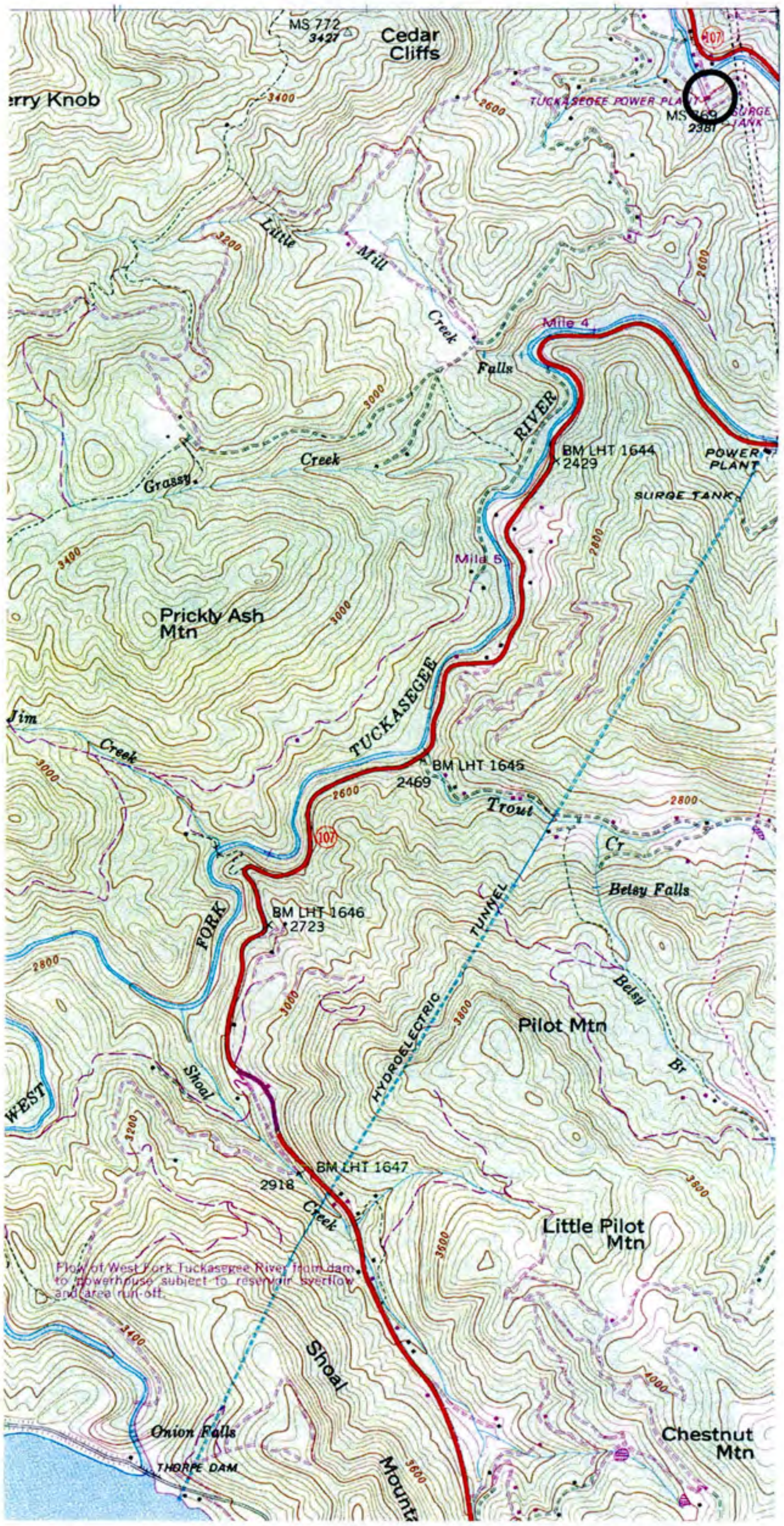


Figure 39: Location of the West Fork Hydroelectric Project, Map 3 of 3. (USGS Quadrangle-Glenville, NC)

THORPE DAM AND POWERHOUSE SITE PLAN

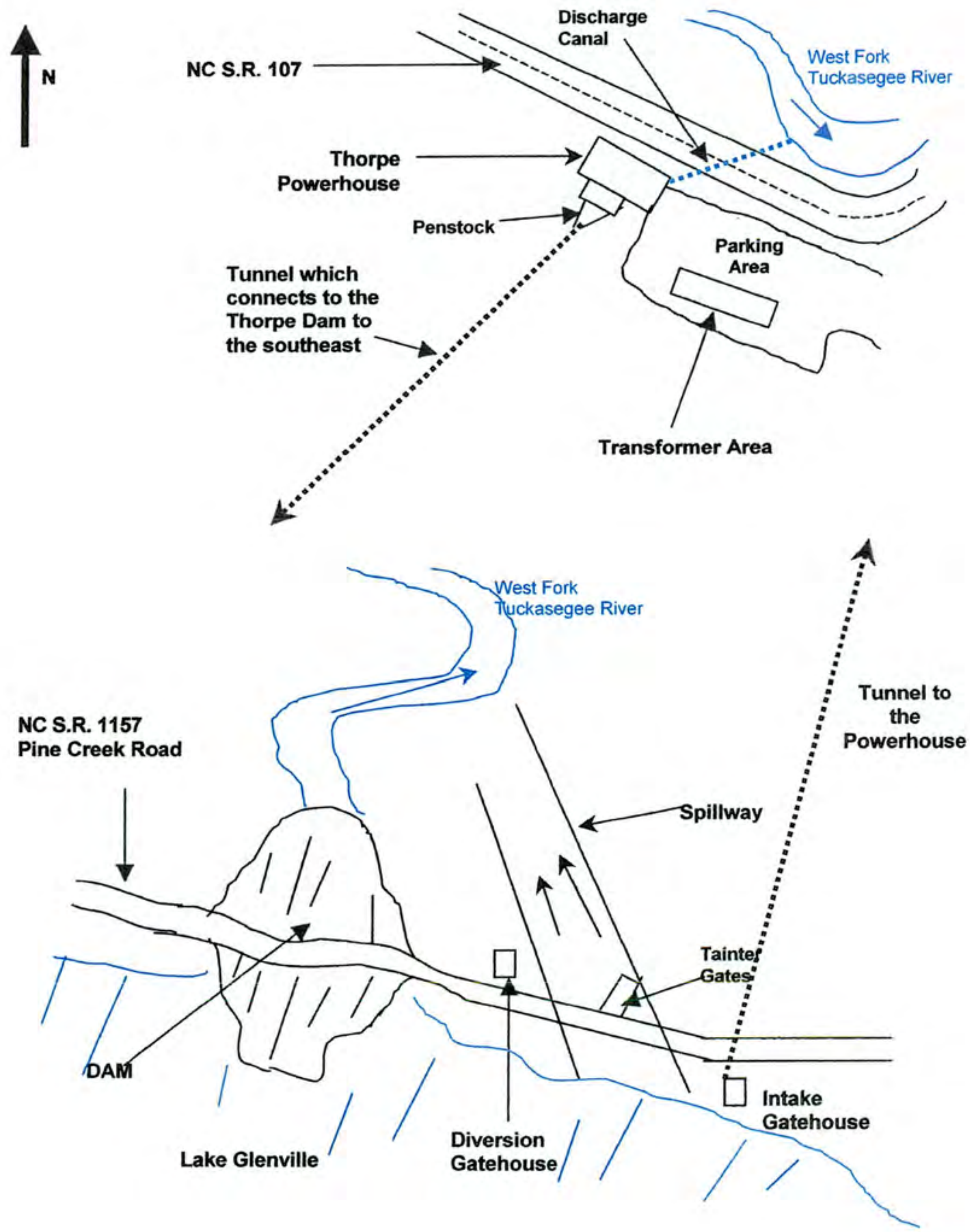


Figure No. 40. Thorpe Powerhouse and Dam Site Plan.

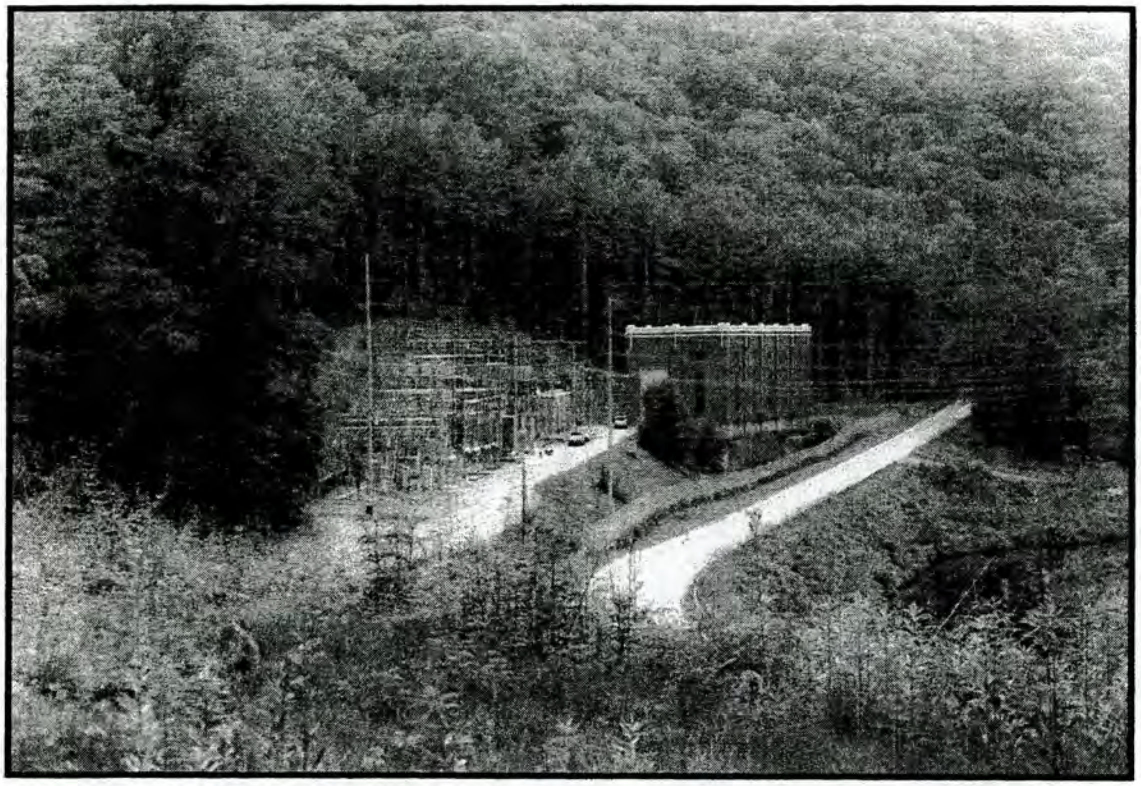


Figure No. 41. The Thorpe Powerhouse, view from the worker's housing village.

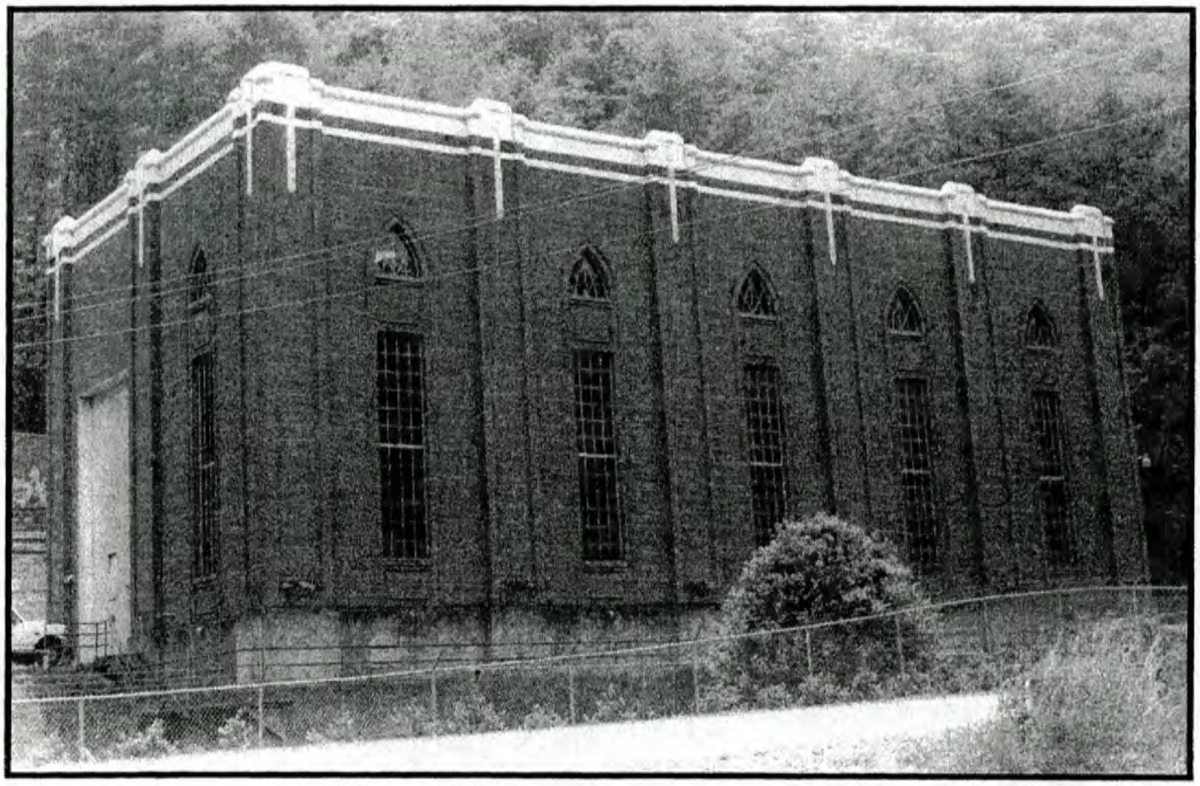


Figure No. 42. The Thorpe Powerhouse, west and north facades.

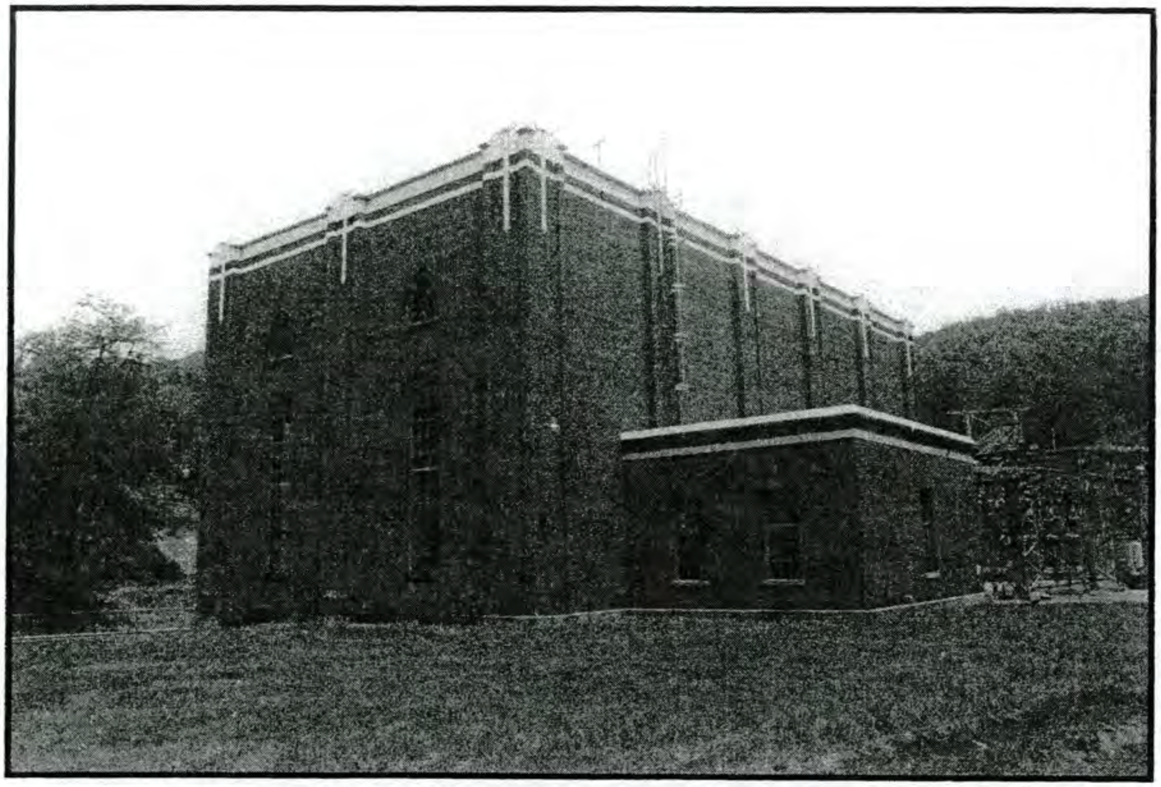


Figure No. 43. The Thorpe Powerhouse, south and east facades.

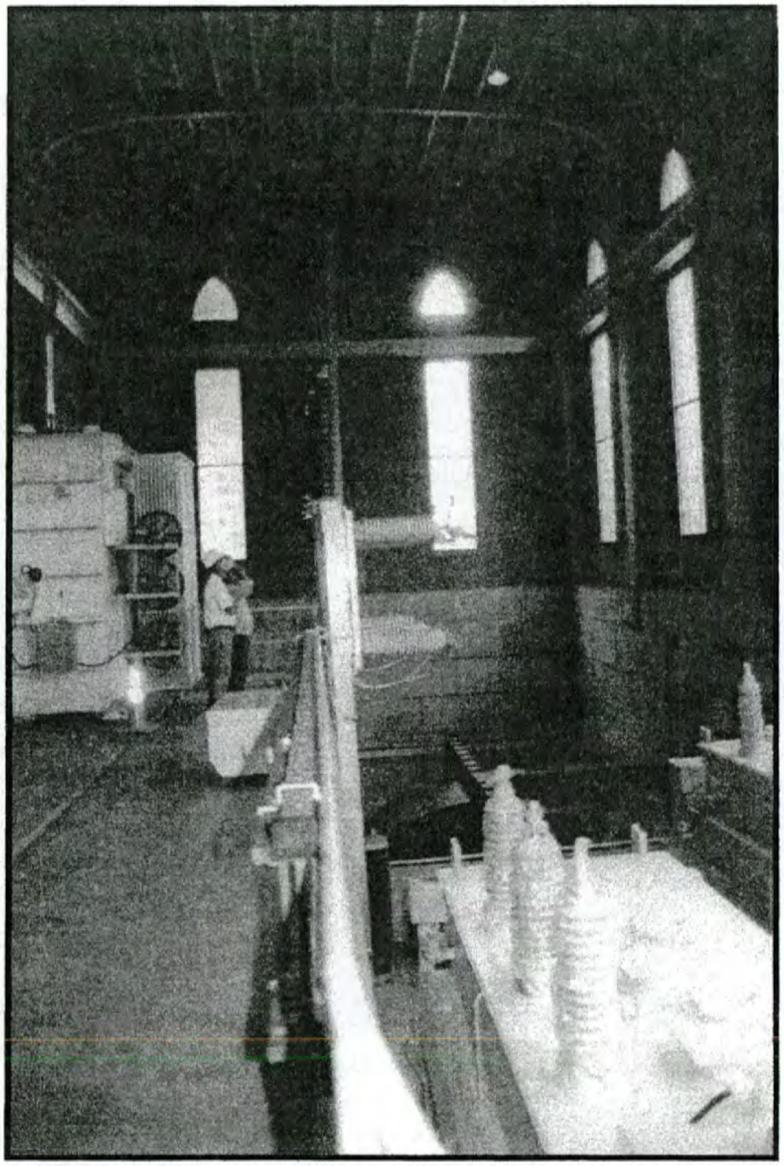


Figure No. 44. Interior view of the Thorpe Powerhouse.

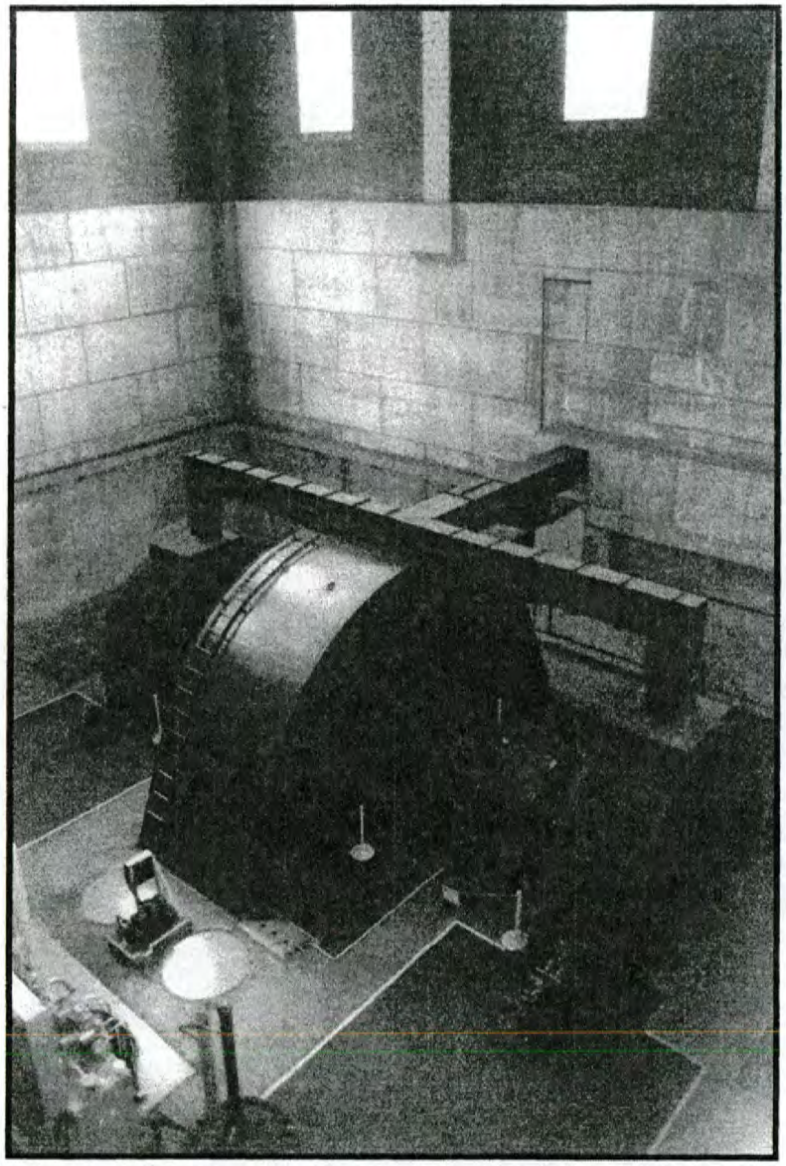


Figure No. 45. Interior view of the Thorpe Powerhouse and turbine.

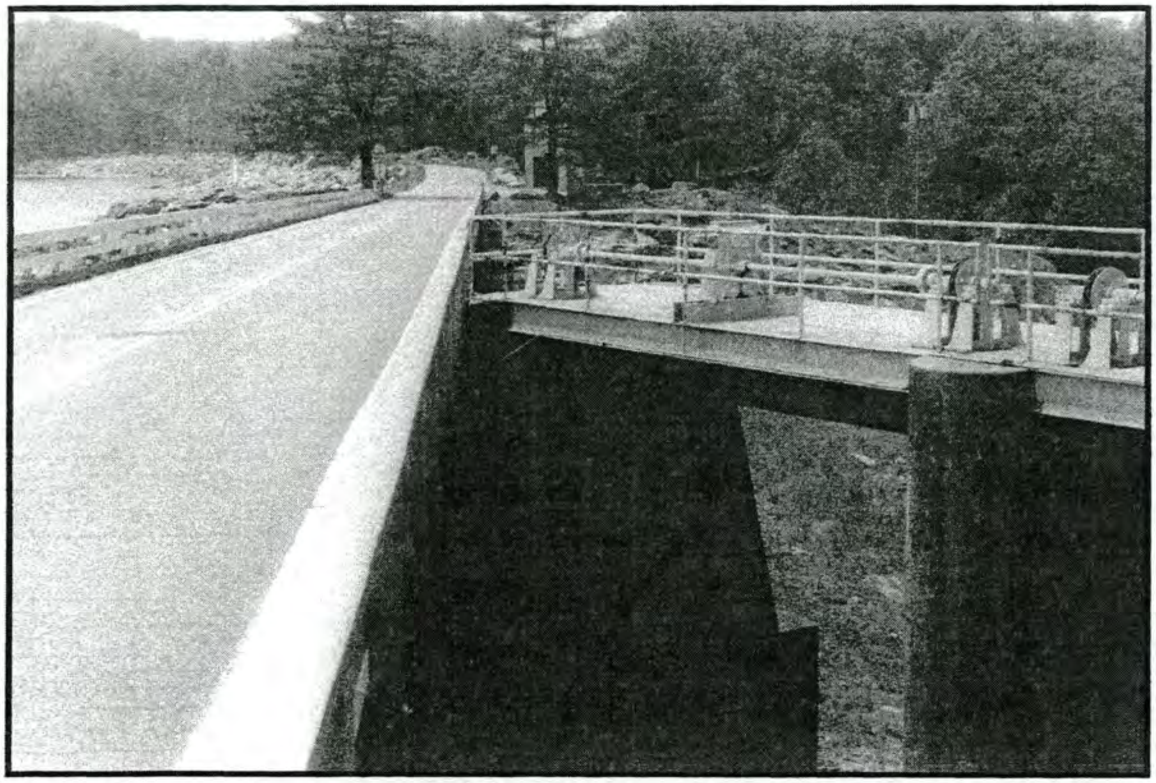


Figure No. 46. The Thorpe Dam showing paved State Route 1157, and the concrete spillway.

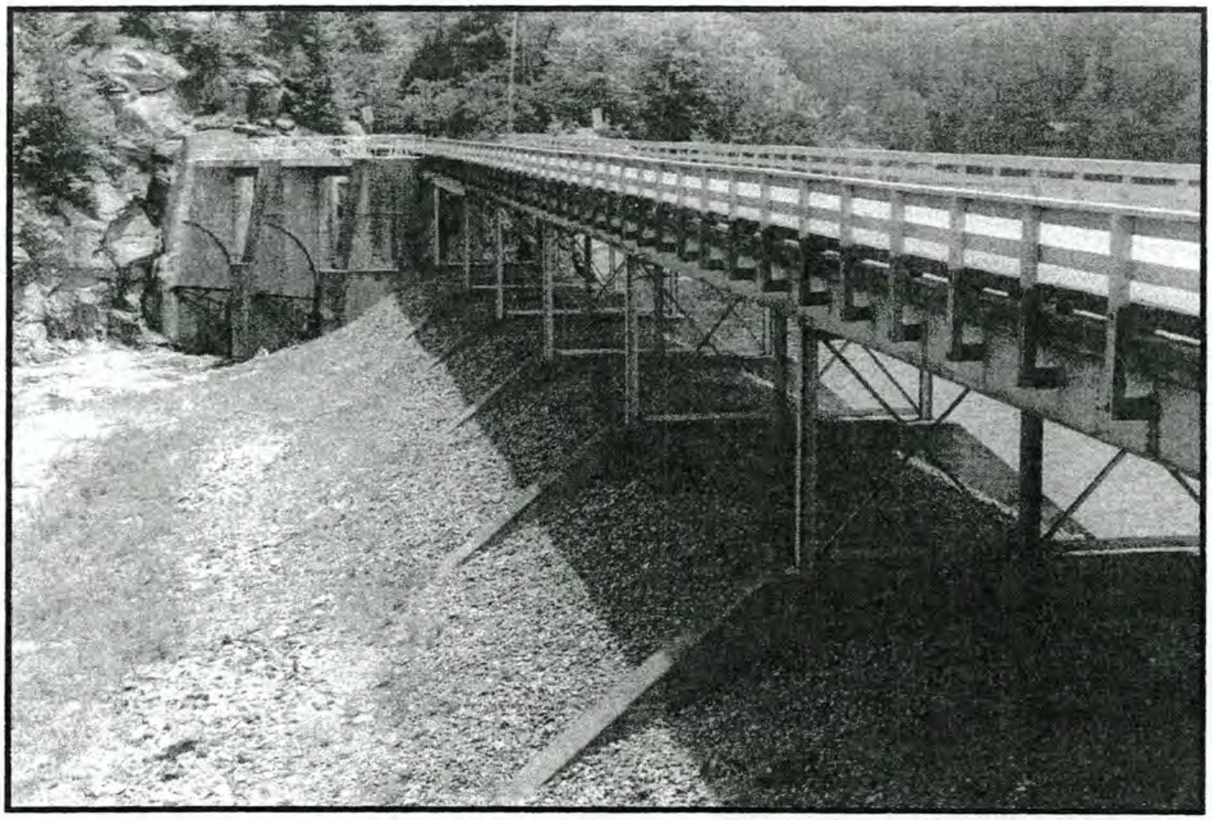


Figure No. 47. The Thorpe Dam showing paved State Route 1157, and the concrete spillway.

Figure No. 48. The Thorpe Dam, concrete spillway and tainter gates.

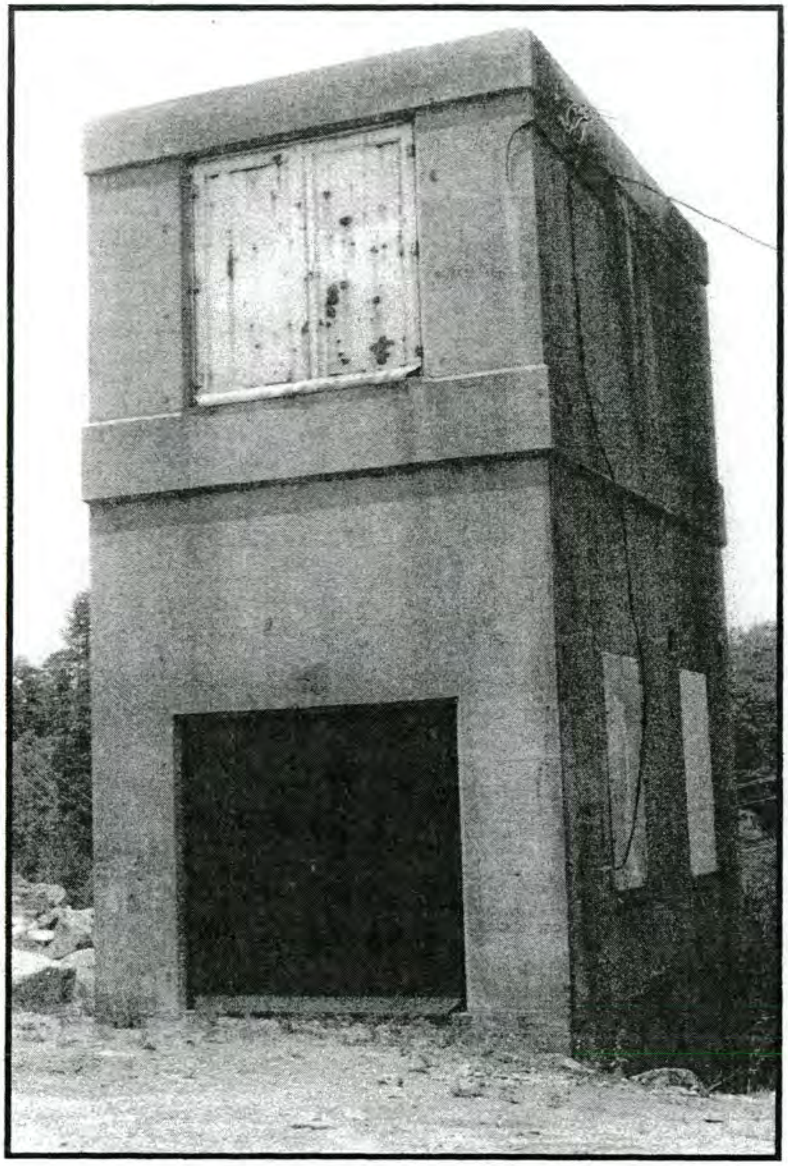


Figure No. 49. Thorpe Dam diversion gatehouse, south and east facades.

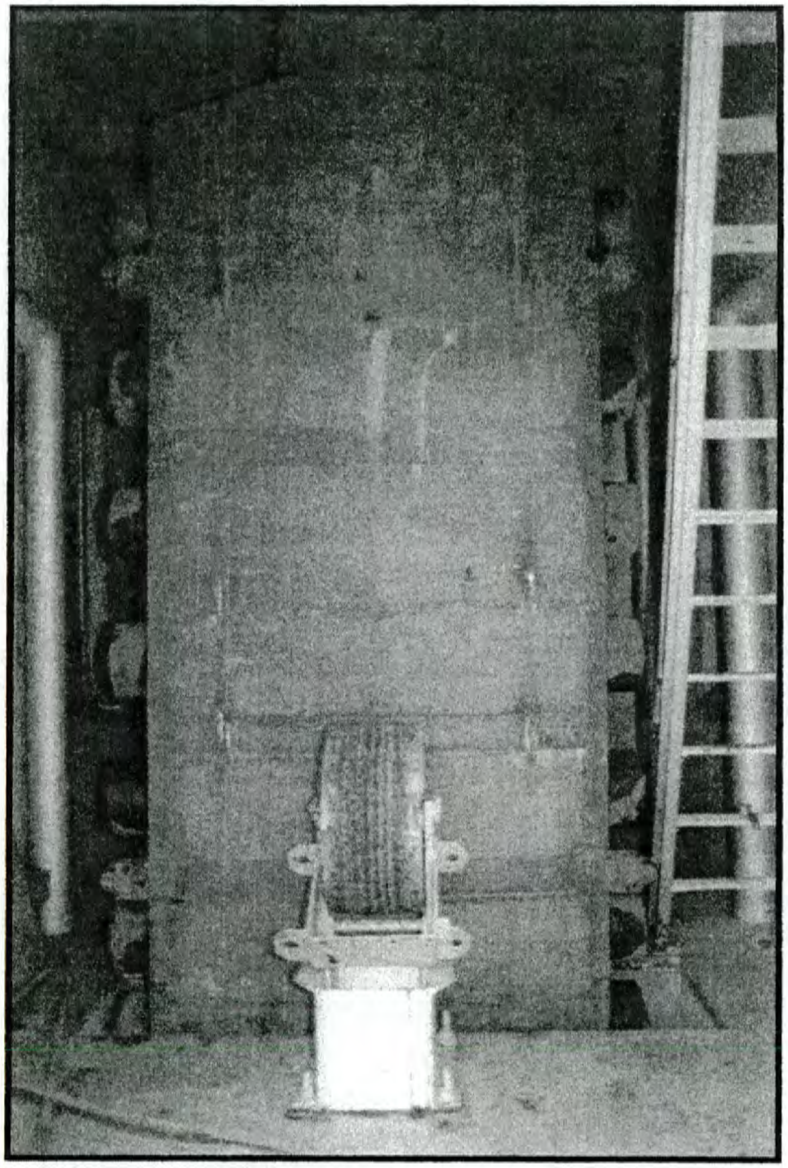


Figure No. 50. Interior view of the Thorpe Dam diversion gatehouse showing raised steel gate.

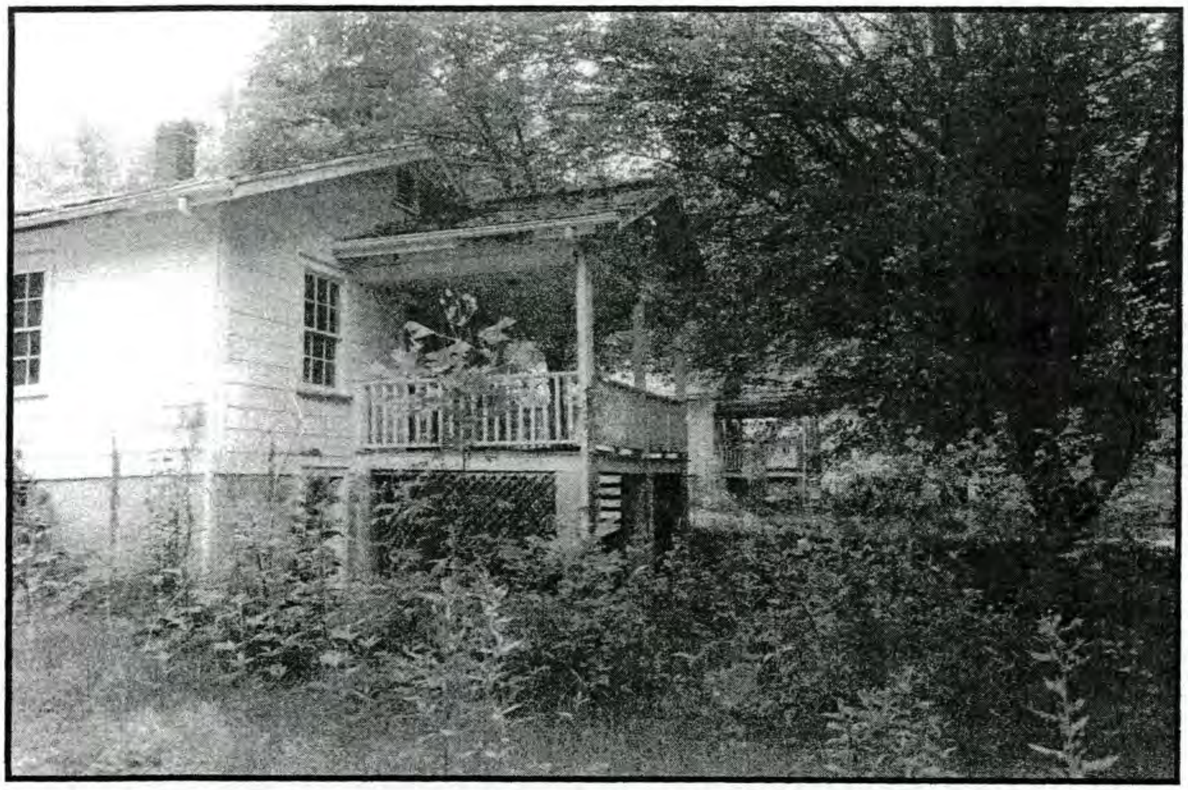


Figure No. 51. Thorpe worker's housing, general view of main facades.

Figure No. 52. Thorpe worker's housing, general view of rear facades.

Figure No. 53. Thorpe worker's housing, Dwelling No. 19.

Figure No. 54. Thorpe worker's housing, Dwelling No. 20.

Figure No. 55. Thorpe worker's housing, Dwelling No. 8.

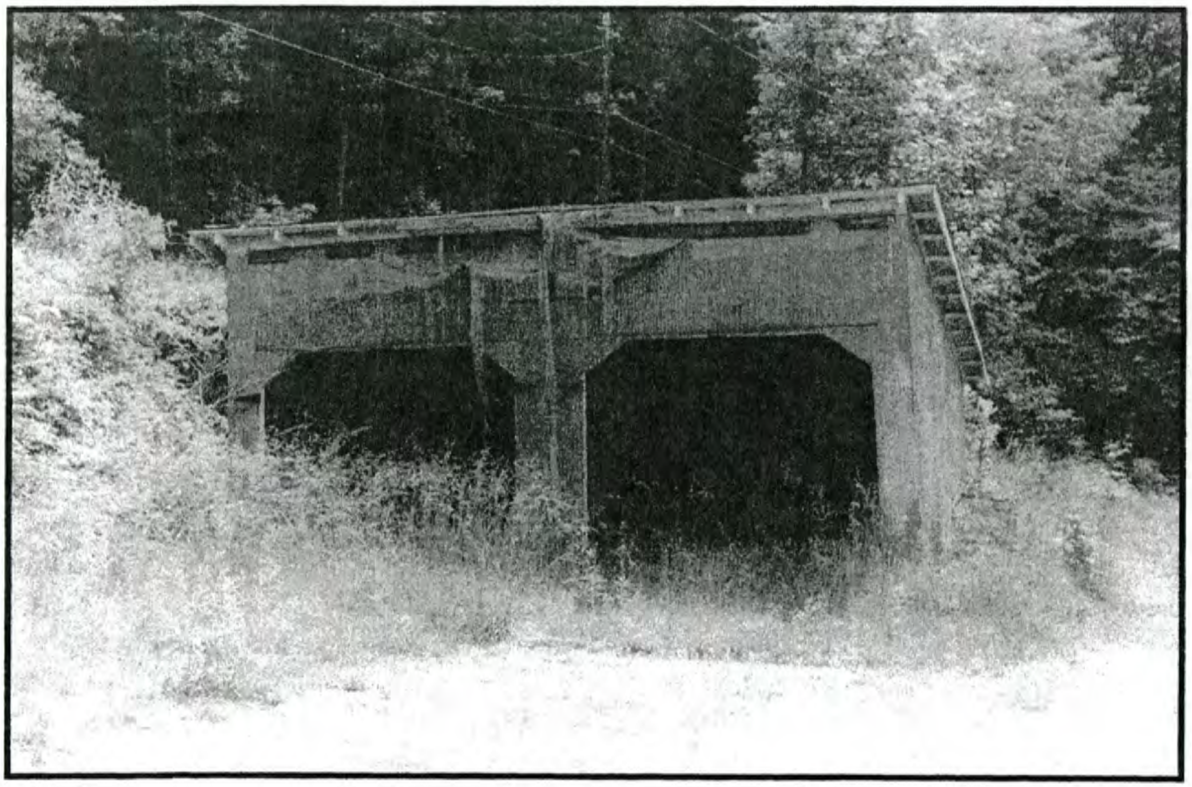


Figure No. 56. Thorpe worker's housing, associated garage.

TUCKASEGEE DAM AND POWERHOUSE SITE PLAN

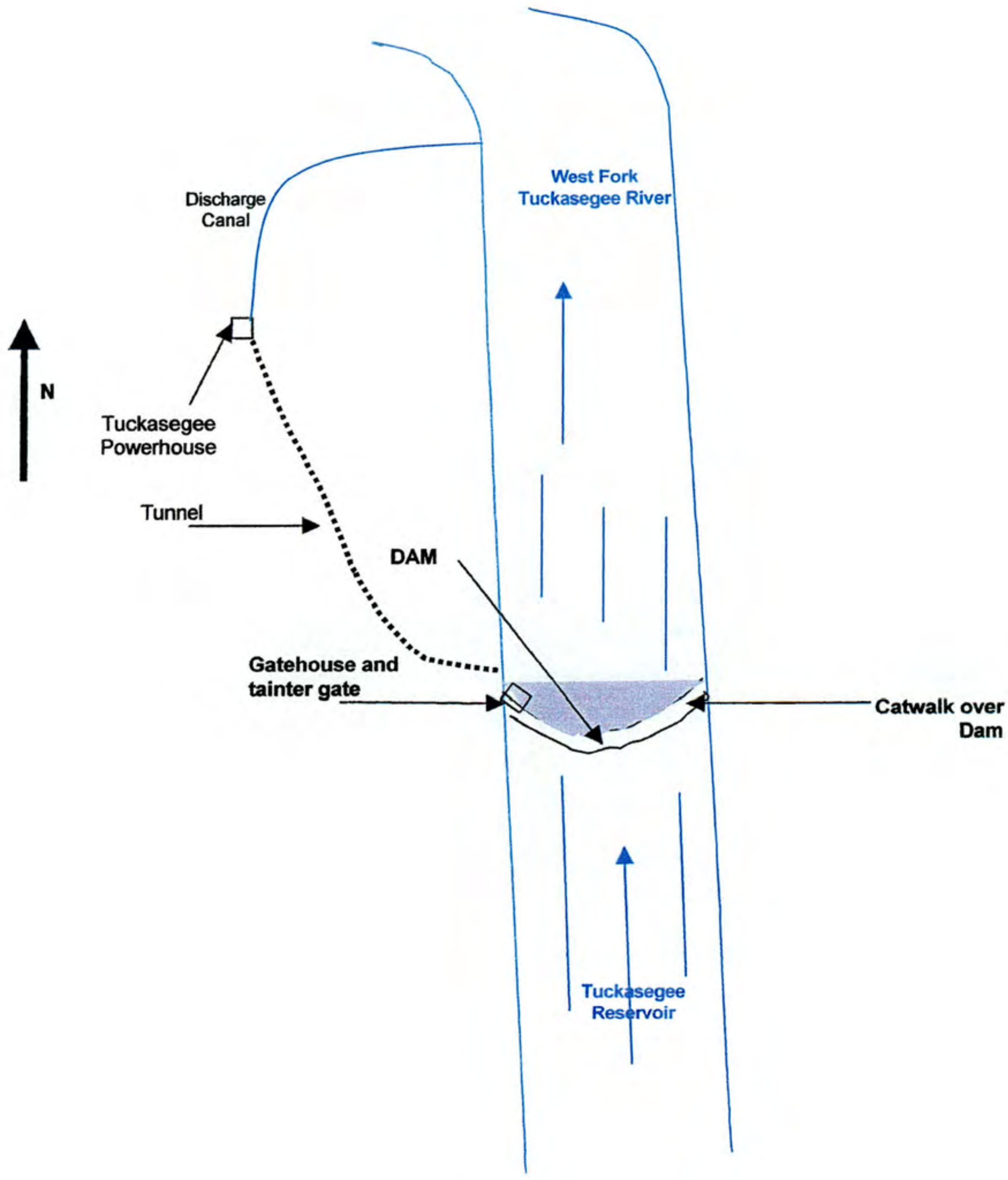


Figure No. 57. Tuckasegee Dam and Powerhouse Site Plan.

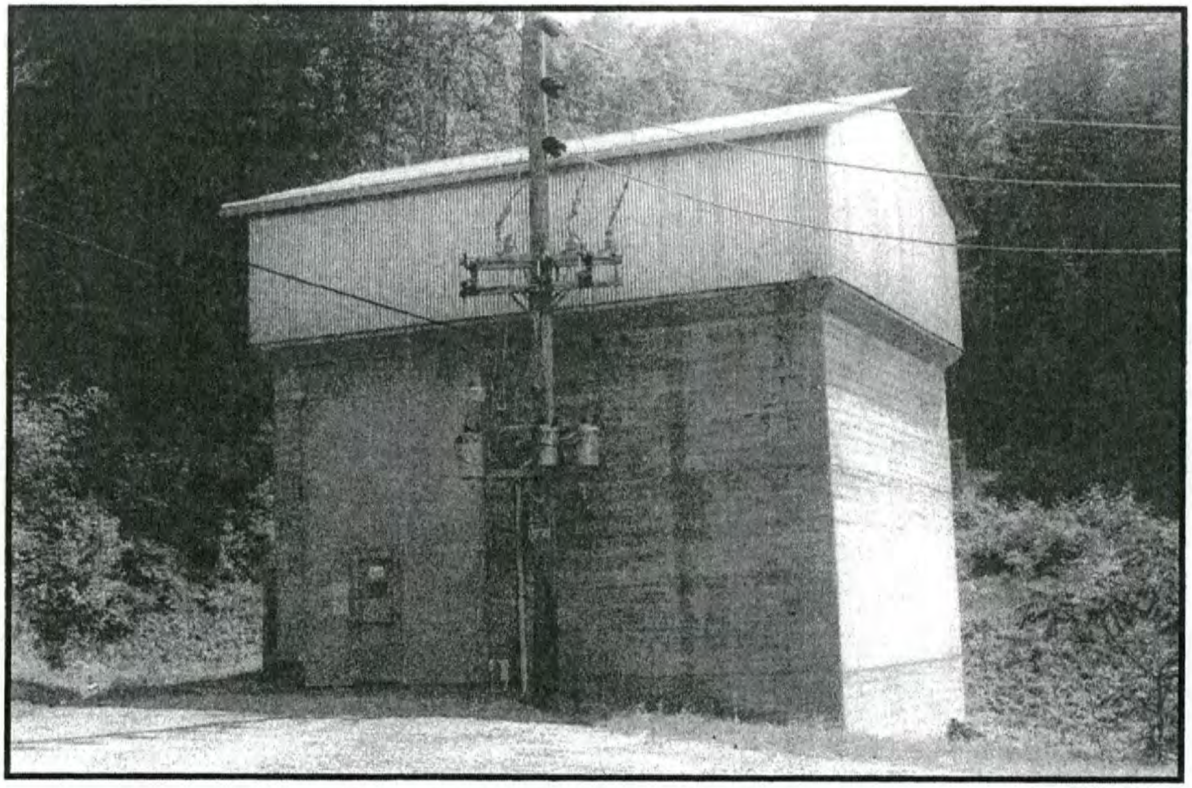


Figure No. 58. The Tuckasegee Powerhouse, north and west facades.

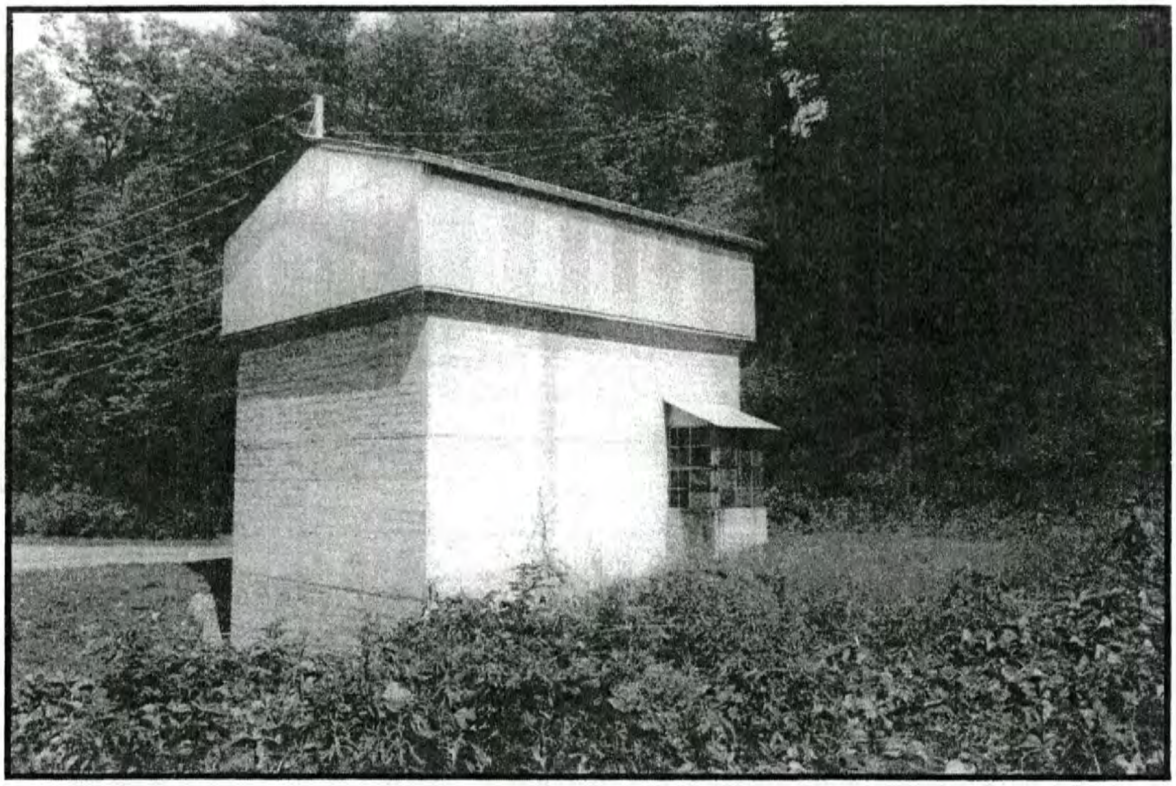


Figure No. 59. The Tuckasegee Powerhouse, west and south facades.

Figure No. 60. The Tuckasegee Dam, view from above.

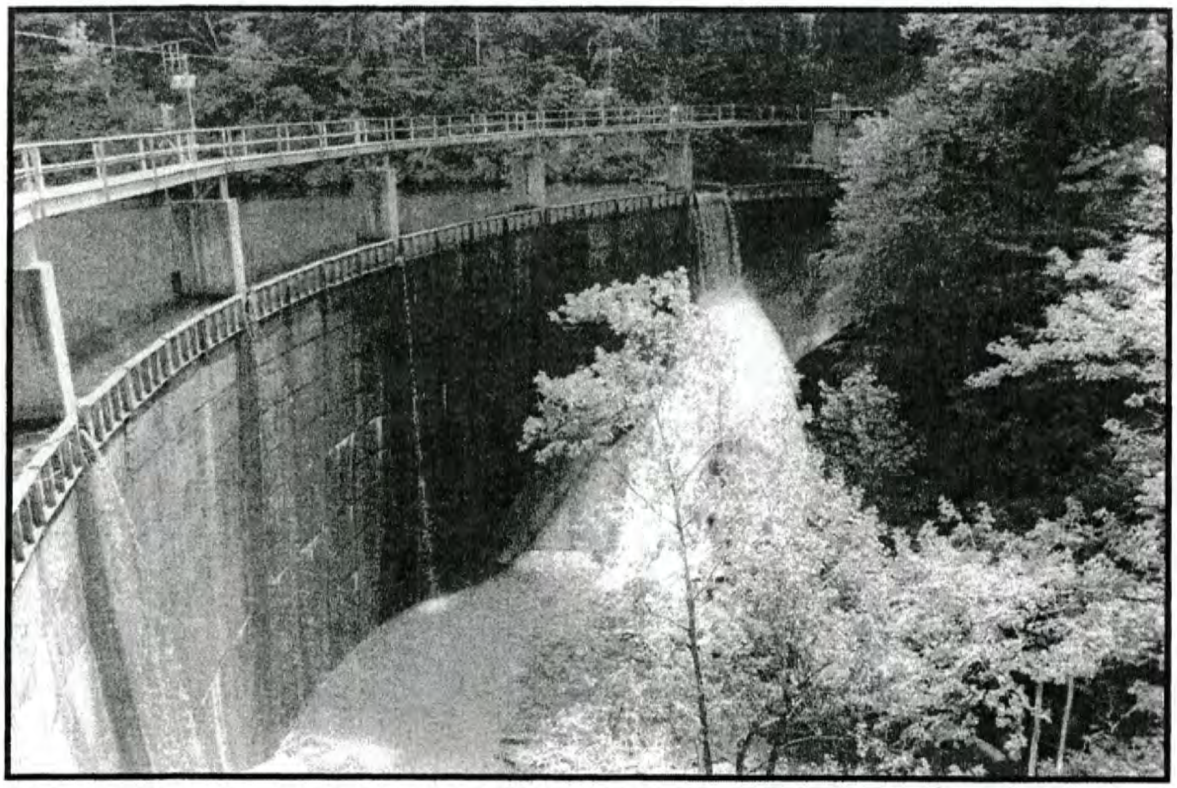


Figure No. 61. The Tuckasegee Dam, view from below.

Historical Overview

In the 1920s construction began on the Nantahala Hydroelectric Plant on the Nantahala River in Macon and Clay Counties. Due to a decrease in the demand for electricity resulting from the economic problems of the Depression, construction on the plant was suspended in 1931.[185] In July of 1940, in conjunction with the wartime demand for aluminum, work resumed on the plant with the purpose of the plant being to provide power to Alcoa's aluminum plant in Tennessee. The facility was built by the Utah Construction Company of Salt Lake City. Retired NP&L employee Mac Whittaker remembered that security was tight during construction:

> 'We were under real heavy security'....There were armed guards on the gate and a high, timbered stockade protected the powerhouse site. 'You had to have a pass to get in.' There were guardhouses at the powerhouse and up on the mountain.... An electric eye, hidden in the brush, kept a lookout for intruders.[186]

Around the same time, three suspected German saboteurs were caught off the coast of South Carolina. The three had disembarked from a submarine and landed on the coast in a small boat. Upon interrogation, U.S. Government officials learned that suspects had targeted the Baden, Thorpe, Nantahala, and several other Alcoa facilities. Another incident of suspected sabotage occurred when a guard at the plant noticed sticks of dynamite lying under the powder magazine. The fuse had gone out, averting massive damage to the project.[187]

Construction personnel from Utah Construction Company, NP&L and Alcoa made up the 1,500 to 2,000 strong workforce. The majority of the men were married and those who did not live in the vicinity brought their families with them. The construction camp took on the appearance of a company town and consisted of houses, bunkhouses, a mess hall, commissary, a guesthouse and camps. Children of the workers attended school in nearby communities. The adults played bridge and the wives went together to Robbinsville and Andrews for shopping trips.

Construction of the plants occurred in shifts, 24 hours a day, seven days a week:

> They dug the tunnel....by going four ways at once, the separate sections meeting 'within an inch or less.' The dam itself was probably the most challenging job. A giant 50-cubic-yard electric shovel, Euclid trucks and crawler tractors helped with the heavy work of moving rock and clay.[188]

By June of 1942 the plant had been completed. It was the company's second largest plant with a 251-foot rock-fill and a sloping earth core dam that proved to be economical and reliable and served as a model for later design and construction techniques at NP&L. The spillway was designed for "large, sharp-crested

[185] Alcoa et al. 1958, 19; NP&L 1990, 4; Thorpe 1939, v-8.

[186] NP&L 1990, 4.

[187] Alexander 1983, 1; NP&L 1990, 4.

[188] NP&L 1990, 5.

floods of short duration," while the completed reservoir was 3 miles long with a surface area of 1,420 acres. The turbine had a 60,000 hp capacity and was connected to a General Electric generator.

By 1949, NP&L had built three small dams at White Oak Creek and Dicks Creek, whose discharges diverted into the Nantahala tunnel. The Dicks Creek Dam was made of concrete and stood 12' high and 50' long. The dam at White Oak Creek was also built of concrete, and is 110' long and 15' high. An even smaller dam was built on a tributary of Dicks Creek, known as the Diamond Valley Dam. This small concrete dam is only 12' in width and impounds an area the size of a bathtub. NP&L officials believe Diamond Valley to be the smallest hydroelectric dam in the country.

These three hydroelectric structures are often referred to as "vest pocket" dams due to their relatively small size and scale. The Dicks Creek and White Oak Creek Dams empty their waters via connector pipes into the main Nantahala Dam pipe. The impoundments are the size of a small pond. The Dicks Creek Dam was built by shifts of men working around the clock. Rock was hauled to the site and laid out in three-tiered sections of fifty feet each. The tiny Diamond Valley Dam is located at 2,935 feet elevation, the highest elevation of the Nantahala facilities. Although small, the dam is estimated to contribute approximately one million kilowatt hours of electricity per year, enough to supply power for 111 homes. An eighteen-inch pipe runs from the little dam to the Dicks Creek facility. Dicks Creek Dam is approximately 100 yards above the mouth of Diamond Valley Creek. In order to collect Diamond Valley's output, the connecting pipe had to be run underground at an angle back up Dicks Creek under Junaluska Road.[189]

Description

The Nantahala Hydroelectric Plant consists of a powerhouse, four dams, two gatehouses, a tunnel and waterpipe. The Nantahala Powerhouse was surveyed in 1994 by representatives of the North Carolina Department of Cultural Resources and given the survey number MA-353. A dam operator's house, five worker's houses, and several other ancillary buildings and structures are associated with the facility, but are located outside of the FERC project boundary. Of these, the inventory of 1994 gave survey numbers to the Community Building (MA-354), and the Worker's Housing (MA-355). The Nantahala Powerhouse is a one-story, poured concrete building built with the design influences of streamlined classicism. It has poured concrete walls and a gable roof of wood decking and corrugated steel. On the main (N) facade is an original solid steel hinged door set within a large steel panel. Windows on the north facade are original sixty-light steel design with eight-light hinged inset panels. On all four facades are clerestory windows of twenty-light fixed steel design. Dividing the window bays are concrete wall pilaster strips. On the west facade is an original solid steel sliding track door. The pedestrian door on this facade is original two-panel steel design. Also on the west facade of the building is a steel tainter gate and spillway. A concrete diversion wall directs the water from the spillway. There is no other fenestration except for a louvered metal vent on the south facade. On the west facade is a one-story office wing with sixteen-light steel awning windows.

The interior of the powerhouse has a terrazzo floor, and walls and ceilings of poured concrete. In the northwest corner of the building is a ca. 1970, partitioned office with a linoleum floor, acoustical tile ceilings, and frame walls with large fixed glass windows. This office encloses the switchboard, which has both original and added units. At the upper floor lever is a crane for moving electrical equipment and turbine. The turbine is a Vertical Francis type manufactured by the Newport News Shipbuilding and Drydock Co., in 1941. The AC Generator is from the General Electric plant in Schenectady, New York.

[189] *Asheville Citizen* 31 January 1991.

The Nantahala Dam impounds a reservoir which contains 1,605 acres at full capacity. The dam is of rock fill with a clay core, and has a concrete spillway with four tainter gates. The tainter gates are steel, and have concrete counter weights attached to the four electric winches. Adjacent to the spillway is a ca. 1990 concrete block generator house with a gable roof of asphalt shingles and a solid steel door.

At the south end of the dam are two original poured concrete gatehouses. Both gatehouses are of similar design and construction, and are separated from each other by approximately 250'. Both buildings have poured concrete foundations and walls, and roofs of poured concrete. The interiors contain steel gates and winch systems for controlling the intake to the tunnel. On the main facades, the buildings have original double doors of four-panel steel design. Similar doors are located on the second floor. On the Diversion Gatehouse, windows are original fifteen-light steel fixed design on the first floor, and twelve-light design on the second floor. Windows on the first floor of the Intake Gatehouse are original twenty-one-light steel design with six-panel inset hinged windows. Second floor windows are original twelve-light fixed design.

Also at the south end of the dam is a one-story, frame, dam operator's house built in 1942 (watchman's house). This Bungalow style-influenced dwelling has a poured concrete foundation, a gable roof of asphalt shingles, and an exterior of asbestos shingles. The house has two interior brick chimneys. On the main (S) facade is an original shed roof entry porch with ca. 1970 square wood posts. The main entrance has an original six-light and three-panel glass and wood door. On the east facade is a gable roof wing with a full porch on the south facade. This porch has an original corner wood post. This wing has an original six-light and three-panel glass and wood door on this facade. Windows are original six-over-six rectangular wood sash. In the gables are louvered vents. The interior floor plan has been altered with an added kitchen in the entry hall. The house has added acoustical ceiling tiles, wall board walls, and five-panel wood doors. The wood floors have been covered with carpet.

Below the Nantahala Dam are three smaller dams and impoundments constructed in 1949 which feed into the Nantahala pipeline. The White Oak Dam is of stone and concrete and is approximately 16' high and 110' in length. A steel tainter gate is located at the spillway. A small, mechanized winch controls the gate which leads into the intake pipe. The Dicks Creek Dam is of also of stone and concrete and is approximately 16' high and 110' in length. A steel tainter gate is located at the spillway. A small, mechanized winch controls the gate which leads into the intake pipe. The Diamond Valley Dam is of poured concrete and measures 6' in height and 12' in length. It impounds an area the size of a bathtub, and feeds its water into the Dick's Creek Reservoir through an 18" culvert.

The four dams feed their water into the Nantahala tunnel and pipeline. The tunnel was built through rock beneath the intervening mountains, and the pipeline is an elevated steel water pipe supported by poured concrete piers. The length of the main tunnel and pipeline from the Nantahala Dam is 29,654', or 5.6 miles. The tunnel and pipeline which feeds into the main pipeline from the White Oak Dam is 11,445' in length, and the Dicks Creek pipeline is 3,875' in length.

To the west of the Nantahala Powerhouse are five remaining worker's dwellings built in 1942. These houses are located outside the project boundary on Powerhouse Drive, and are one-story in height and built with Bungalow style-influences. The dwellings were built in gable front forms with rear lateral wings. The dwellings have gable roofs of asphalt shingles, interior brick chimneys, and gable roof, partial-width porches with square wood columns. In the gables are louvered vents, and at the eaves are exposed rafters. The five dwellings differ somewhat in their exterior siding and fenestration. These variations are as follows:

101 Powerhouse Drive - This dwelling has an original six-light and two-panel glass and wood door on the main facade. Windows are ca. 1980 one-over-one aluminum sash. The exterior has original asbestos

shingles. The rear porch has replacement columns.

102 Powerhouse Drive - This dwelling has an original six-light and two-panel glass and wood door on the main facade. Windows are ca. 1980 one-over-one aluminum sash. The exterior has original asbestos shingles. The rear porch has replacement columns.

103 Powerhouse Drive - This dwelling has an exterior siding of ca. 1990 pressboard. The dwelling has an original six-light and two-panel glass and wood door on the main facade. Windows are ca. 1980 one-over-one aluminum sash. The rear porch has replacement columns.

104 Powerhouse Drive - This dwelling has an exterior siding of ca. 1990 pressboard. The dwelling has an original six-light and two-panel glass and wood door on the main facade. Windows are ca. 1980 one-over-one aluminum sash. The rear porch has replacement columns.

105 Powerhouse Drive - The dwelling at this location is the most original of the five. The dwelling retains its original porch columns, asbestos shingle siding, and original six-over-six wood sash windows. The main entrance has an original six-light and two-panel glass and wood door. The shed roof porch on east facade has original square wood columns. The door on this facade also is an original six-light and two-panel design.

Associated with these dwellings are three original garages of frame and corrugated metal. These garages have shed roofs and walls of corrugated metal, and hinged wood and metal doors.

Between the powerhouse and dwellings are three buildings. One of these is a ca. 1942, gable front frame warehouse building with shiplap siding, a gable roof of asphalt shingles, exposed eave rafters, and a poured concrete foundation. On the main (W) facade is an entrance with a ca. 1990 solid metal door. There are two doors on the south facade, both of original five-panel wood design. Windows are original fixed six-light design. On the north facade is a shed roof porch added ca. 1970.

There is also a one-story frame storage building with paired five-panel wood doors, six-over-six wood sash windows, and asbestos shingles. This building was possibly moved to this location. There are also two corrugated steel garages adjacent to this building. To the west of the powerhouse is a ca. 1995 concrete block garage with a metal gable roof and overhead track garage doors.

National Register Assessment

In 1994, the Nantahala Powerhouse and the adjacent worker's housing were deemed potentially eligible for the NRHP, and placed on the Study List following a survey of Macon County. These properties were considered eligible under criterion A and C for their historical and architectural significance. The Consultant concurs with this assessment. In the opinion of the Consultant, the Nantahala Hydroelectric Plant has significance under criterion A in the category of Military, and under criterion C for the architectural design of the powerhouse and adjacent worker's housing. This eligibility includes the Nantahala Dam and its associated buildings. The plant is not eligible in the category of Social History because almost all of its electricity prior to 1955 was sent to the Alcoa plant in Maryville, Tennessee, rather than to residential or commercial customers in western North Carolina. Power to local customers from this plant was not provided in any appreciable quantities until the 1960s.

At the beginning of World War II, it became apparent that America's ability to meet the projected need for aluminum for the war effort was insufficient. In response, the nation's largest producer of aluminum, Alcoa, made plans to increase production and build a new plant at its facility in Blount County, Tennessee. The aluminum smelting process requires an enormous amount of electrical power, and both the Thorpe and Nantahala plants were built to help supply this need. The Nantahala plant was completed and placed into operation in 1942. Both of these hydroelectric plants provided the necessary electricity to help power the Alcoa facility in Tennessee which made aluminum for aircraft. The significance of these two hydroelectric plants was noted in the February issue of *Engineering News-Record*, in the article "More Power for Bomber Production." The article states that the immediate goal of these plants was to produce electricity for the manufacture of bombers, and that the annual electricity produced each year by these plants could build 1,230 B-17 "Flying Fortress" bombers.[190] Alcoa was one of America's essential industries during World War II, and both the Thorpe and Nantahala plants contributed to its success.

Under criterion A, the Nantahala Hydroelectric Plant including the powerhouse, dam, tunnels, pipelines, worker's housing, and ancillary buildings and structures would be eligible for the NRHP. These components of the complex were essential to its operation and contributions to electrical generation for the Alcoa plant during World War II. All of these properties retain sufficient integrity to meet registration requirements for their respective property types.

The Nantahala Powerhouse is also eligible under criterion C. The powerhouse's design is illustrative of "streamlined" or "simplified" classicism which was widely used in the 1930s and 1940s for governmental and industrial buildings. This design approach combined the elements of classical and Art Moderne influences within a simplified vocabulary and lack of ornamentation.[191] The powerhouse reflects this approach in its smooth concrete walls, horizontal and vertical pilaster strips, and undecorated fenestration and roofline. It was built in a rectangular plan with large, multi-light steel windows, and open floor space on the interior. The building retains much of its original interior and exterior detailing, and possesses sufficient integrity to meet registration requirements for this property type.

The Nantahala worker's housing also retains sufficient integrity to meet registration requirements as a historic district for this property type and is eligible under criterion C. Built in gable front forms reflective of the Bungalow style, this grouping of dwellings collectively conveys a feeling of time and place from its period of construction, and is illustrative of the types of worker housing built for industrial developments in the mid-20th century.

In consultation with the North Carolina State Historic Preservation Office, it is the determination that the three auxiliary dams, White Oak Creek, Dicks Creek, and Diamond Valley, and their associated pipelines and tunnels, are eligible for the NRHP under criterion A as contributing components of the larger Nantahala system. These small dams were built in 1949, and were designed to provide additional power for the Alcoa plant in the years following World War II. In the post war years, Alcoa continued to be a leader in the aluminum industry and contributed to US military efforts in the Korean Conflict and the Cold War through supplying an aluminum stockpile.

[190] *Engineering News-Record*, February 26, 1942, 56.

[191] Mary Hollingsworth, *Architecture of the 20th Century* (London: Grange Books, 1995), 73.

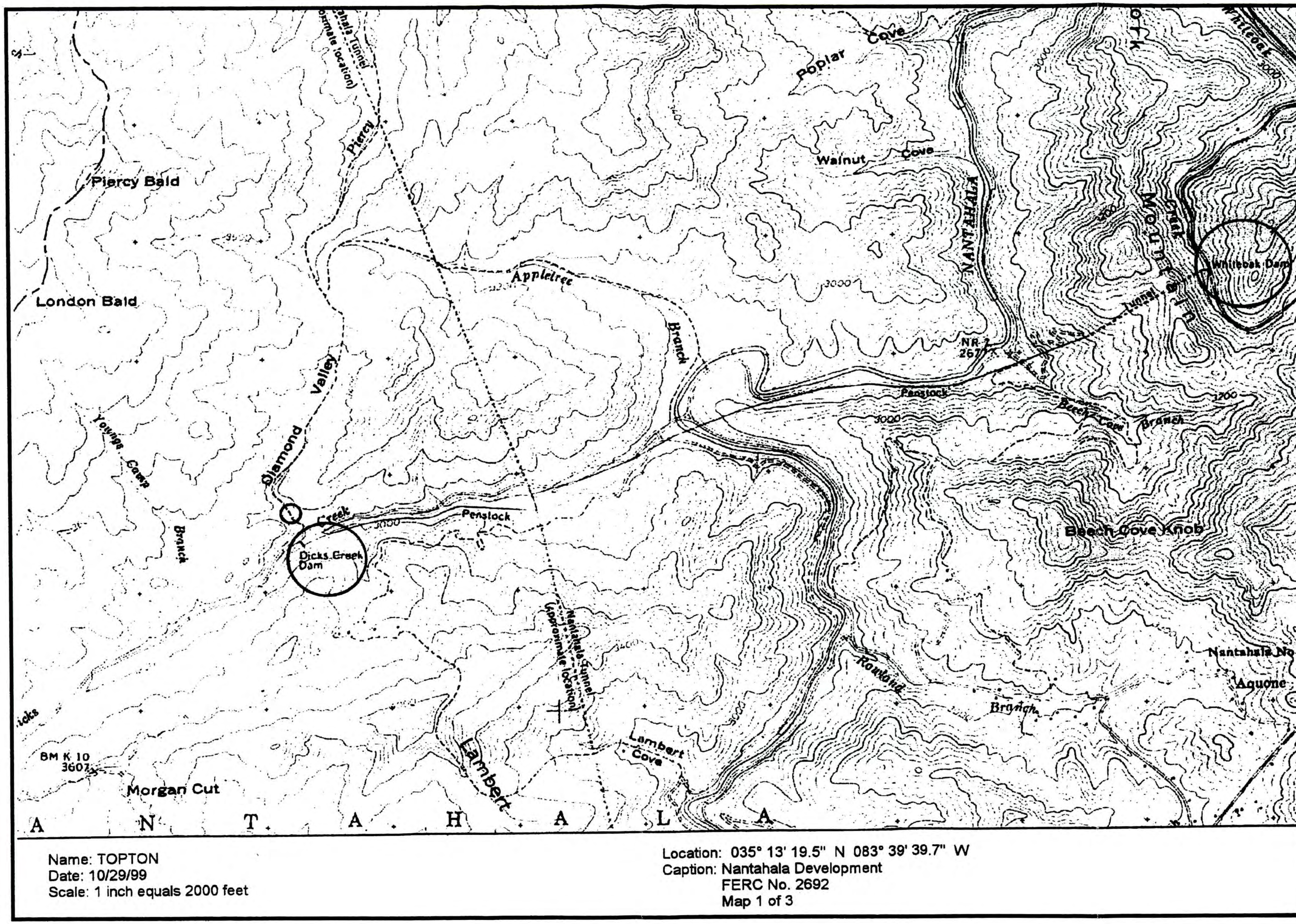
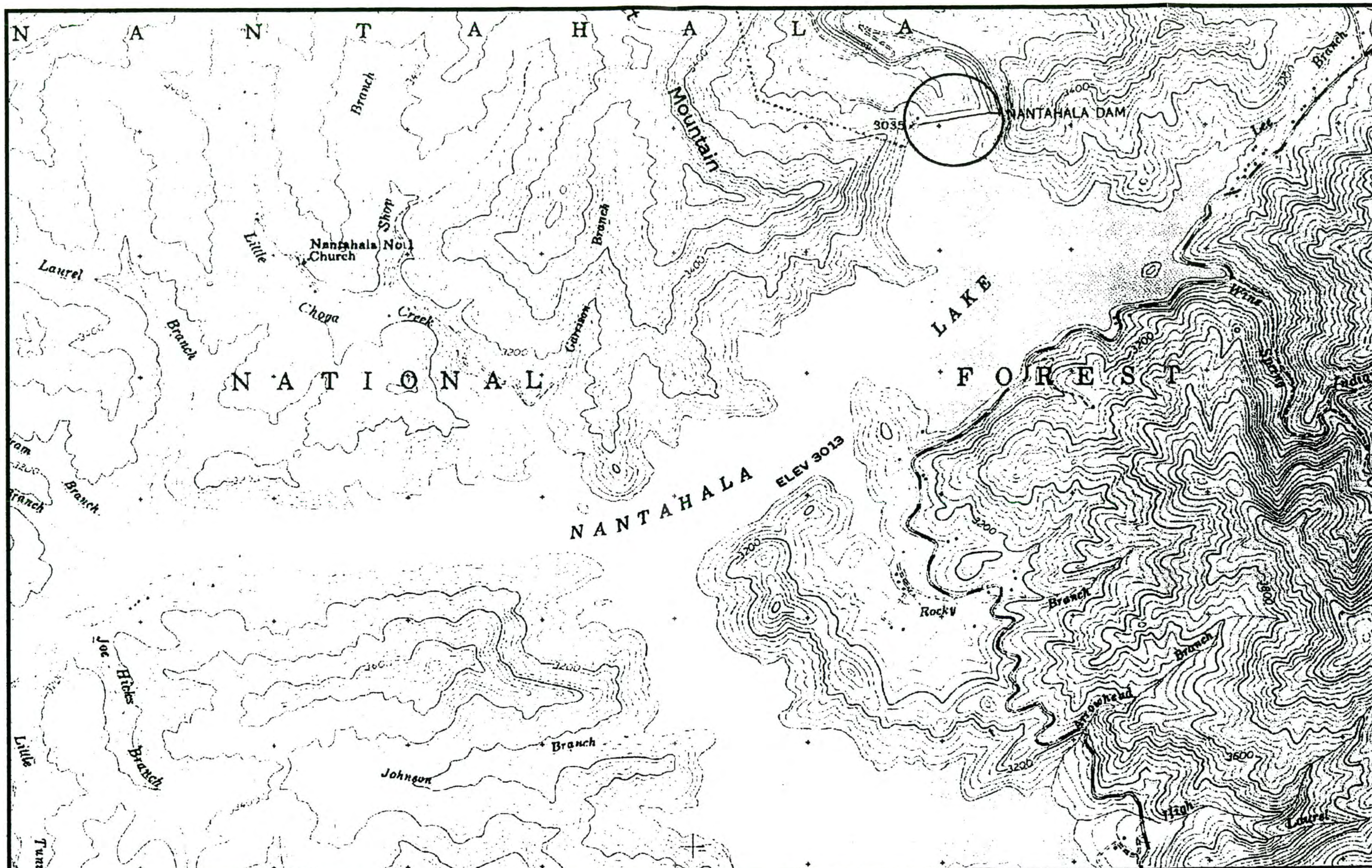


Figure No. 62. Location of the Nantahala Hydroelectric Project, Map 1 of 3.



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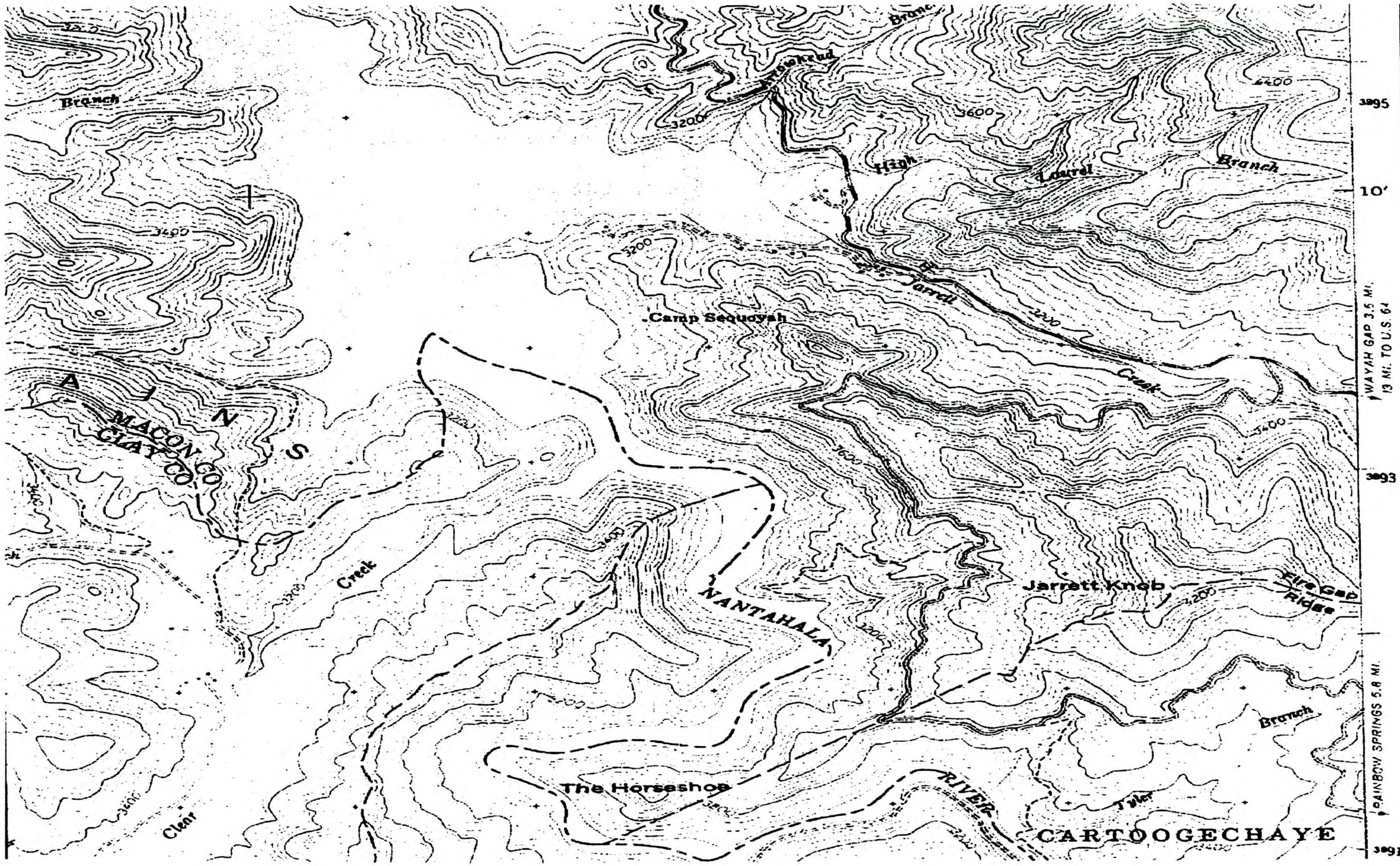
Date: 10/29/99
Scale: 1 inch equals 2000 feet

Location: 035° 11' 05.6" N 083° 39' 59.5" W
Caption: Nantahala Development
FERC No. 2692
Map 2 of 3

Figure No. 63. Location of the Nantahala Hydroelectric Project, Map 2 of 3.



Name: TOPTON
Date: 10/29/99
Scale: 1 inch equals 2000 feet

Location: 035° 08' 59.5" N 083° 38' 59.2" W
Caption: Nantahala Development
FERC No. 2692
Map 3 of 3

Figure No. 64. Location of the Nantahala Hydroelectric Project, Map 3 of 3.

NANTAHALA DAM AND POWERHOUSE SITE PLAN

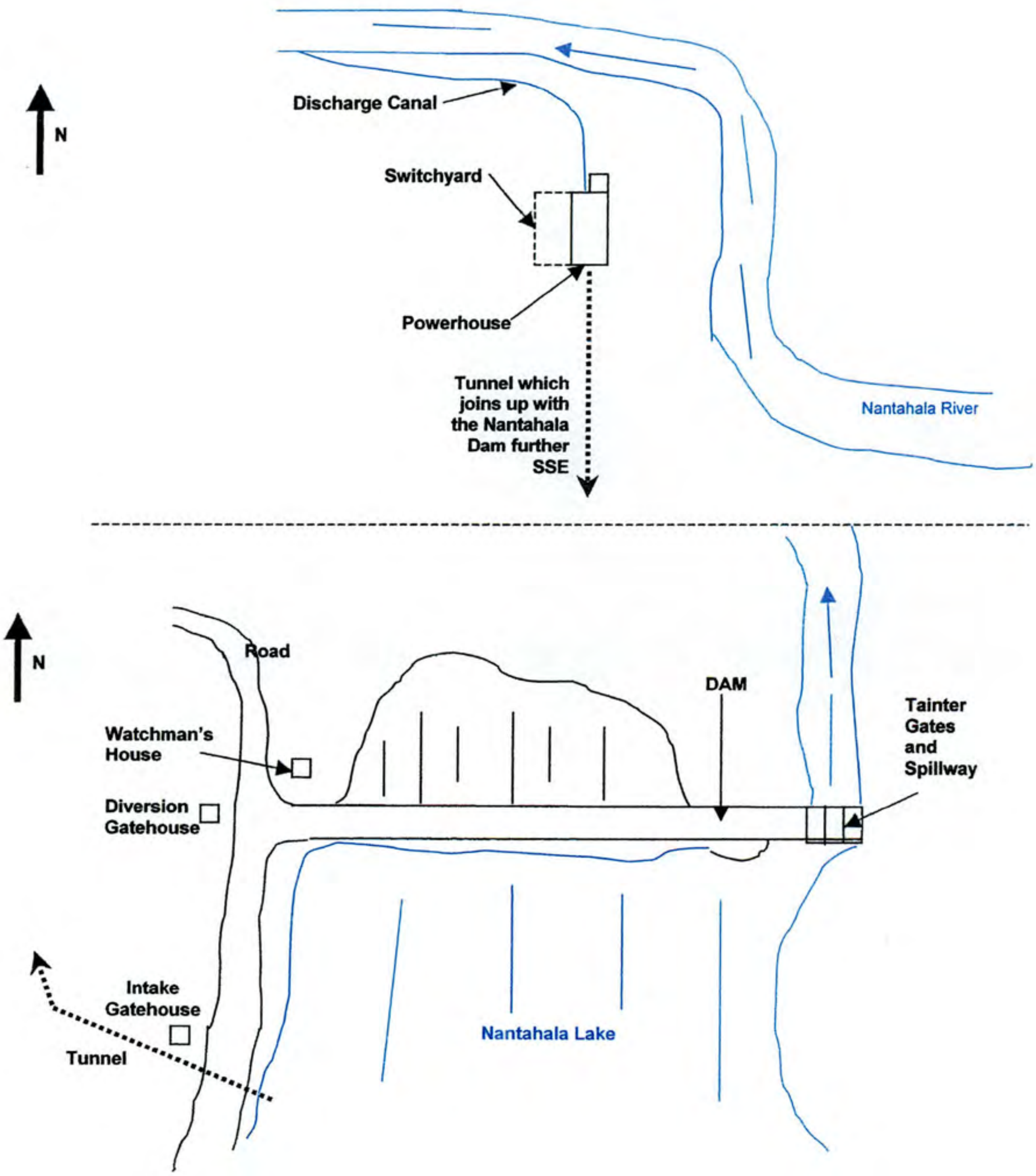


Figure No. 65. Nantahala Dam and Powerhouse Site Plan.

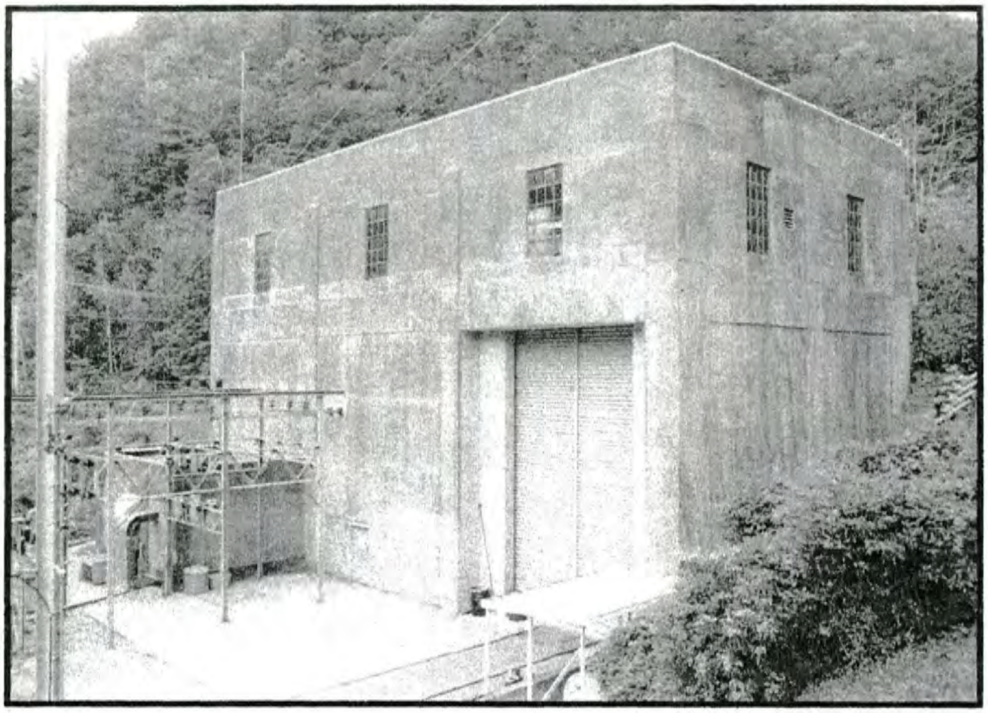


Figure No. 66. The Nantahala Powerhouse, north and west facades.

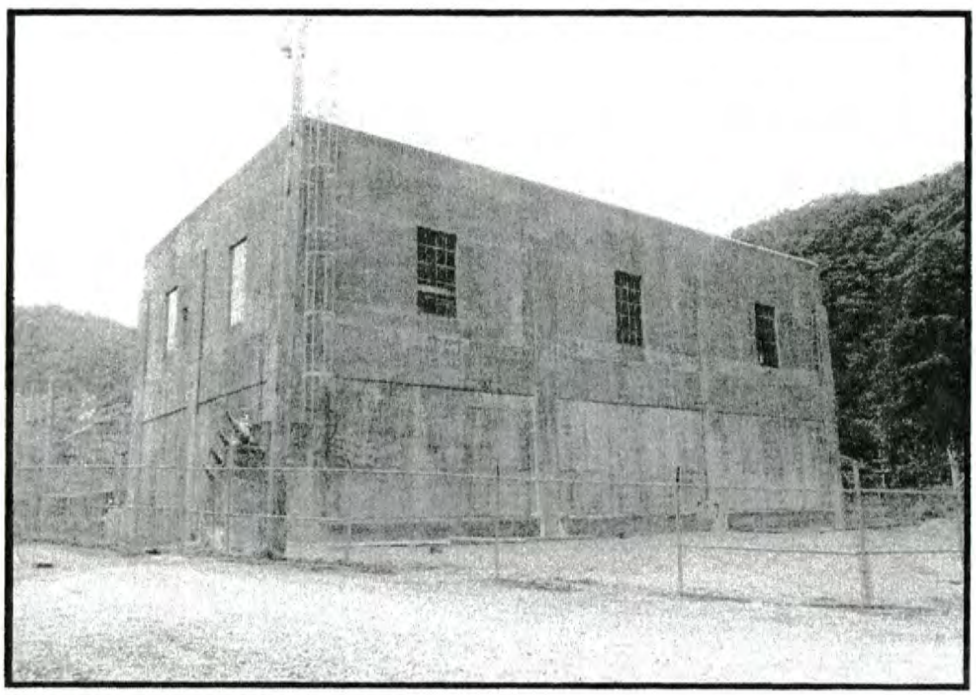


Figure No. 67. The Nantahala Powerhouse, west and south facades.

Figure No. 68. The Nantahala Powerhouse, south and east facades.

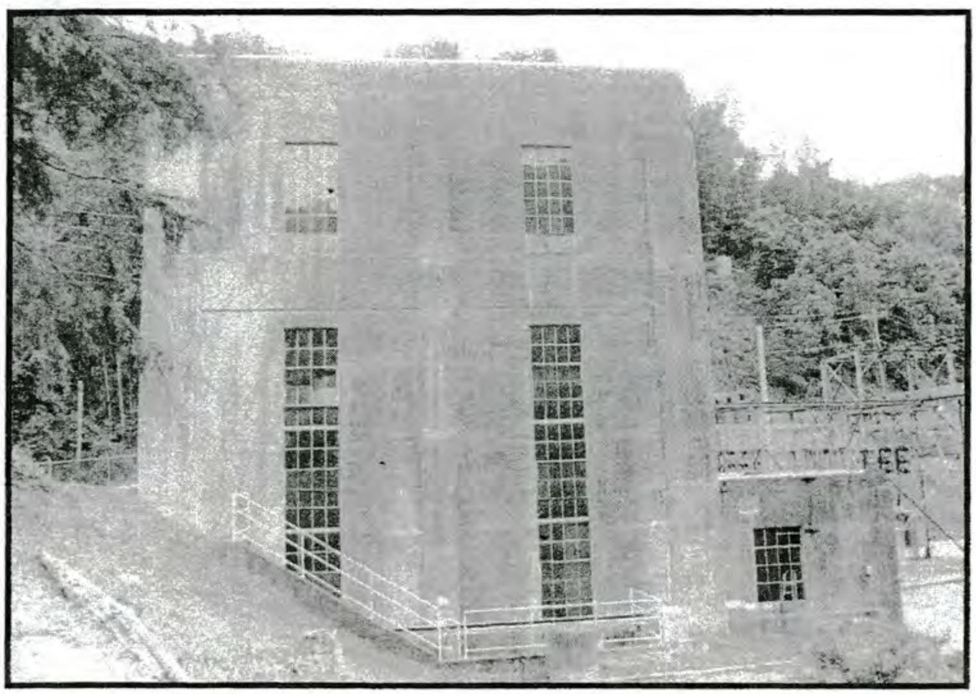


Figure No. 69. The Nantahala Powerhouse, east facade.

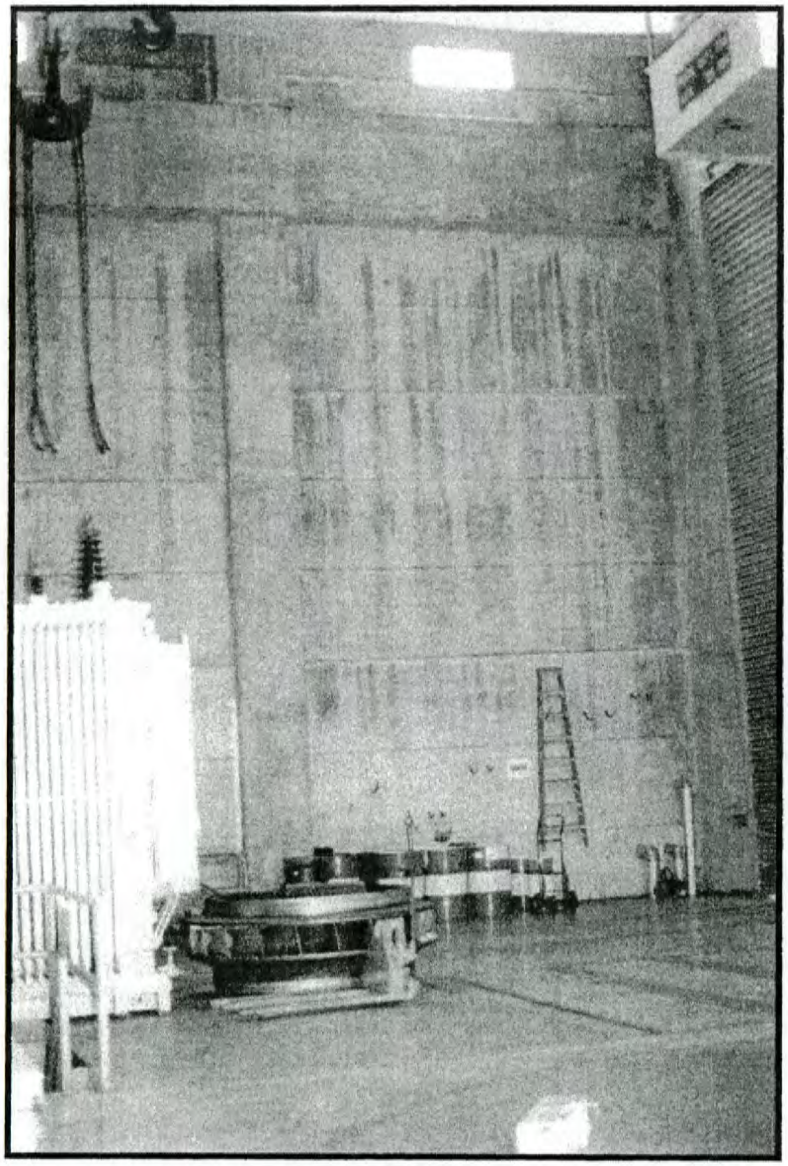


Figure No. 70. The Nantahala Powerhouse, interior view.

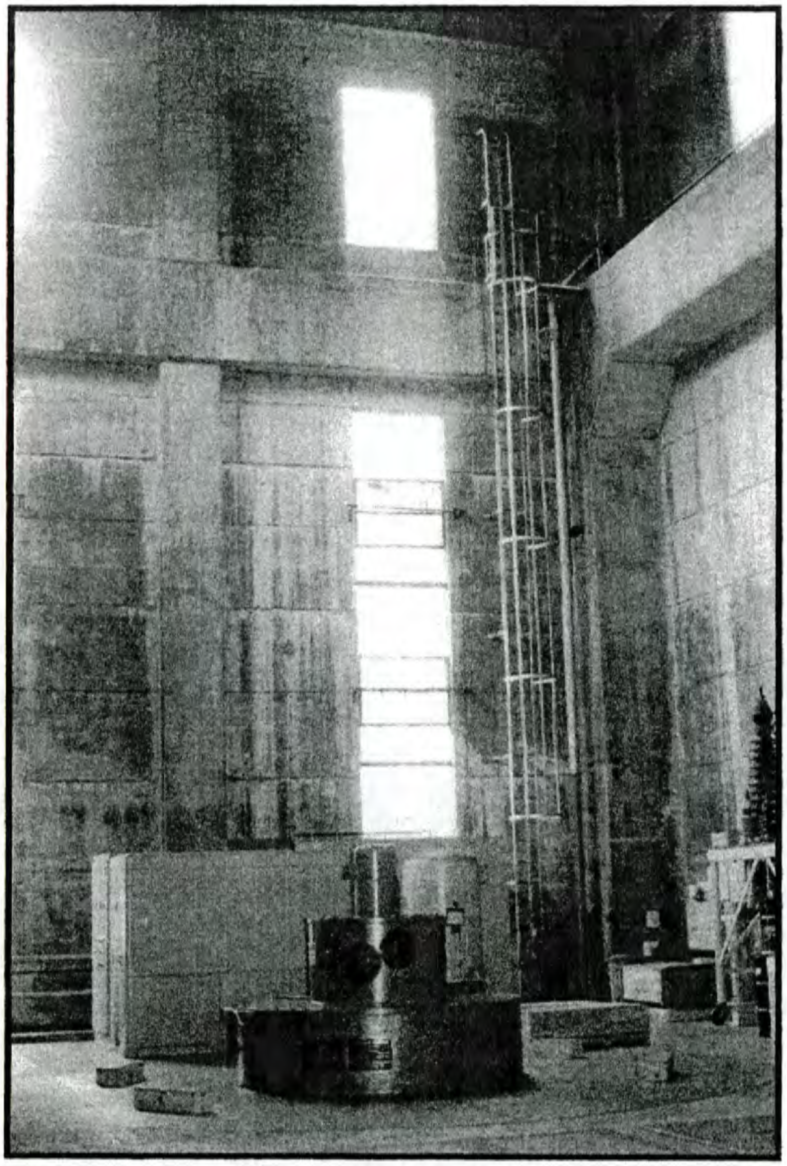


Figure No. 71. The Nantahala Powerhouse, interior view and turbine.

Figure No. 72. The Nantahala Dam, view above dam.

Figure No. 73. The Nantahala Dam, view below dam.

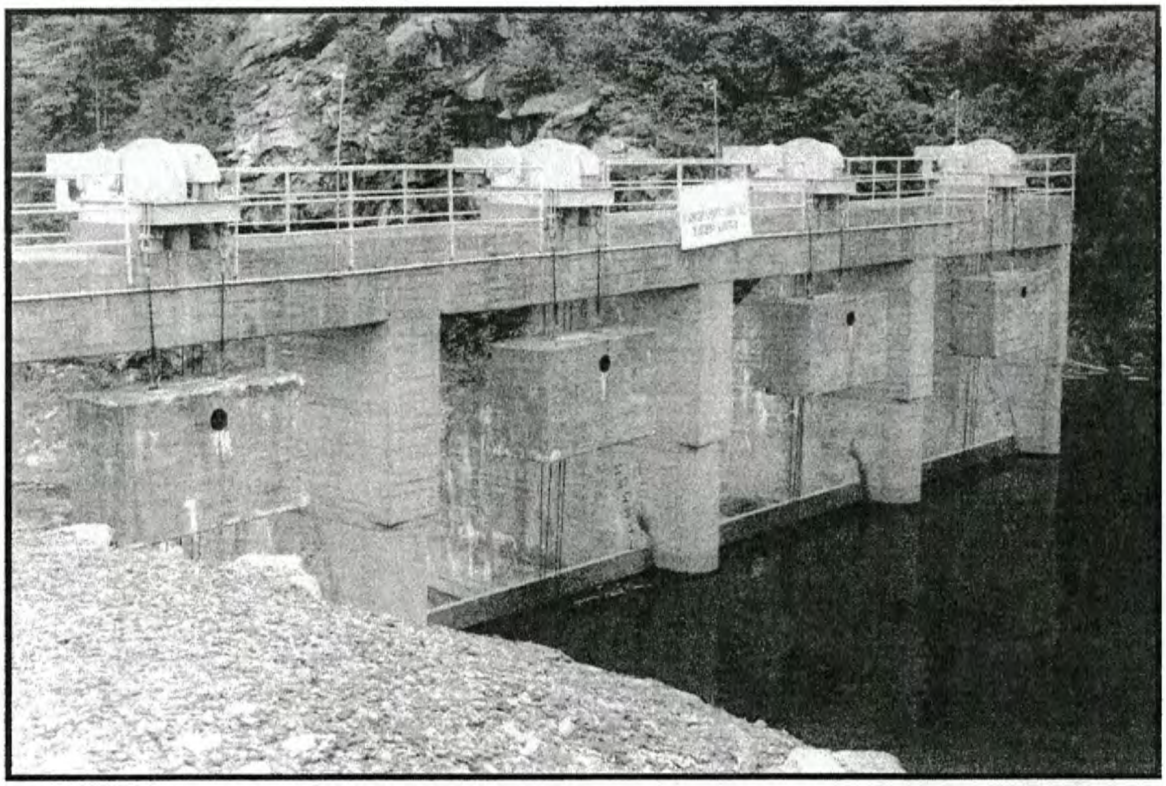


Figure No. 74. The Nantahala Dam, concrete spillway.

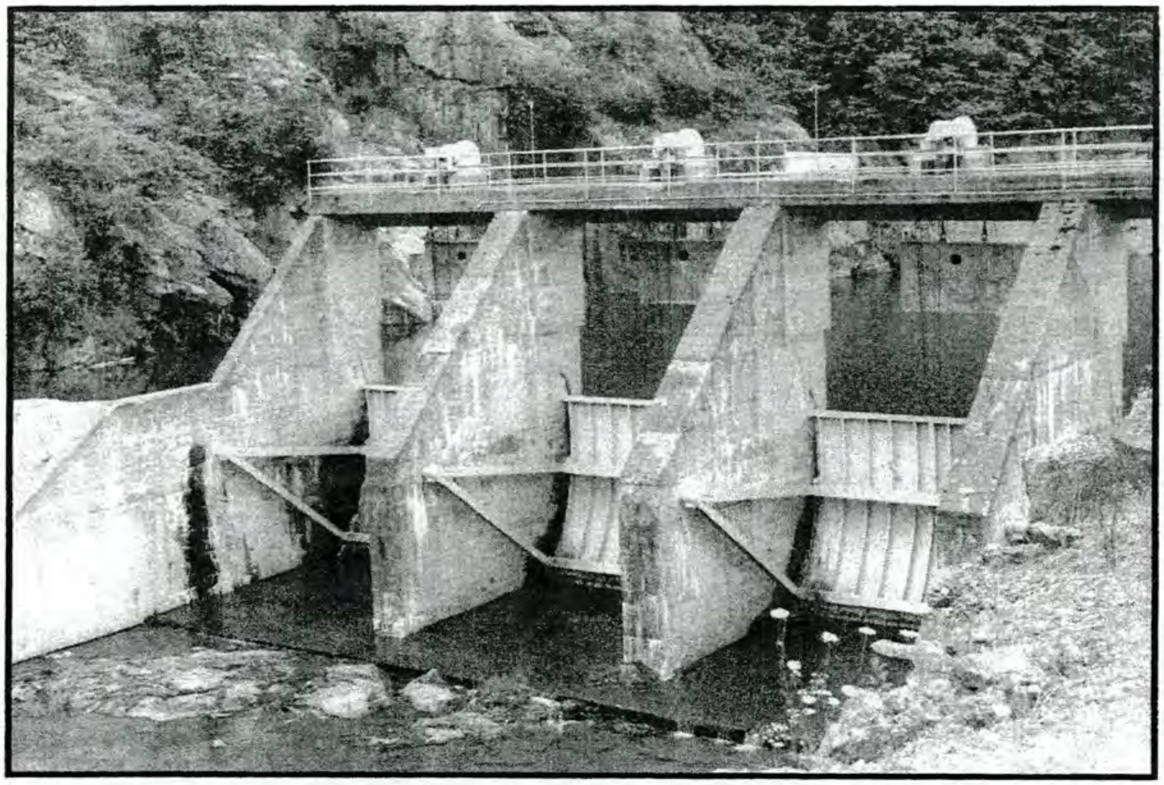


Figure No. 75. The Nantahala Dam, view of spillway and tainter gates.

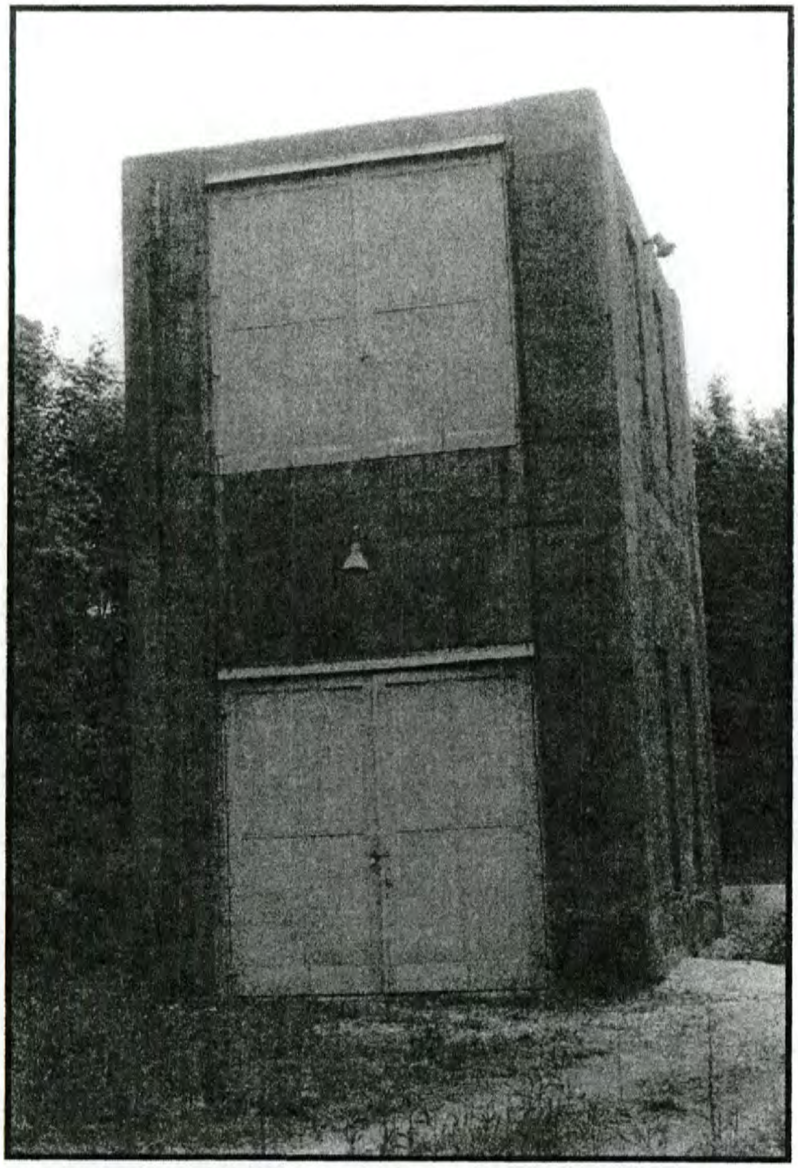


Figure No. 76. Nantahala Dam diversion gatehouse.

Figure No. 77. Nantahala Dam intake gatehouse.

Figure No. 78. The Watchman's House.

Figure No. 79. The Nantahala worker's housing, Dwelling No. 2.

Figure No. 80. The Nantahala worker's housing, Dwelling No. 3.

Figure No. 81. The Nantahala worker's housing, Dwelling No. 4.

Figure No. 82. The Nantahala worker's housing, Dwelling No. 5.

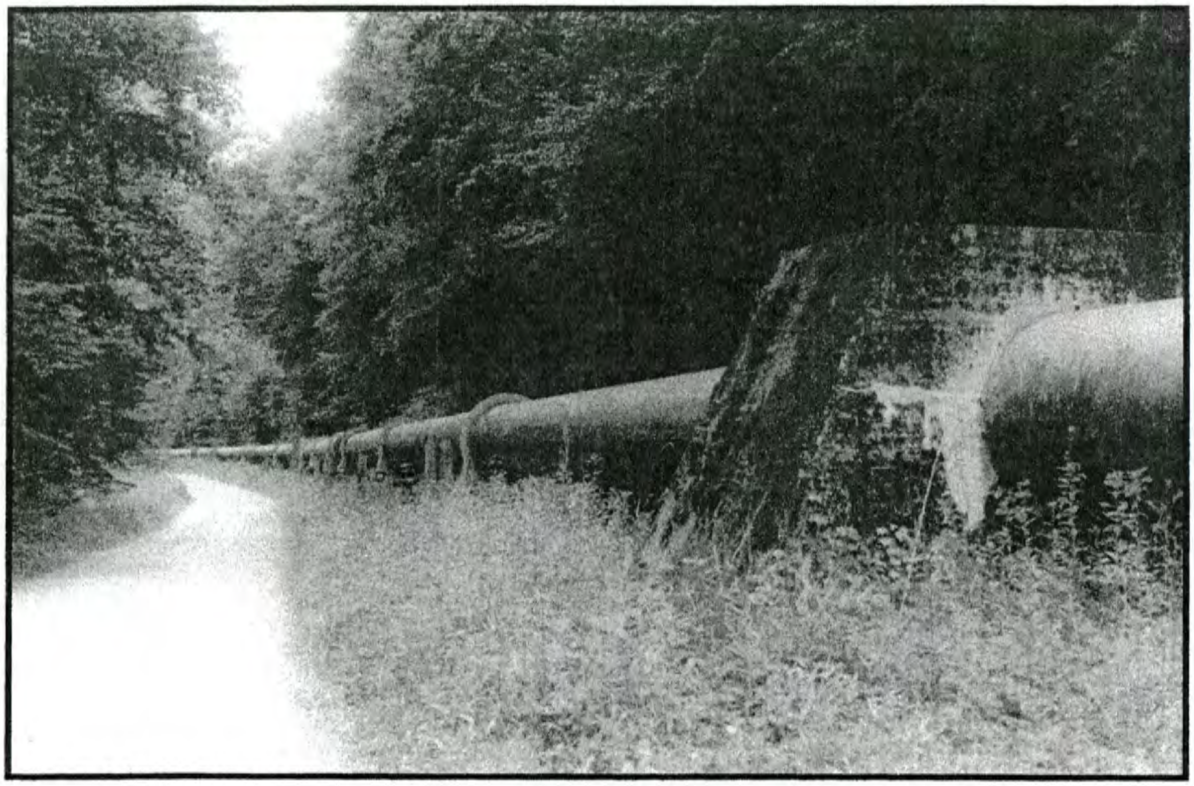
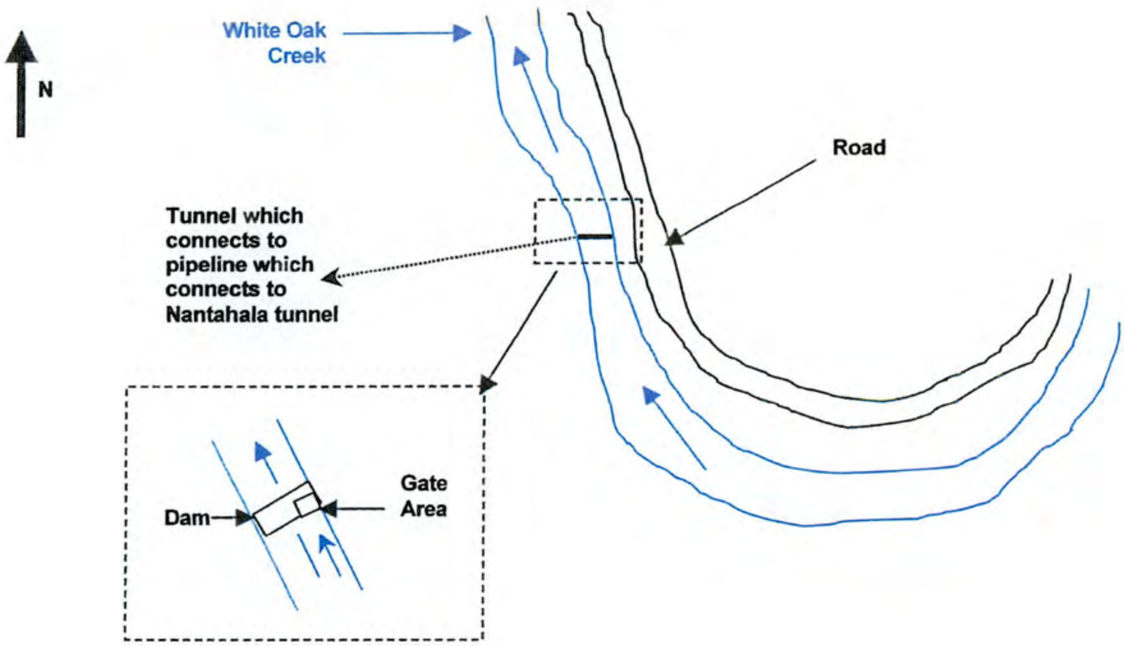


Figure No. 83. Typical raised steel water pipeline and concrete piers supplying water to the Nantahala Powerhouse.

WHITE OAK CREEK DAM SITE PLAN



DICKS CREEK DAM

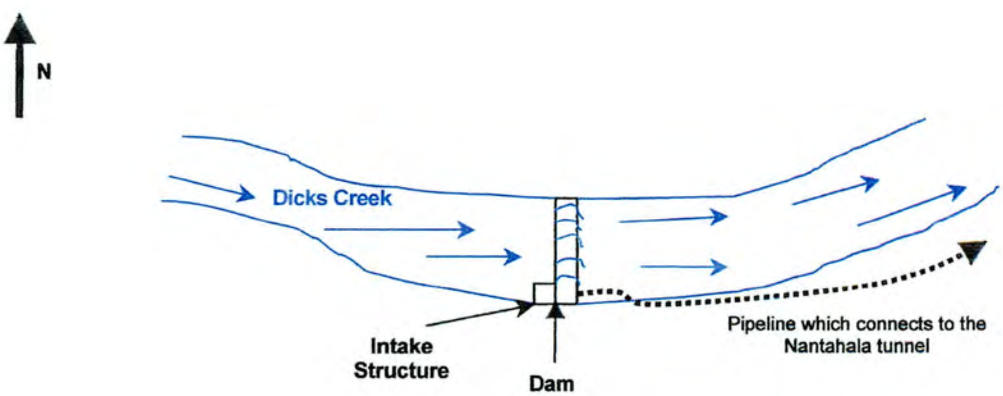


Figure No. 84. Dicks Creek Dam and White Oak Creek Dam Site Plans.

DIAMOND VALLEY DAM SITE PLAN

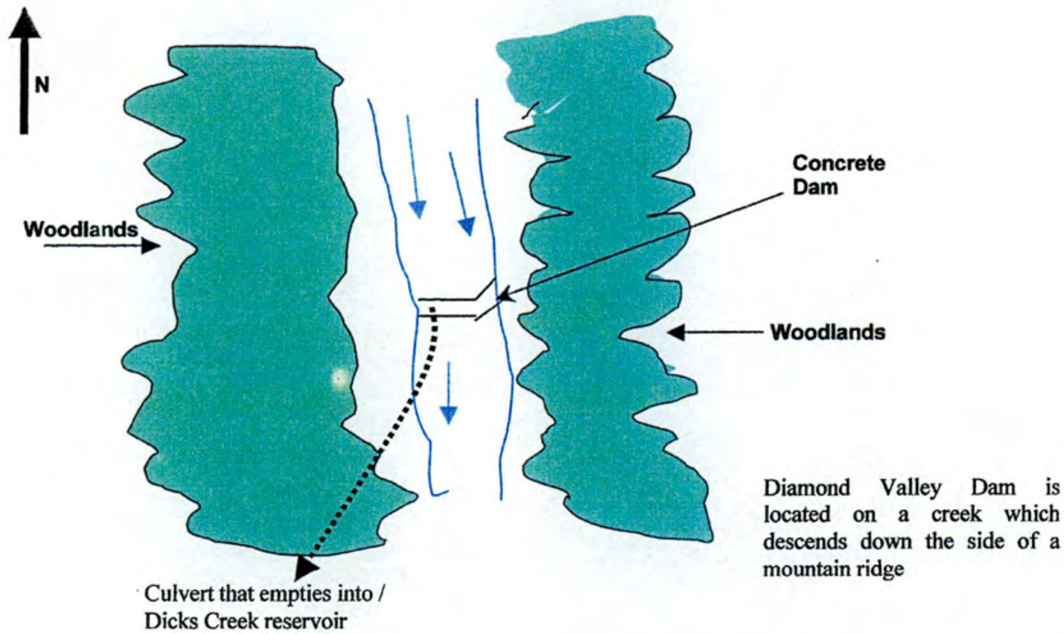


Figure No. 85. Diamond Valley Dam Site Plan

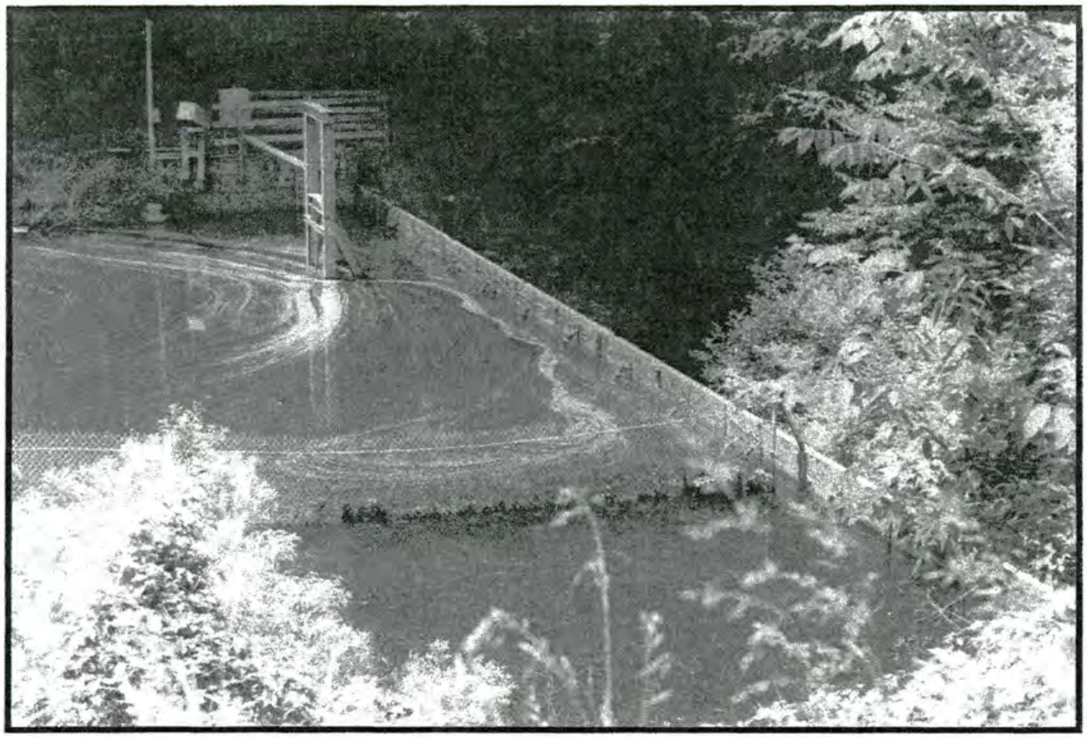


Figure No. 86. The White Oak Creek Dam, view above dam.

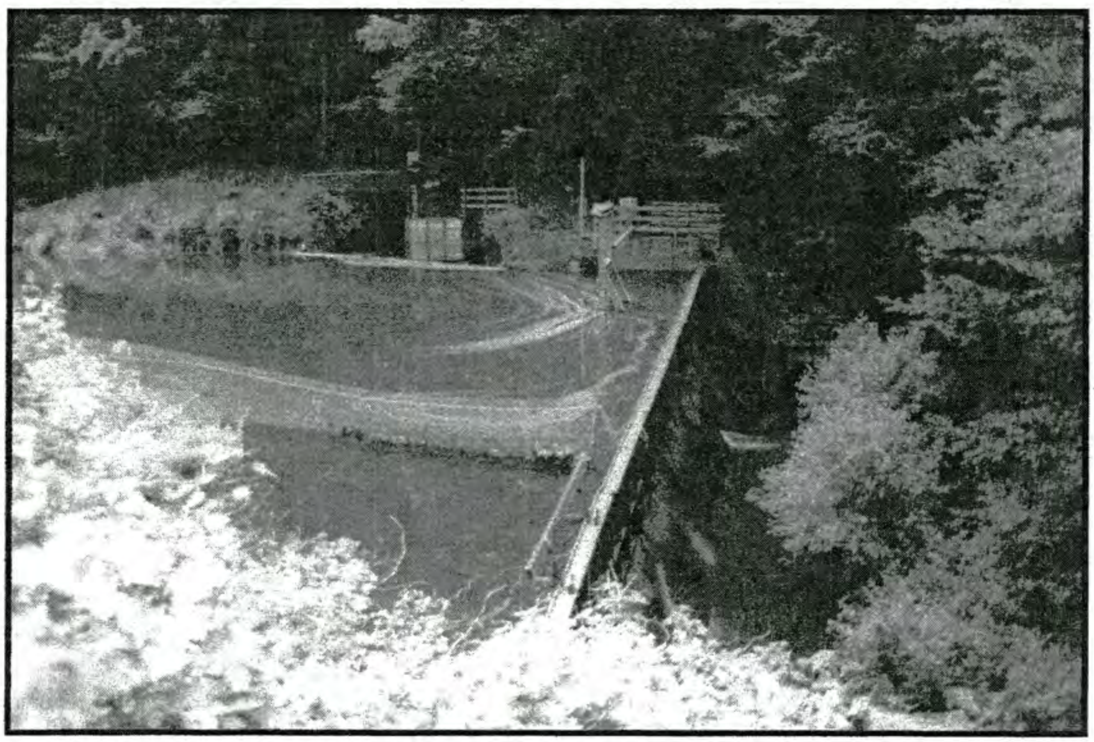


Figure No. 87. The White Oak Creek Dam, view below dam.

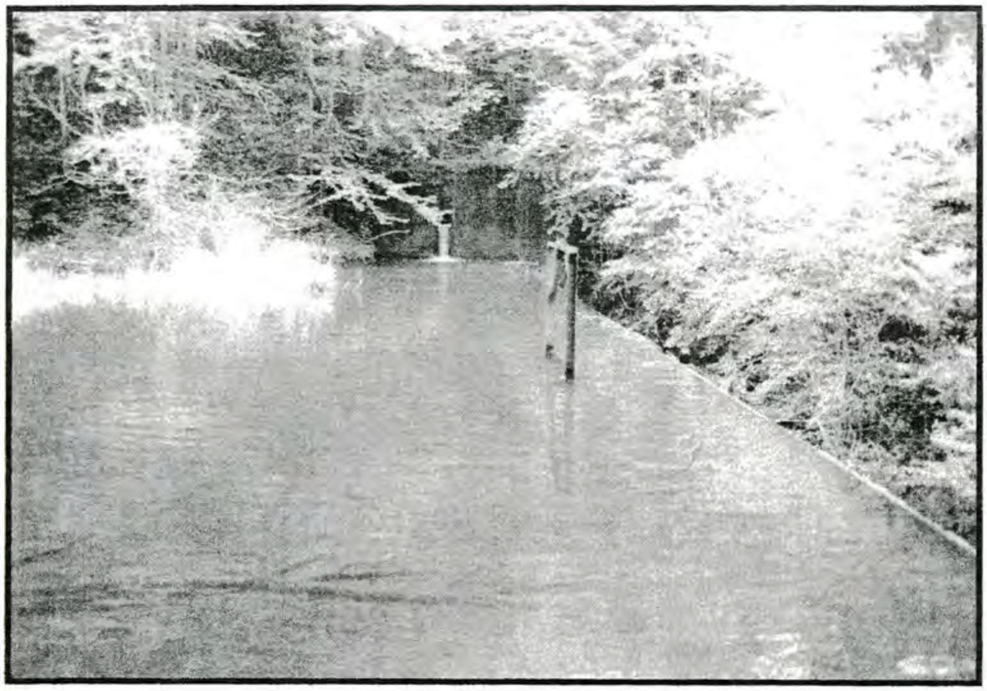


Figure No. 88. The Dicks Creek Dam, view above dam.

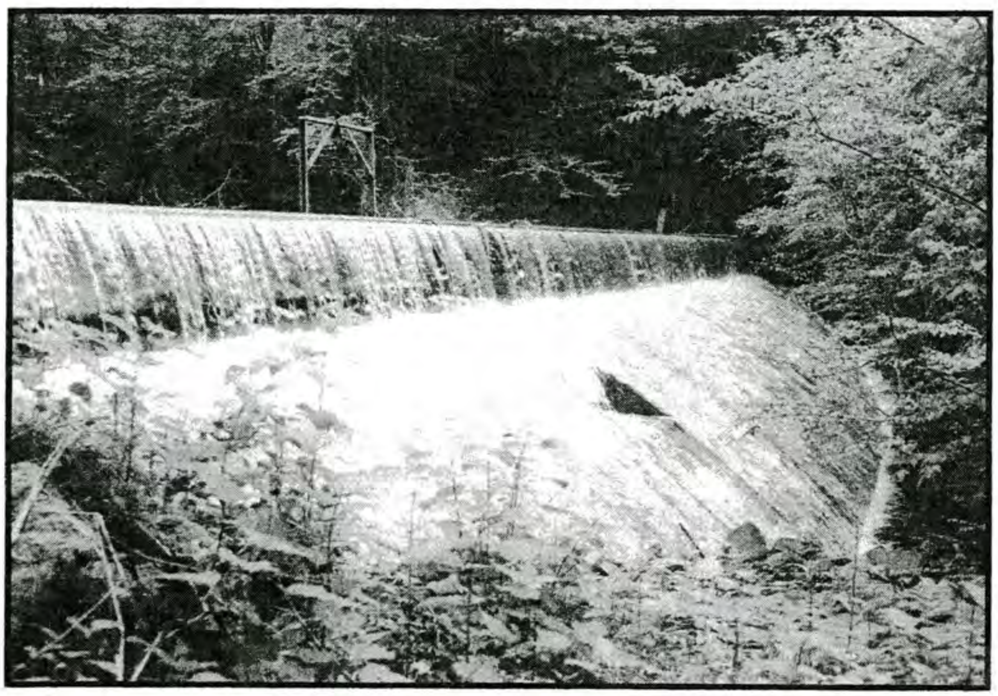


Figure No. 89. The Dicks Creek Dam. view below dam.

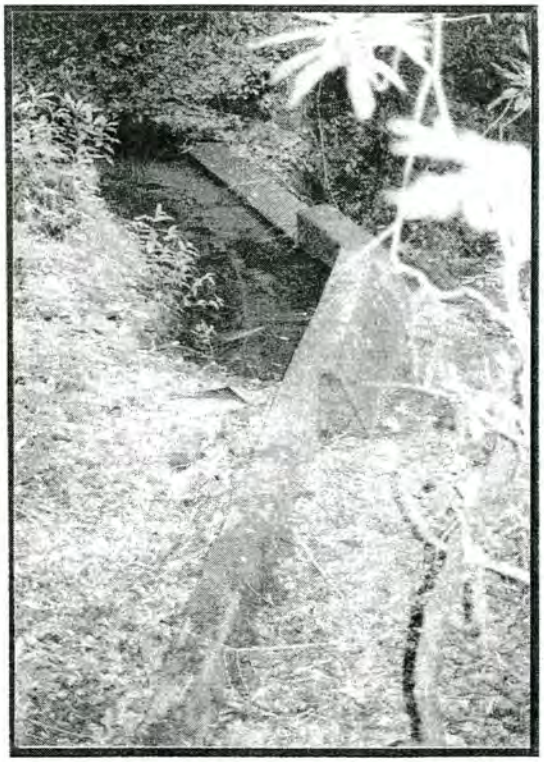


Figure No. 90. The Diamond Valley Dam, view above dam.

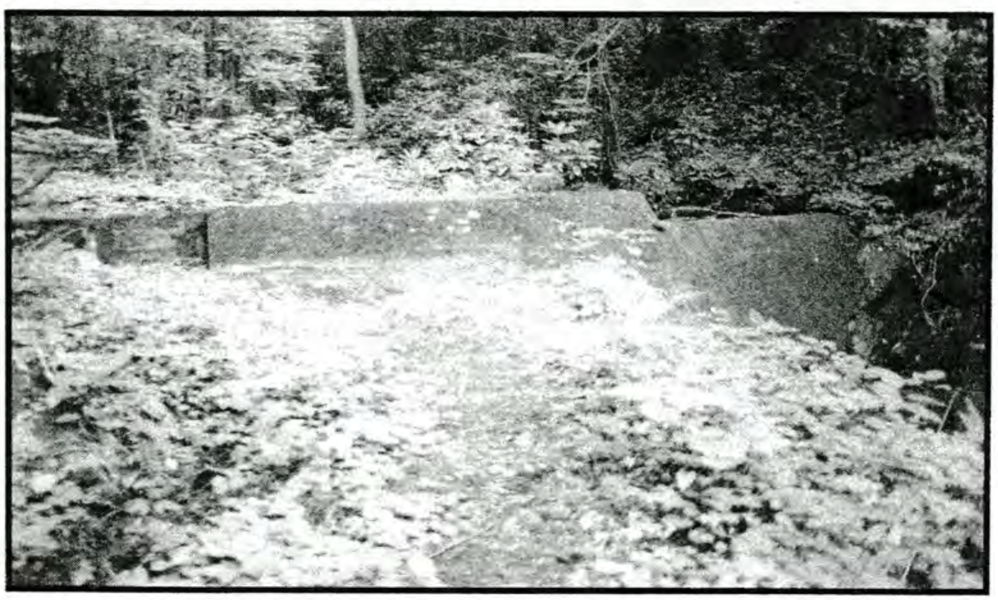


Figure No. 91. The Diamond Valley Dam, view below dam.

8. East Fork Hydroelectric Project

Historical Overview

The East Fork Hydroelectric Project is located on the East Fork of the Tuckasegee River in Jackson County. The Project consists of four components: the Cedar Cliff Development completed in 1952; the Bear Creek Development built in 1953; the Wolf Creek Development completed in 1955, and; the Tennessee Creek Development also completed in 1955. These developments were designed to provide additional electrical power into the NP&L system utilizing the watershed of the East Fork of the Tuckasegee River.

Construction began in September of 1950 on the Cedar Cliff Hydroelectric Plant on the East Fork of the Tuckasegee River, 2.3 miles upstream from Tuckasegee, North Carolina. Upon its completion the plant contained an earth and rock fill dam, a 15-foot diameter tunnel, and a powerhouse. A 66 kv transmission line connected the plant to the Thorpe Powerhouse. The tunnel that was used for diversion during construction became a permanent power tunnel. Work on the plant was completed by 1952.[192]

The Bear Creek Hydroelectric Plant was begun in January of 1952. This plant is located 3.6 miles southeast of the community of Tuckasegee. Work on the dam and powerhouse was completed in October of 1953, and the plant went on line in January of 1954. The 66 kv transmission line is connected to the Thorpe Powerhouse.

Construction of the Tennessee Creek Development began October 20, 1952 between seven and eight miles southeast of the community of Tuckasegee. Located on the East Fork of the Tuckasegeee River and Wolf Creek, the development consists of two dams and reservoirs – Wolf Creek and East Fork – interconnected by a tunnel, with a tap tunnel and pipeline to the powerhouse providing a maximum static head of 520 feet. The Wolf Creek Dam is the larger of the two earth and rock-fill dams, both of which supply water to the East Fork Powerhouse. A new construction technique was employed in building the dams. Rather than build all the layers of rock and clay from top to bottom at the same time, as it was done at the Nantahala Dam, at Tennessee Creek one layer of rock and clay was completed to the top of the dam and the other layers were added one by one with a single layer completed before the next was begun. First a coarse rock wall was constructed, then a fine rock layer was added, and then clay with more rock layers. The rock was poured from the top of the dam and allowed to take a natural slope. The East Fork Powerhouse was the first powerhouse built by NP&L on which aluminum exterior panels were used on the superstructure. The panels have fiberglass insulation between the exterior and interior sheets. This design was less expensive than similar size concrete structures. The Tennessee Creek Development was completed and placed in operation on May 19, 1955. The installation is controlled remotely by equipment operated from the Thorpe Powerhouse.[193]

Description

The Cedar Cliff Powerhouse is of poured concrete and corrugated steel construction. The main entrance is located on the west facade and has an original solid steel door. This door is set within a larger hinged steel door. There is no other fenestration. On the north facade is a louvered vent covered with a metal grille. The building has a gable roof of steel panels, and the upper wall section is also of steel panels. The interior has a

[192] Alcoa et al. 1958, 24-25; NP&L n.d., I-13-14.

[193] "A History to be Proud of: Tennessee Creek Project," Nantahala Powerline, Winter 1982.

poured concrete foundation, walls, and an upper section of steel frame and steel panels. Near the ceiling is a metal track conveyor system and a 30-ton crane. The building has an original Westinghouse switchboard, and a Vertical Francis turbine manufactured by the Electric Machinery Manufacturing Co. of Minnesota.

The Cedar Cliff Dam is of rock and earth, and has a ca. 1995 concrete driveway on the top along with a retaining wall. It impounds a reservoir containing 121 acres. The dam is 590' in length and has a height of 173'. The dam has a gatehouse of corrugated steel with a solid steel door. The dam has a concrete spillway with a steel tainter gate measuring 25' by 25'. Between the dam and the powerhouse is a tunnel which is 1,137' in length.

The Bear Creek Powerhouse is a two-story, poured concrete building completed in 1953. The main entrance has an original two-panel steel door. This door is set within an even larger hinged steel door. The only other fenestration are louvered vents on the east and west elevations. The interior has a poured concrete floor. The basement level has poured concrete floors, walls, and ceiling. Connecting the two floors is a steel staircase. The east and west facades have louvered vents with steel mesh grates. The turbine was manufactured by the S. Morgan Smith Company, and the AC and DC generators were built by Westinghouse. The original switchboard also remains and was manufactured by Westinghouse.

The Bear Creek Dam is of earth and rock, and has a poured concrete spillway. The dam impounds a reservoir containing 476 acres at full capacity. The dam has one automatic controlled steel tainter gate which measures 25' by 25'. On the dam is an original gatehouse which has a shed roof and exterior of corrugated steel. The entrance has a two-panel steel door, and there is no other fenestration. The gatehouses are suspended over the spillways with concrete and steel grate walkways.

Near the spillway is a poured concrete gatehouse, which contains the winch for the steel gate that fits over the pipe intake. This building has a shed roof and original two-panel steel double doors. The intake gate lowers on a steel and concrete track into the lake over the intake pipe. The tunnel which connects the dam with the powerhouse is 1,484' in length.

The East Fork Powerhouse has a poured concrete floor, walls of vertical steel panels, and a steel panel ceiling. The powerhouse has an original solid steel door on the south facade. The only other fenestration are louvered vents on the east facade. On the west facade is a poured concrete spillway. In the basement of the powerhouse is the turbine base and the penstock bringing in water from the dam. The basement has poured concrete floors, walls, and ceiling. A steel staircase connects the two floors. The interior has an original switchboard manufactured by General Electric. The Vertical Francis turbine was manufactured by the S. Morgan Smith Co. The AC and DC generators were manufactured by General Electric.

The East Fork Dam, which impounds Tennessee or Tanasee Lake, is of earth and rock fill with a length of 385' an a height of 140'. The dam impounds a reservoir containing forty acres at capacity. The spillway is of poured concrete with steel pipe railings. The tainter gate is of steel and measures 25' in width and 19' in height. Above the tainter gate is a steel and corrugated metal gatehouse which contains the electric motor, gears, and winch to raise and lower the gate. This gatehouse has a poured concrete floor, and corrugated steel roof and walls. The gatehouse also has a solid steel door.

The Wolf Creek Dam is 810' in length and 180' in height. This dam is also of earth and rock fill. The spillway is of poured concrete with a steel tainter gate which measures 25' in width and 19' in height. The gatehouse is of corrugated steel with original two panel doors. The interior has an electric motor and winch. The gatehouse has a corrugated steel shed roof and walls. A two-lane paved road runs along the top of the dam.

Connecting the two dams and the powerhouse is a tunnel and steel pipeline. The tunnel measures 4,723' in length, and the pipeline is over 2,468' in length.

National Register Assessment

In consultation with the North Carolina State Historic Preservation Office, it is the determination that the East Fork Hydroelectric Project meets NRHP criterion A as a contributing element of the larger Nantahala system. The properties are eligible under the categories of Industry and Military. The four components of the project were built between 1952 and 1955 to provide additional power to Alcoa. The electricity generated by the East Fork Hydroelectric Project was used to support the operations of Alcoa in Blount County, Tennessee. In the post World War II era, Alcoa continued to be a leader in the aluminum industry. As the principal industry in the region, Alcoa made important contributions to growth and development of East Tennessee. Also, Alcoa's aluminum production contributed to the U.S. government's stockpile of the metal during the Korean Conflict and the Cold War for military use. The East Fork Hydroelectric Project is not eligible under the context of Social History, as it was not until the 1960s that power from the four East Fork plants were used to supply electricity for regional residential and commercial customers.

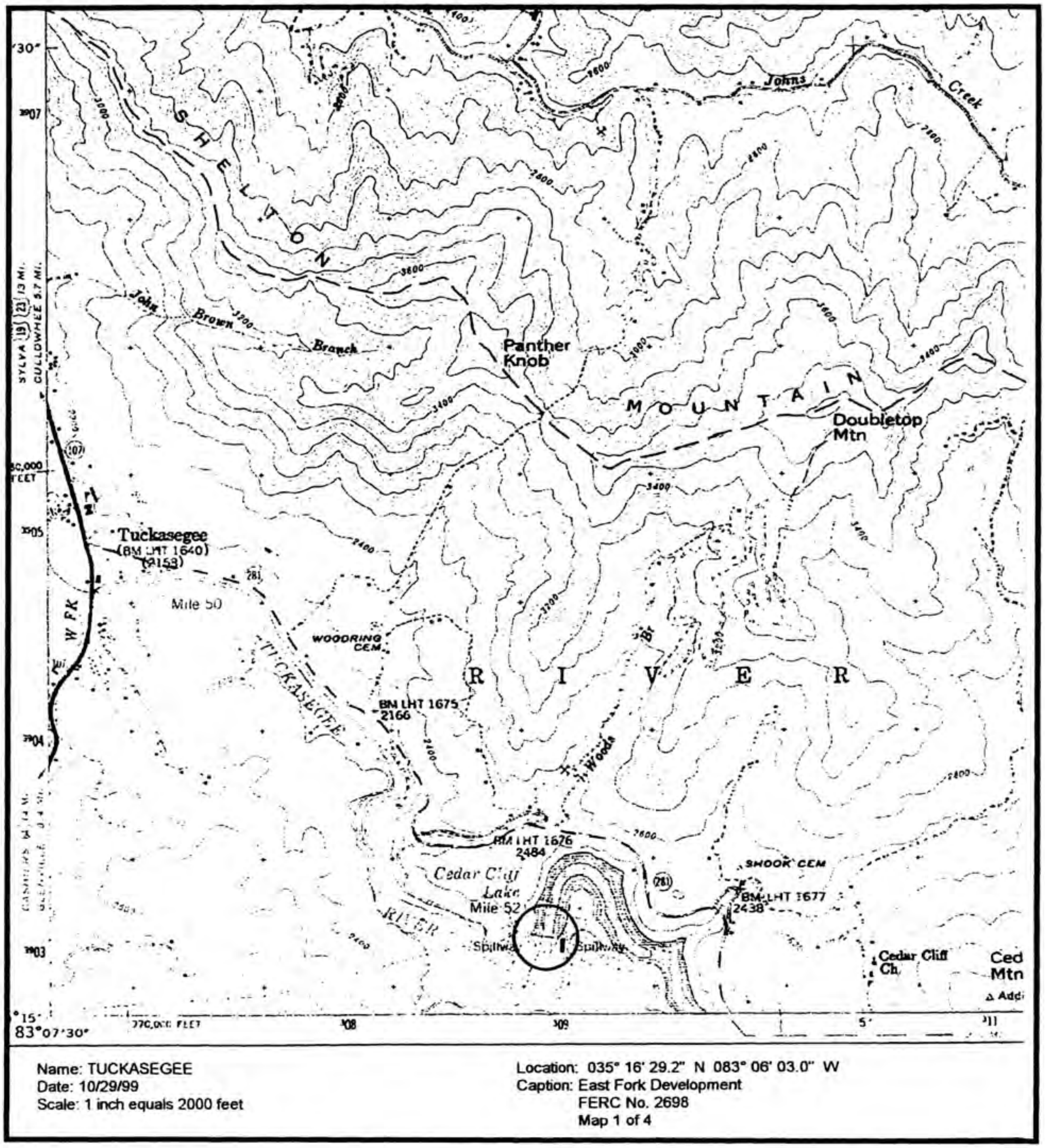
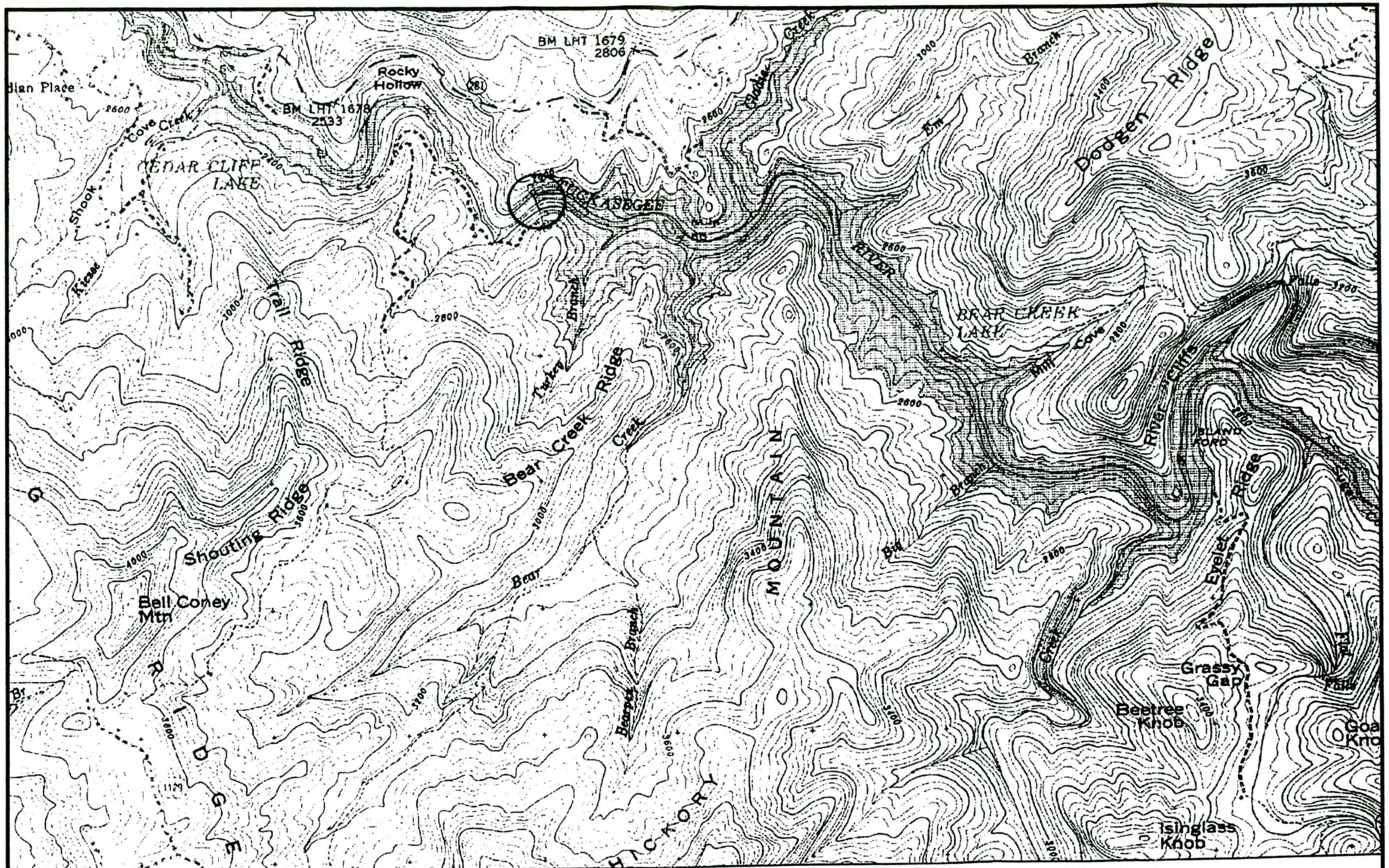


Figure No. 92. Location of the East Fork Hydroelectric Project, Map 1 of 4.



Name: BIG RIDGE
Date: 10/29/99
Scale: 1 inch equals 2000 feet

Location: 035° 13' 54.4" N 083° 03' 52.2" W
Caption: East Fork Development
FERC No. 2698
Map 2 of 4

Figure No. 93. Location of the East Fork Hydroelectric Project, Map 2 of 4.

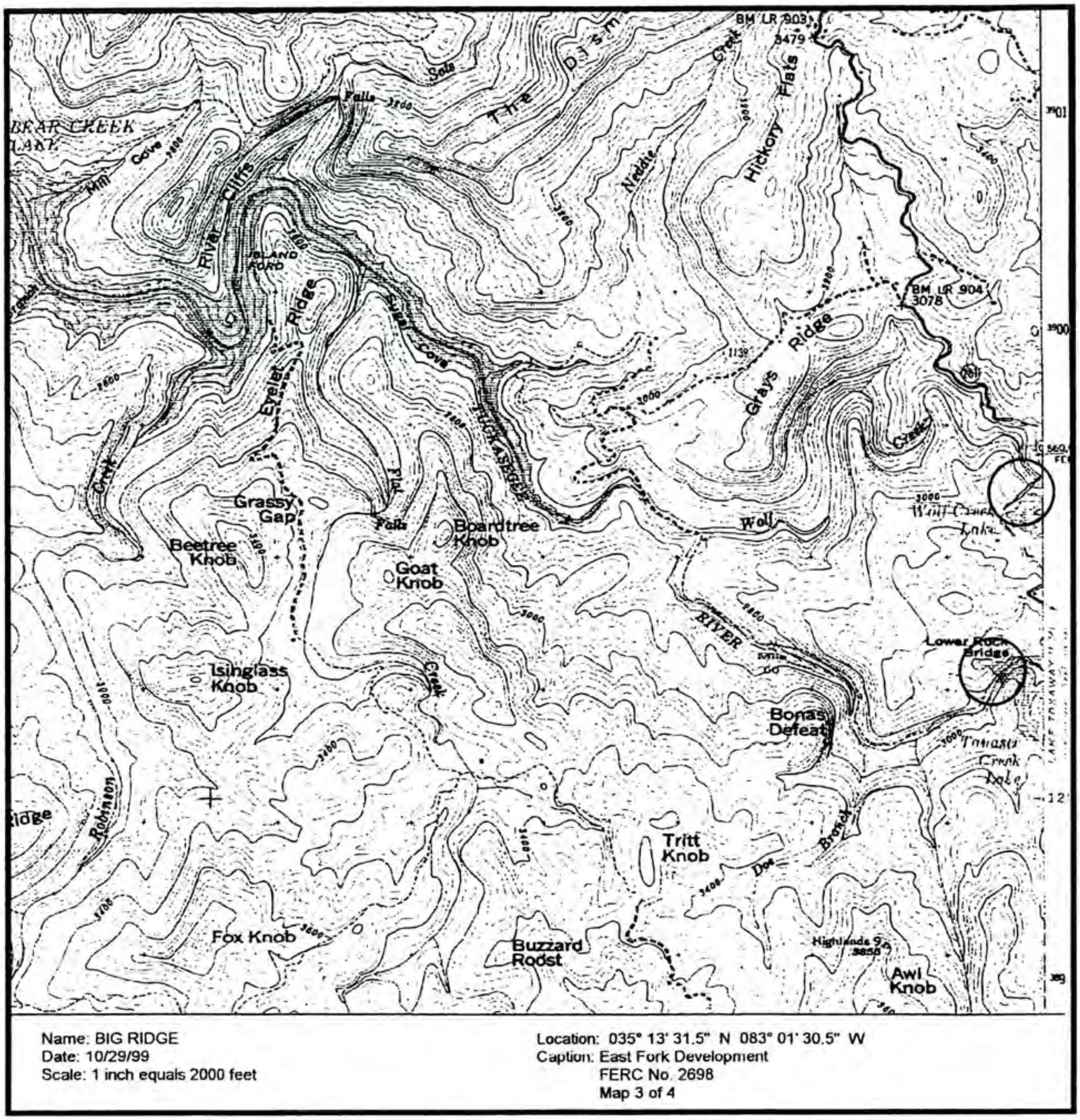


Figure No. 94. Location of the East Fork Hydroelectric Project, Map 3 of 4.

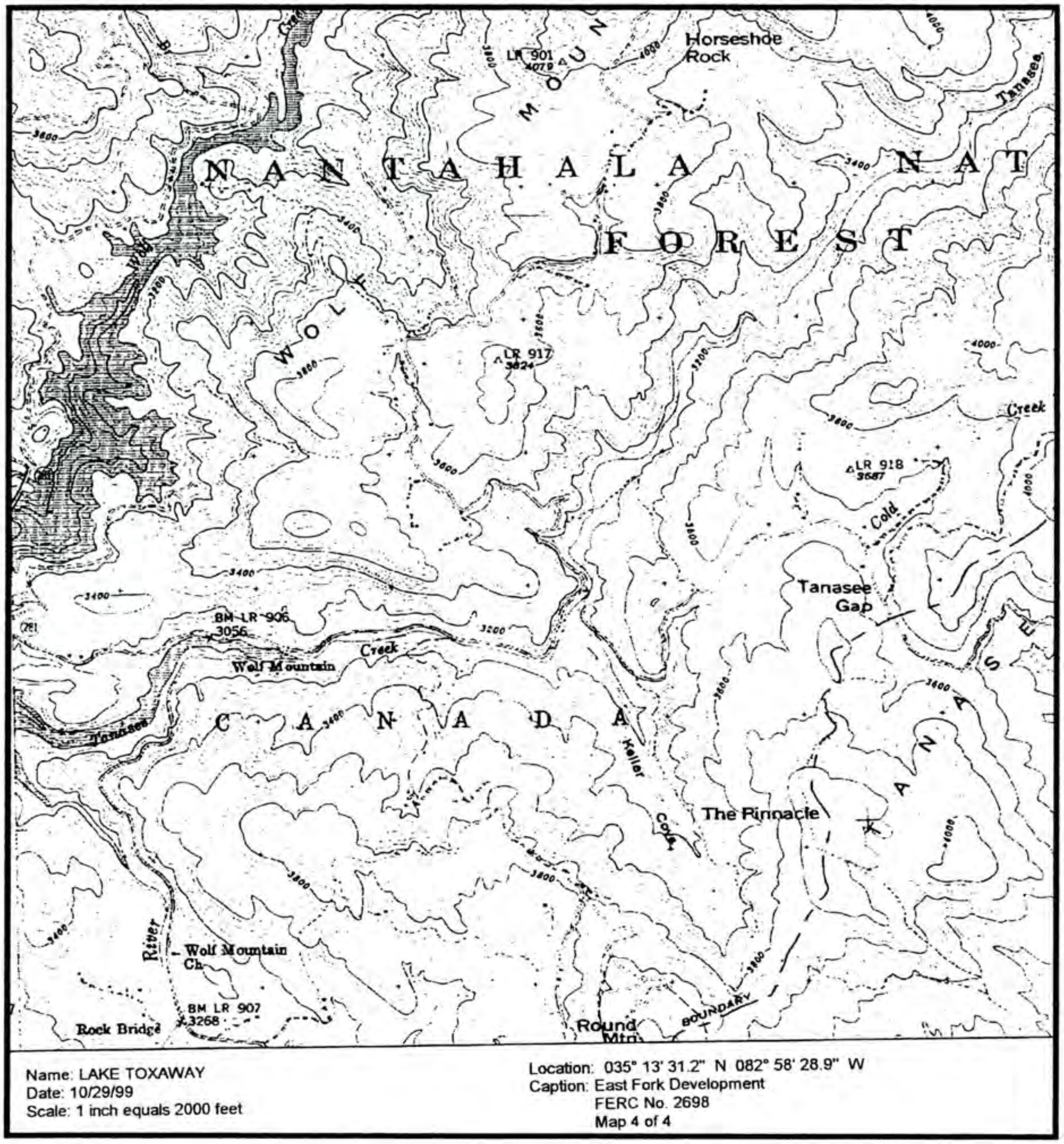


Figure No. 95. Location of the East Fork Hydroelectric Project, Map 4 of 4.

CEDAR CLIFF DAM AND POWERHOUSE

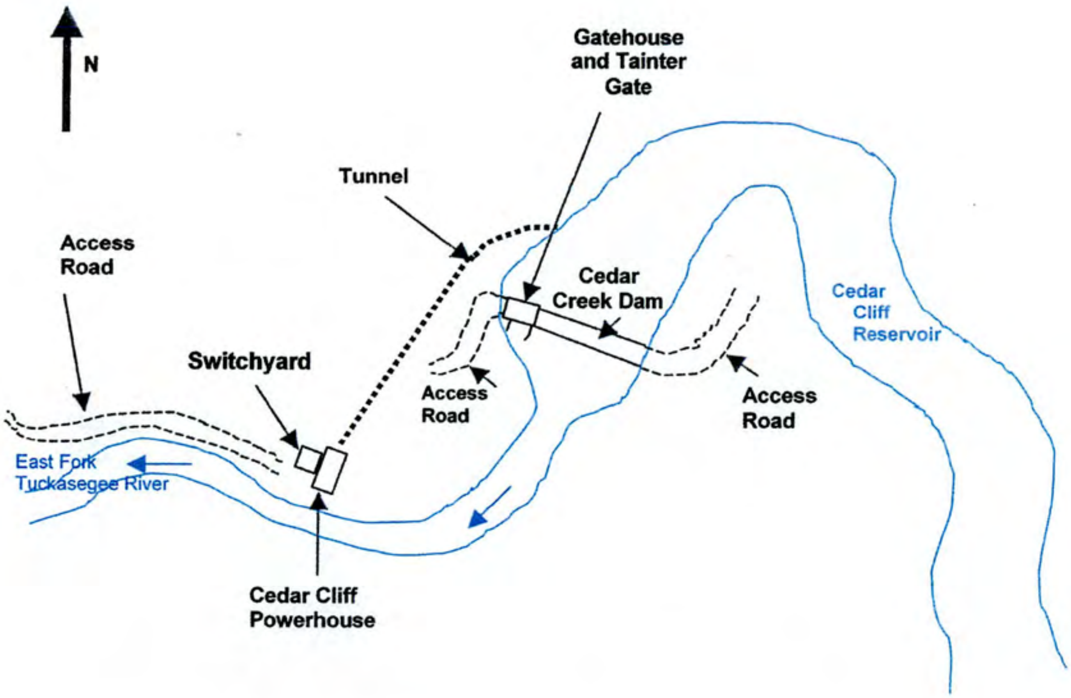


Figure No. 96. Cedar Cliff Dam and Powerhouse Site Plan.

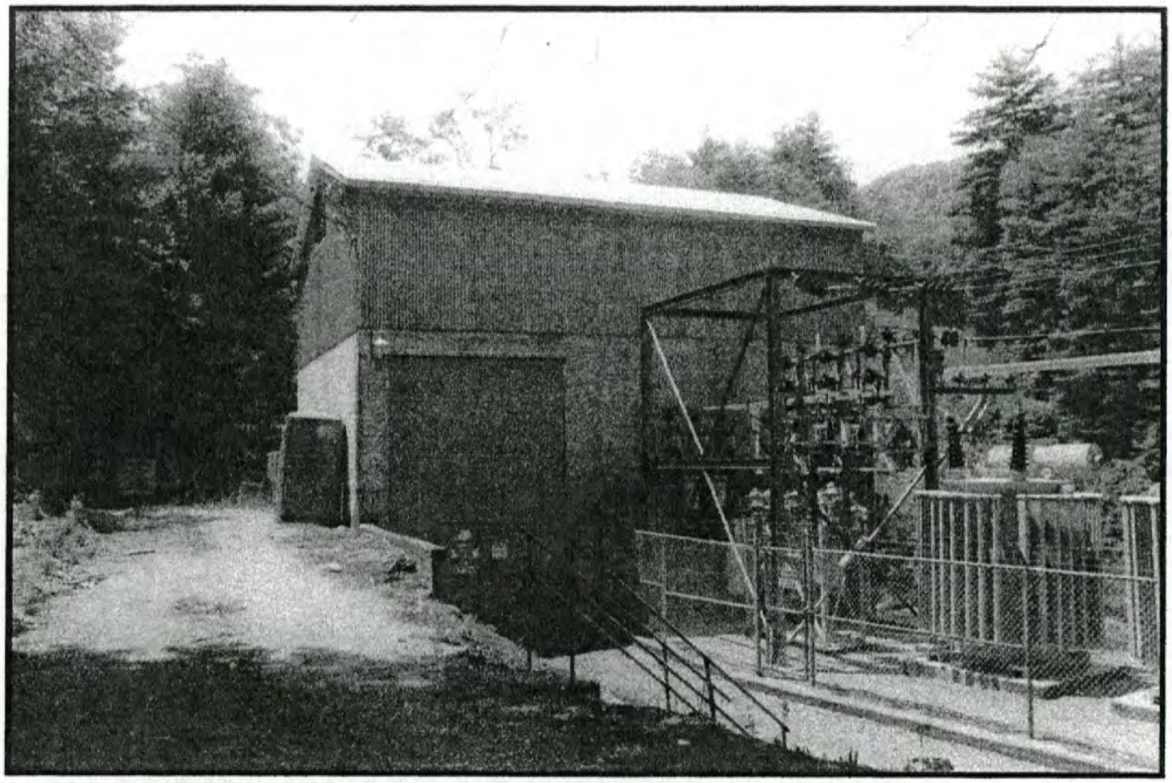


Figure No. 97. The Cedar Cliff Powerhouse, west and north facades.

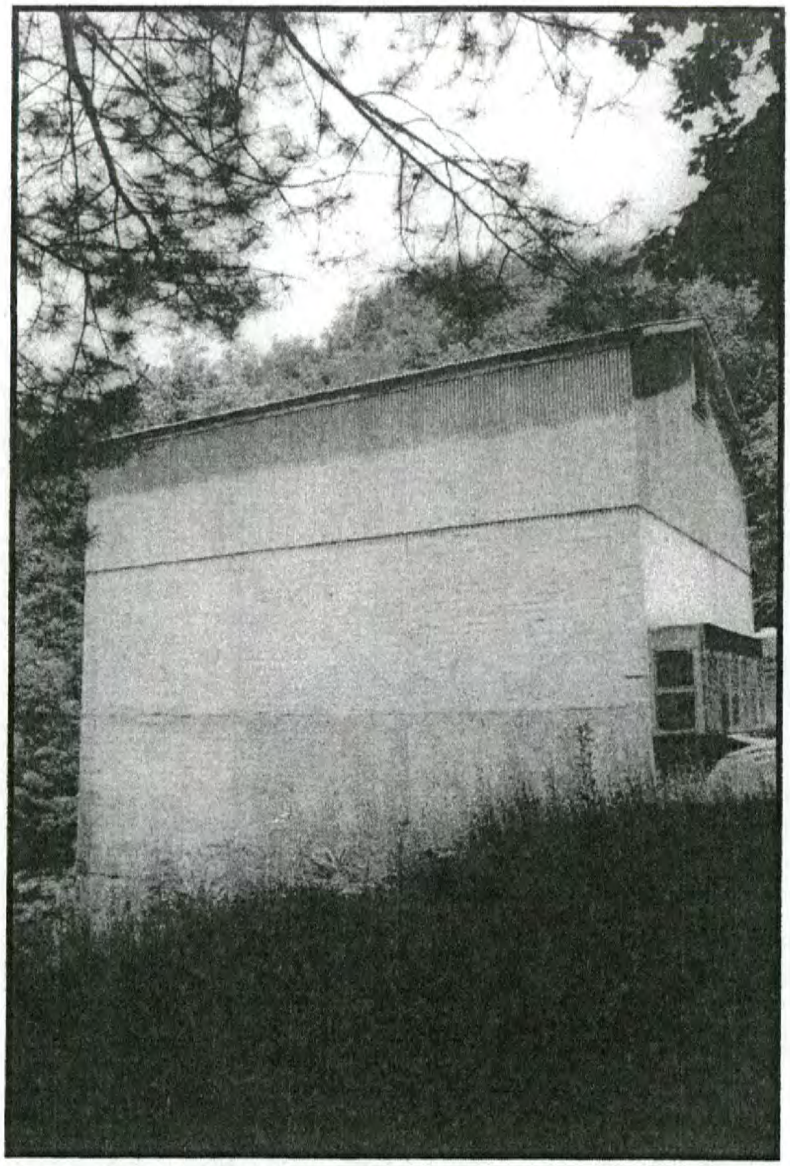


Figure No. 98. The Cedar Cliff Powerhouse, east and north facades.

Figure No. 99. The Cedar Cliff Dam, view below dam.

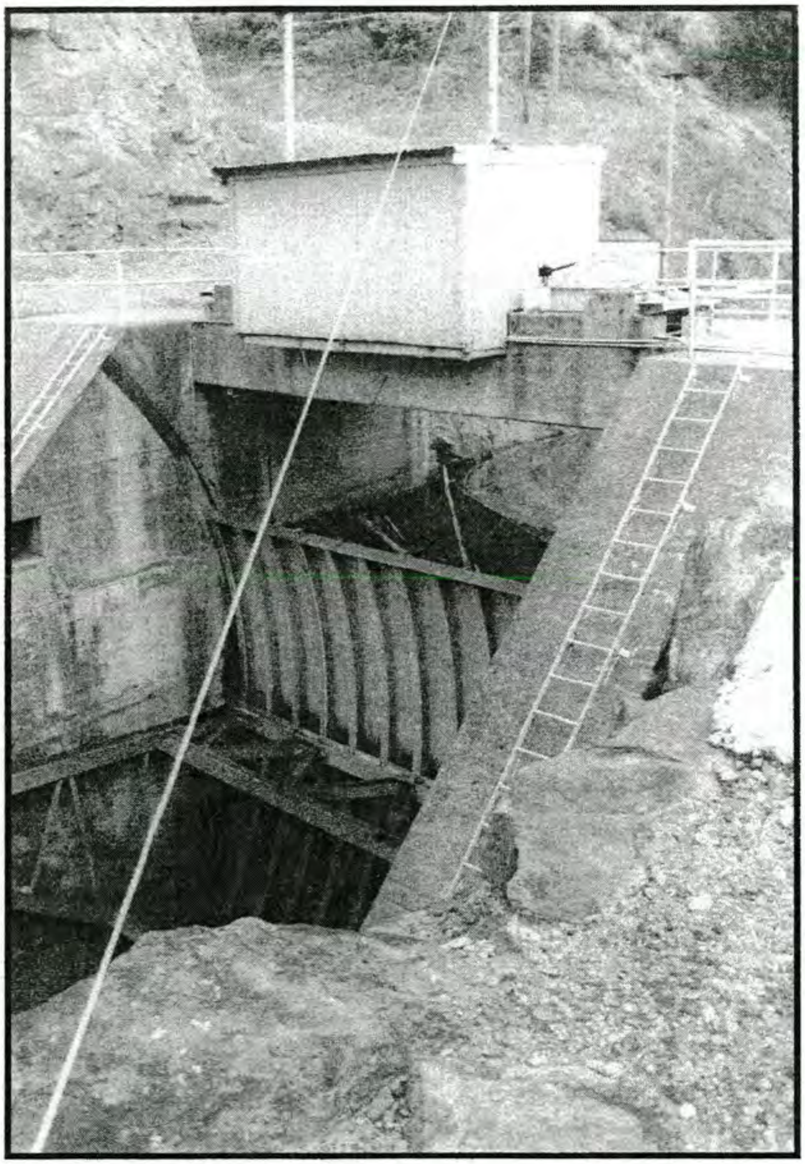


Figure No. 100. The Cedar Cliff Dam spillway and tainter gate.

BEAR CREEK DAM AND POWERHOUSE SITE PLAN

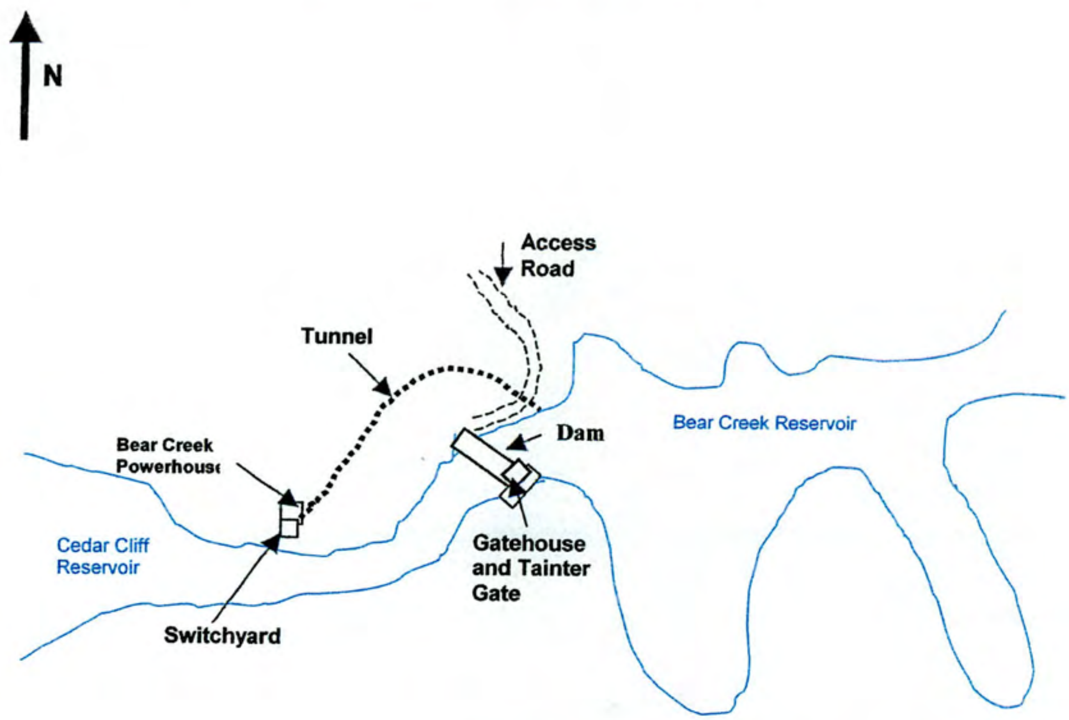


Figure No. 101. Bear Creek Dam and Powerhouse Site Plan.

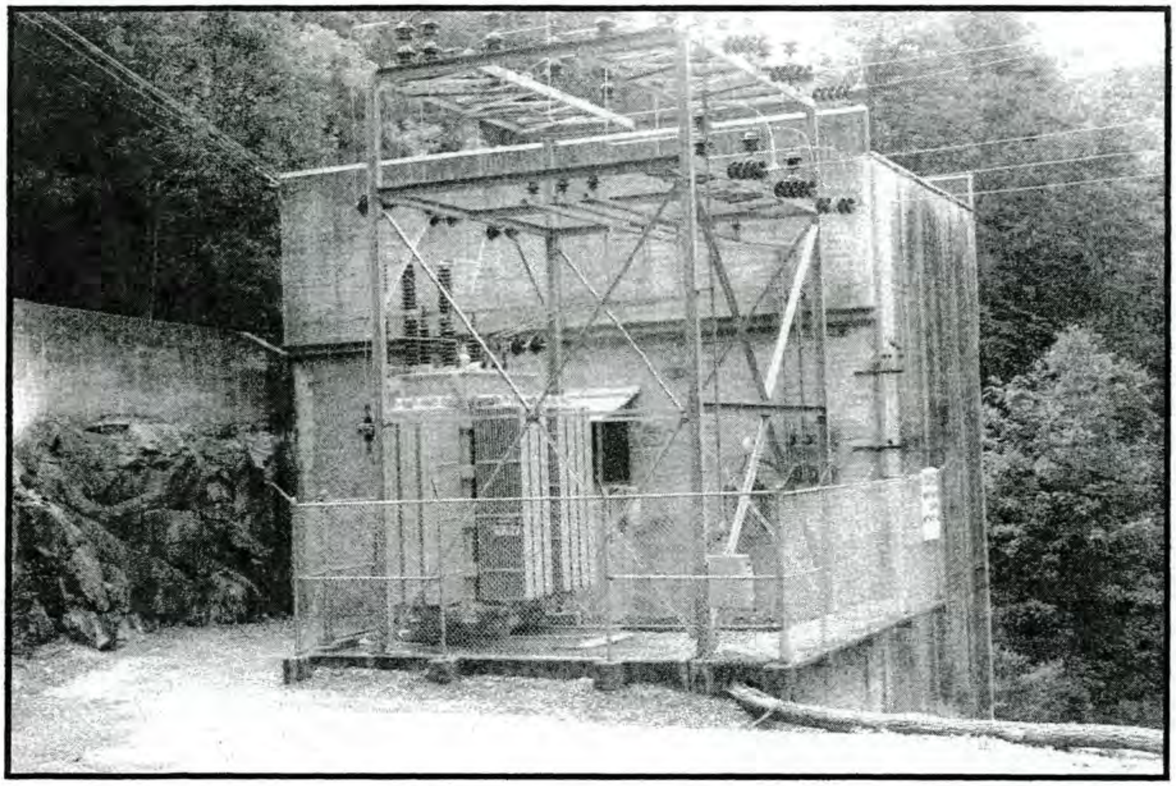


Figure No. 102. The Bear Creek Powerhouse, south and east facades.

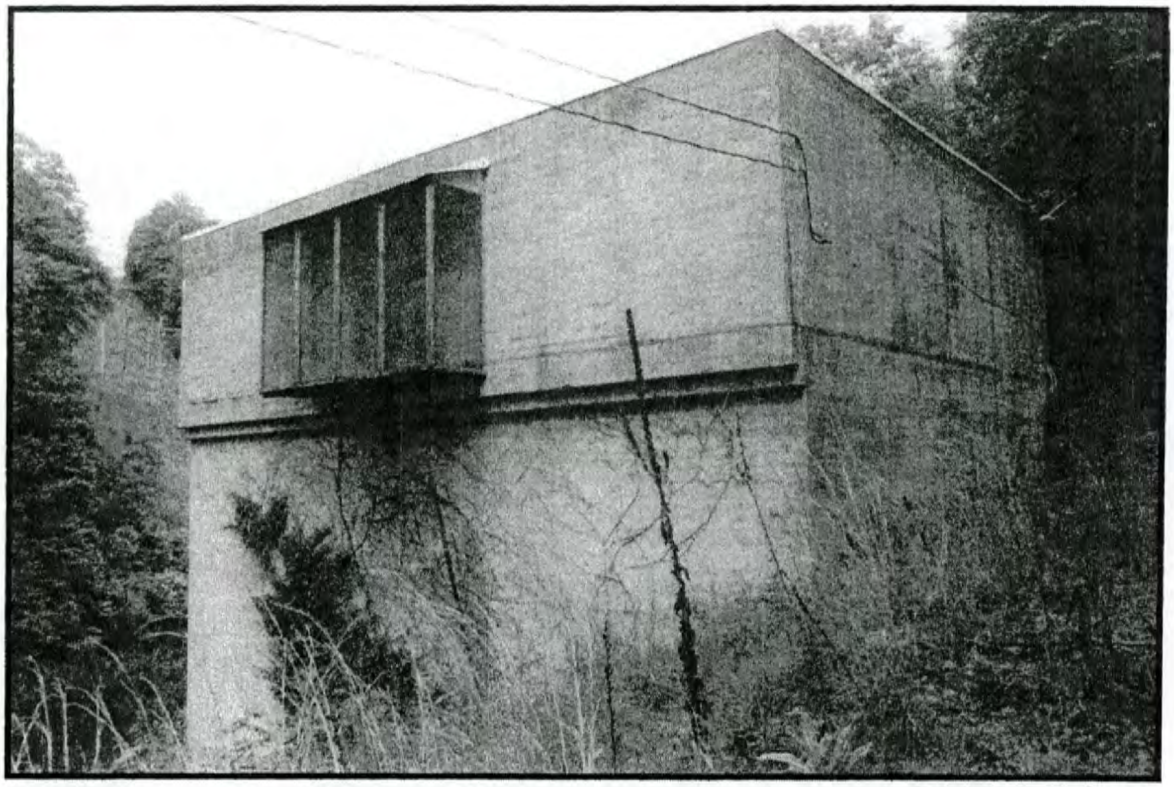


Figure No. 103. The Bear Creek Powerhouse, north and west facades.

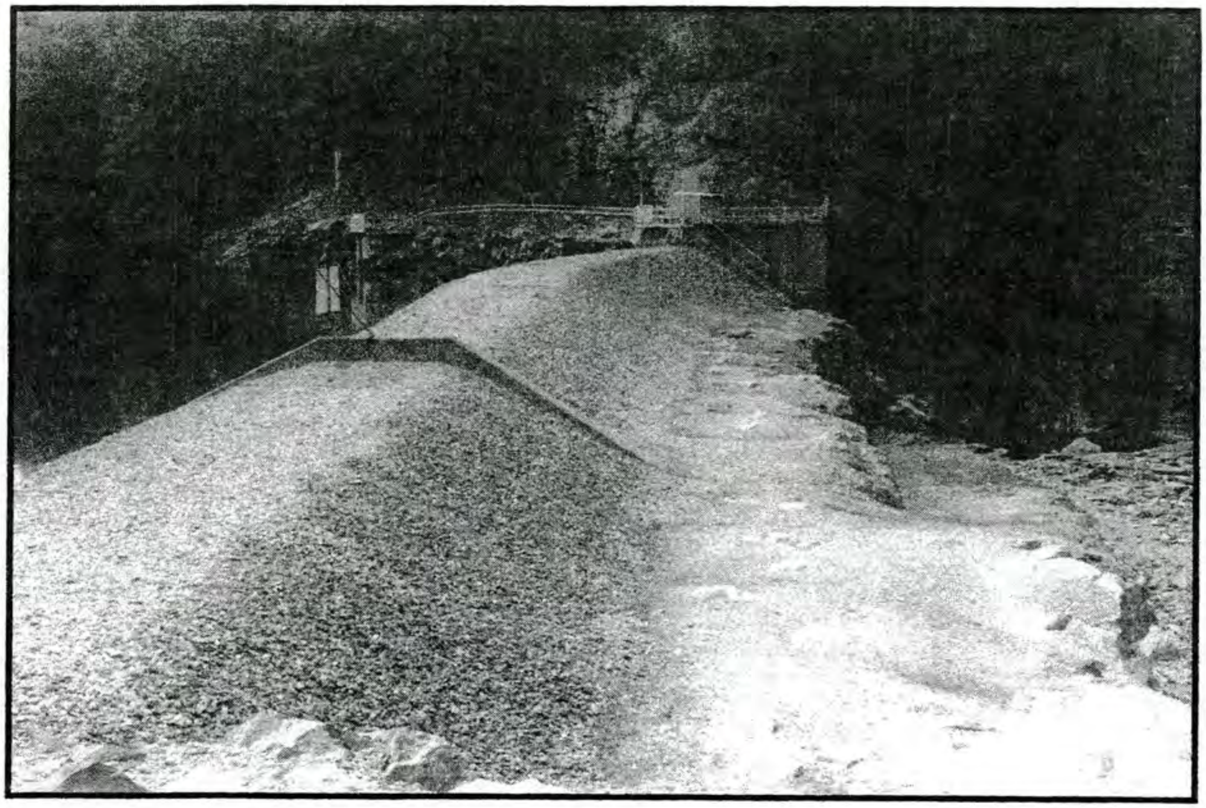


Figure No. 104. The Bear Creek Dam, view below dam.

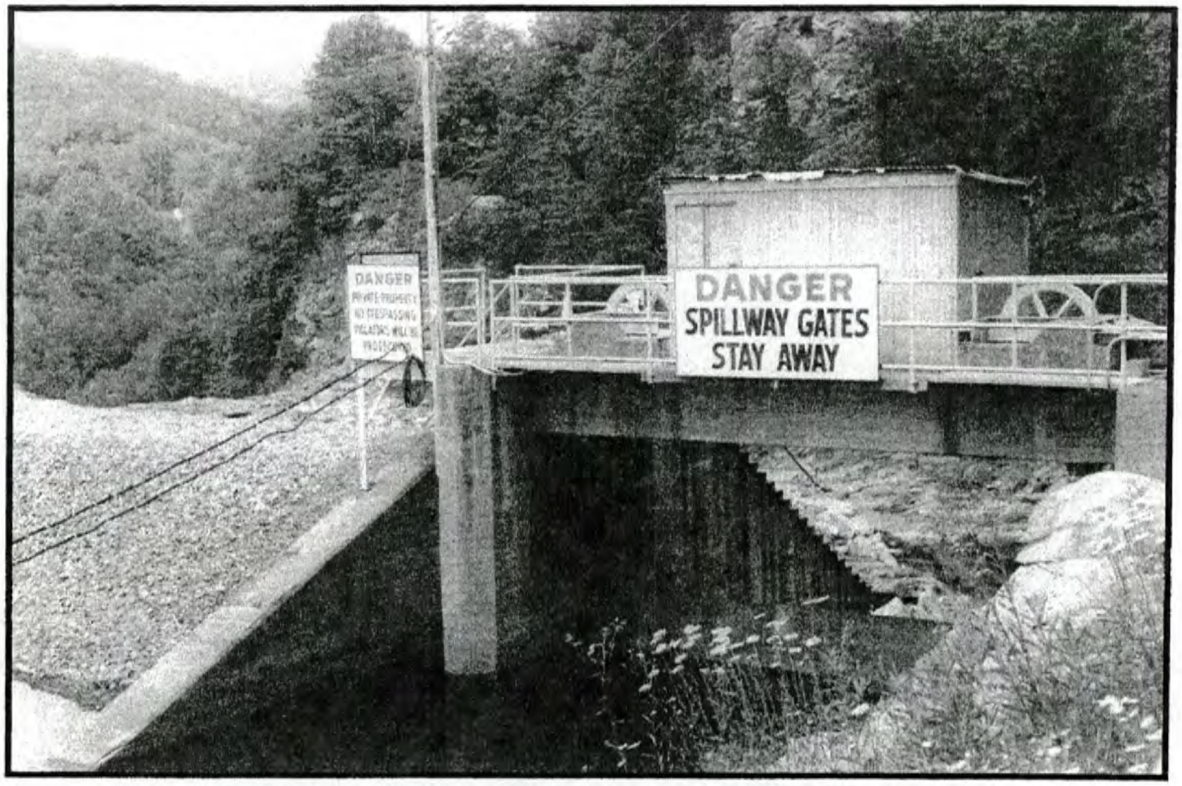


Figure No. 105. The Bear Creek Dam, view of spillway and tainter gate.

WOLF CREEK DAM SITE PLAN

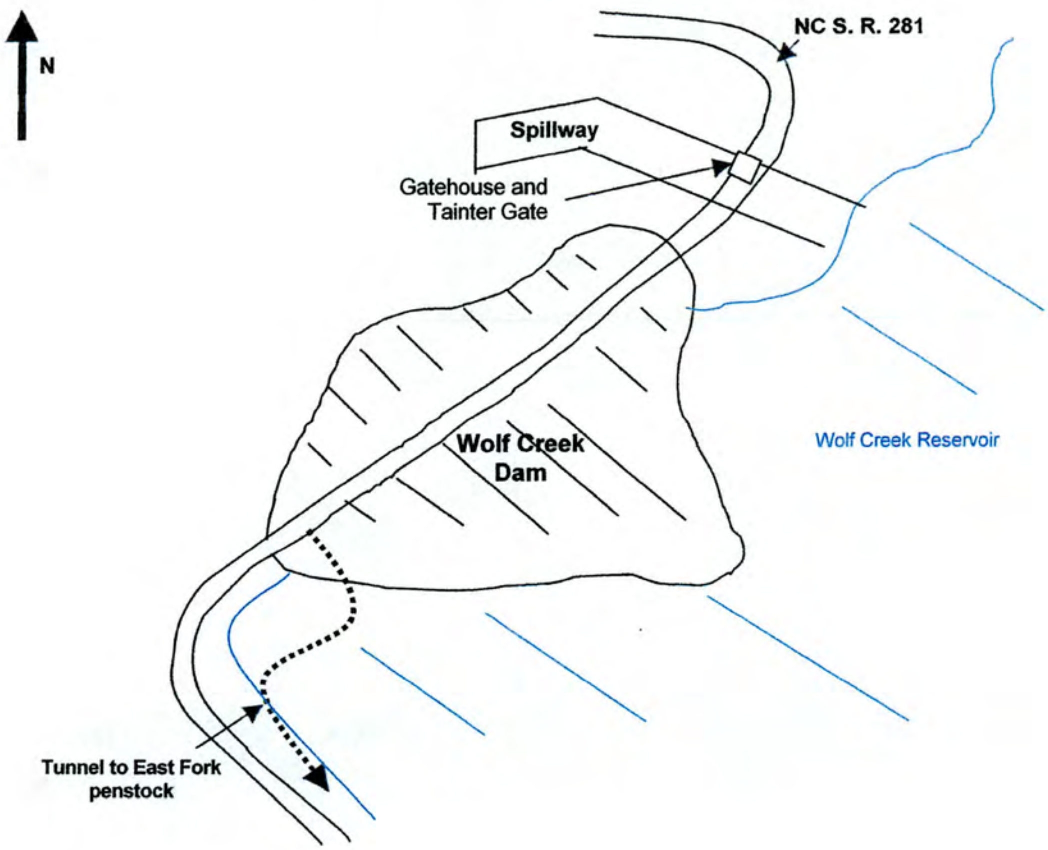


Figure No. 106. Wolf Creek Dam Site Plan.

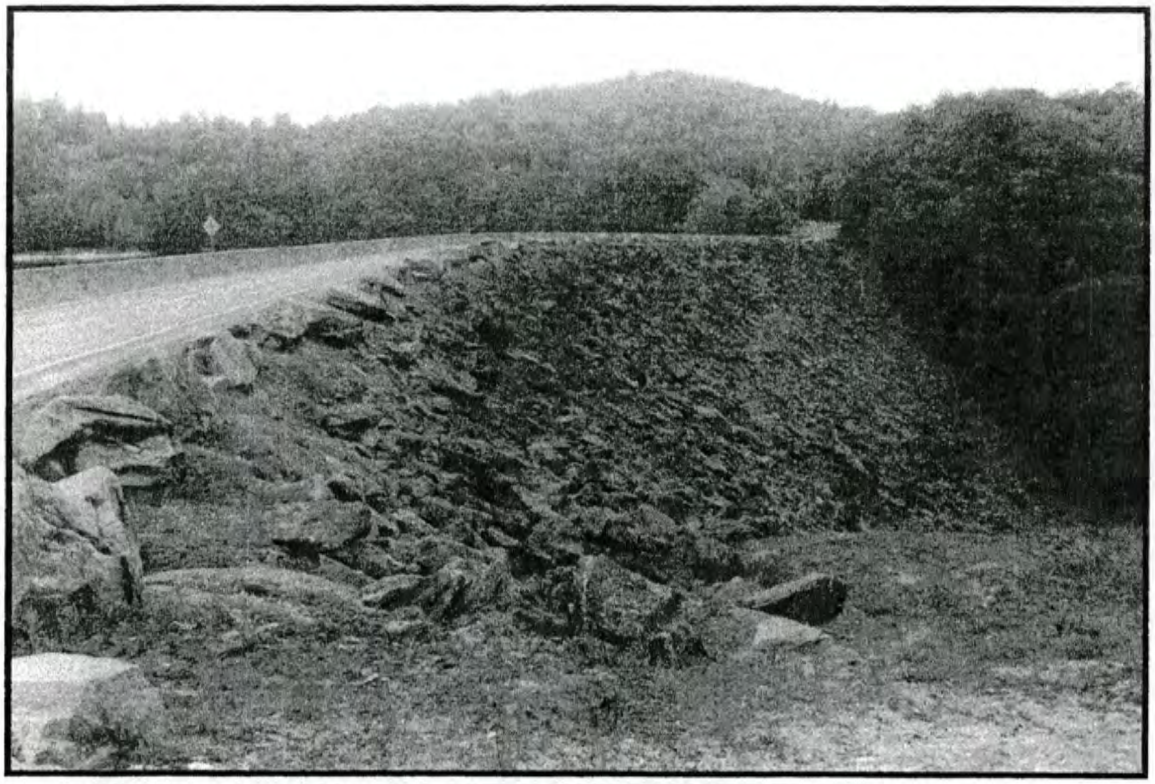


Figure No. 107. The Wolf Creek Dam, view above dam.

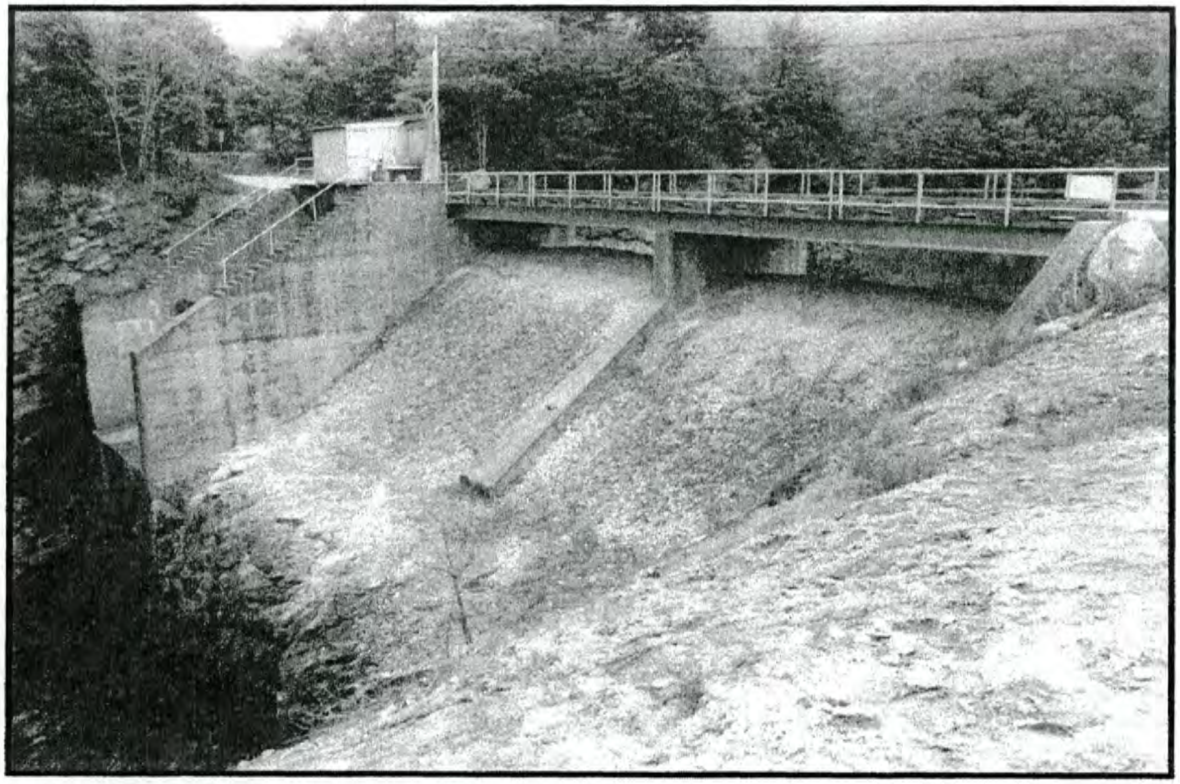


Figure No. 108. The Wolf Creek Dam, view of spillway below dam.

EAST FORK DAM AND POWERHOUSE SITE PLAN

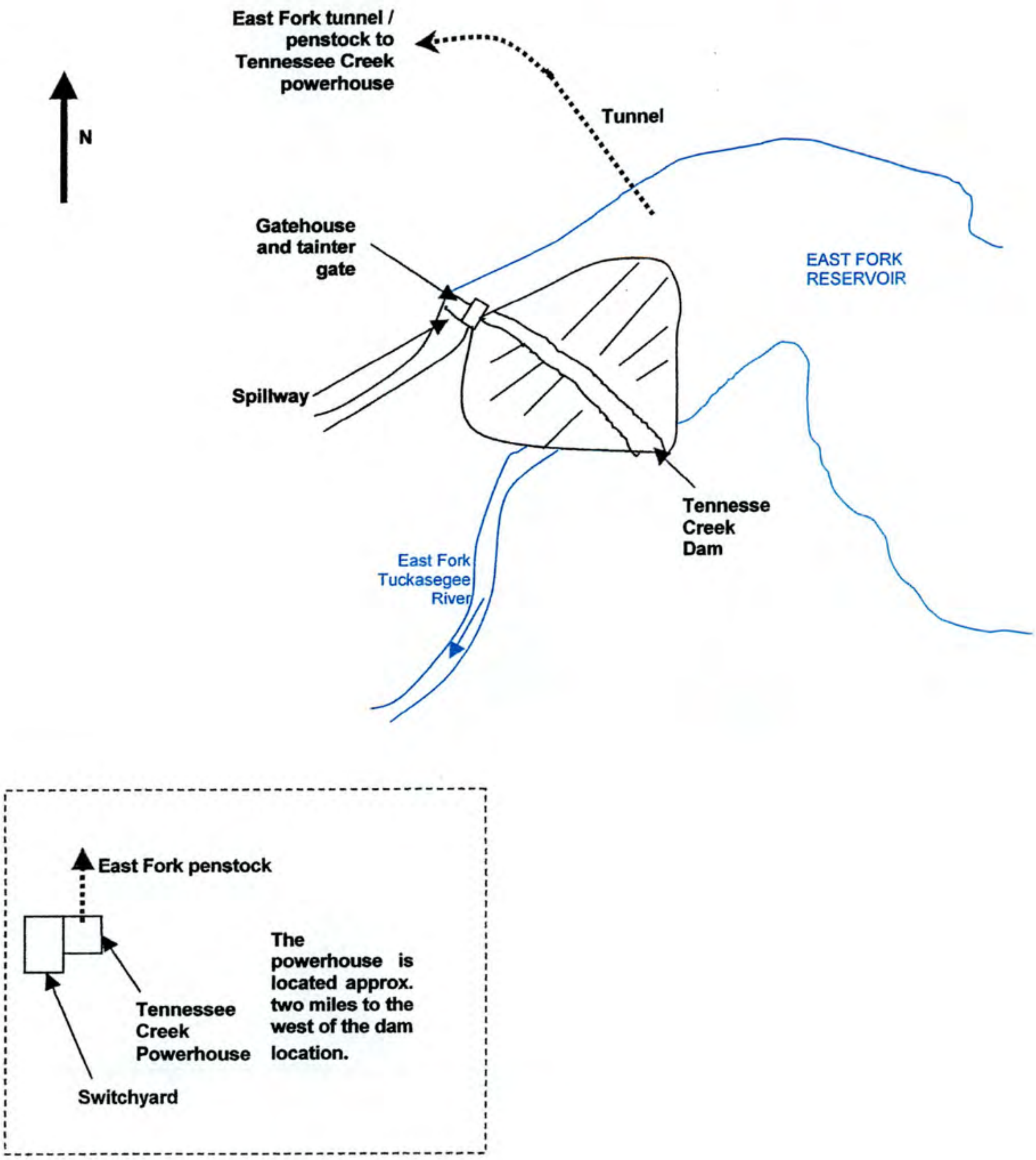


Figure No. 109. East Fork Dam and Tennessee Creek Powerhouse Site Plan.

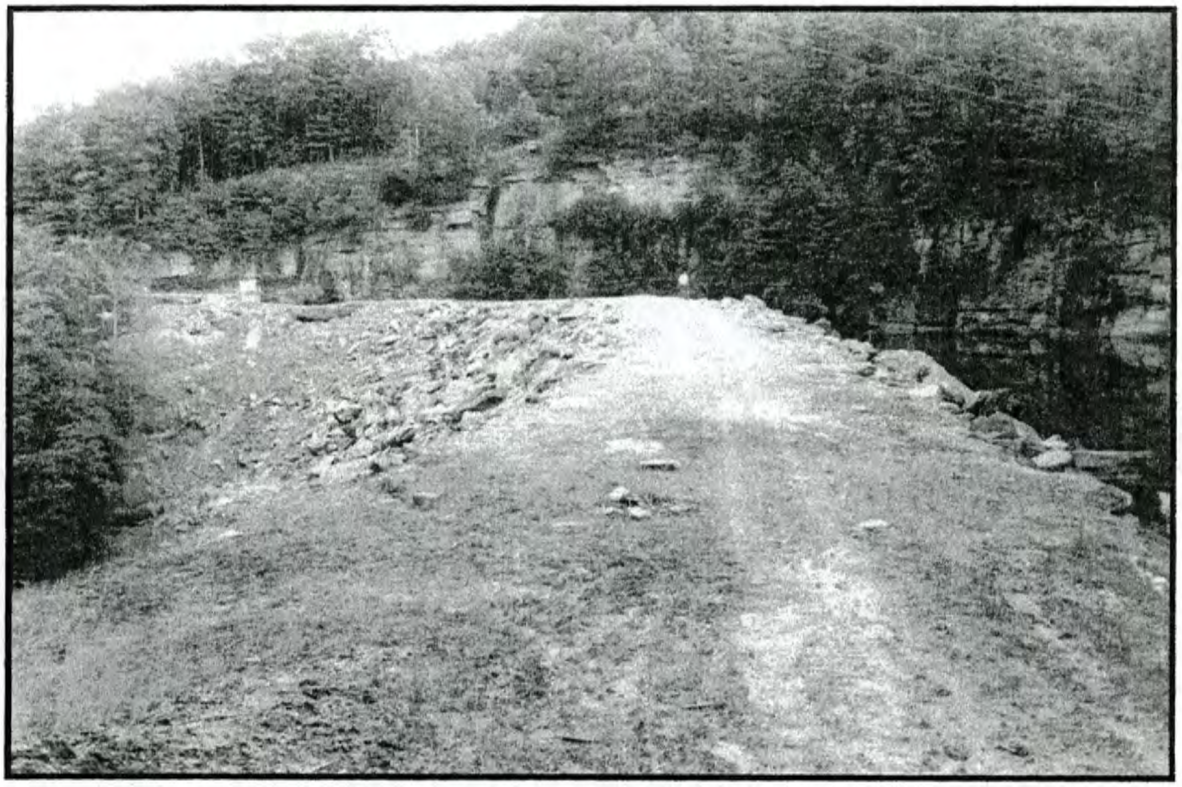


Figure No. 110. The East Fork Dam, view above dam.

Figure No. 111. The East Fork Dam, view of spillway and tainter gate.

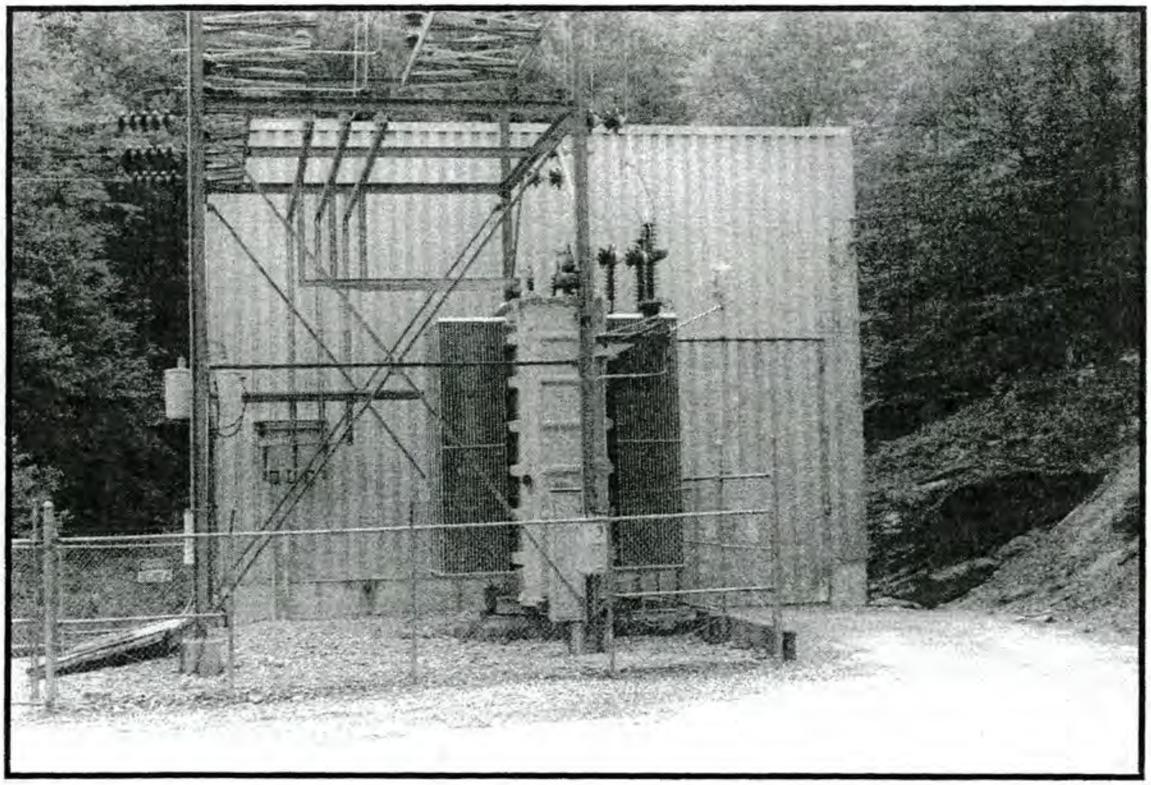


Figure No. 112. The East Fork Powerhouse, south facade.

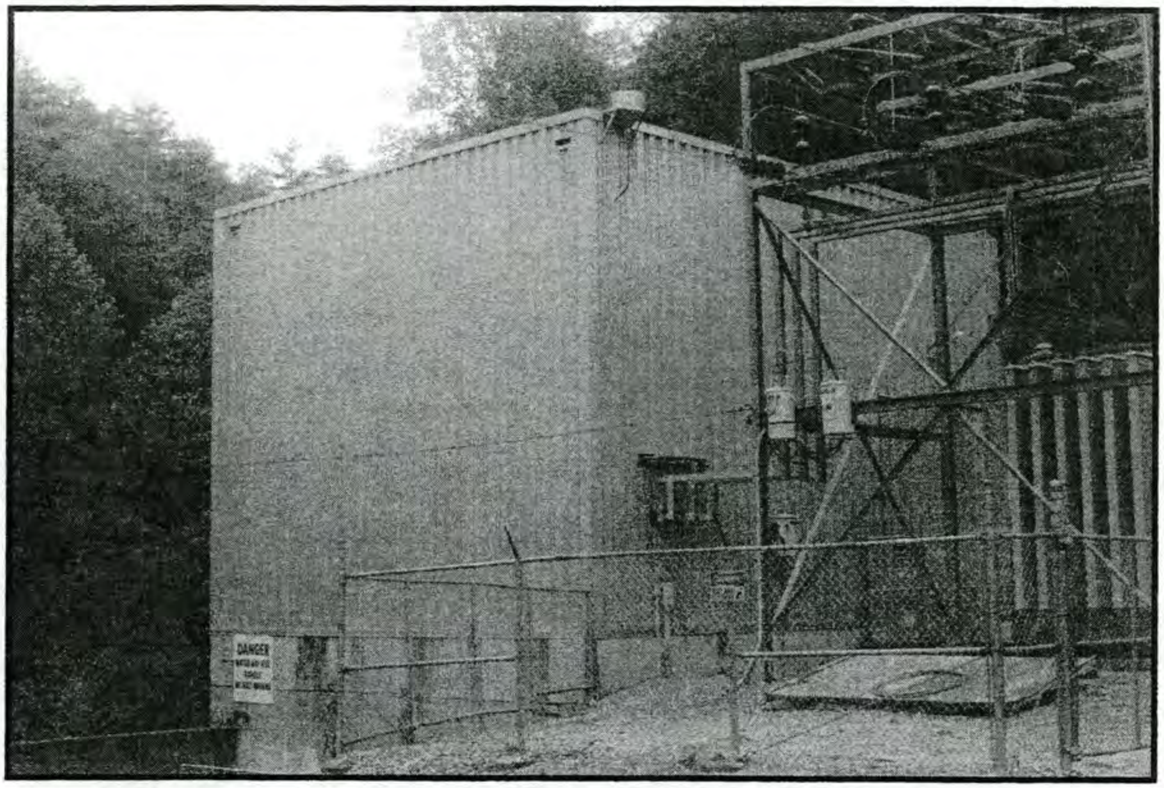


Figure No. 113. The East Fork Powerhouse, west facade.

VIII. SUMMARY

Duke Power, a Division of Duke Energy Corporation, is applicant for a new Federal Energy Regulatory Commission (FERC) license for seven hydroelectric facilities in western North Carolina. As part of the relicensing process, these properties were assessed in 2001 for their historical and architectural significance. This assessment was conducted in accordance with guidelines set forth by Section 106 of the National Historic Preservation Act (NHPA), and the NRHP.

In May and June of 2001, each hydroelectric facility was field inspected to determine its components, evaluate its architectural or engineering significance, and assess its degree of integrity. Extensive historical research was conducted on these hydroelectric facilities and the overall history of hydro-power in the state, at the archives of Duke Power in Franklin, North Carolina, and at the State Archives in Raleigh. As a result of these investigations and discussions with staff of the North Carolina State Historic Preservation Office, the Consultant has the following recommendations of NRHP eligibility:

- **The Dillsboro Hydroelectric Project (FERC No. 2602)**

  The Dillsboro Hydroelectric Project consists of a powerhouse and dam. The powerhouse was constructed in 1940 and the dam in 1927. The Dillsboro Hydroelectric Project has sufficient integrity to meet NRHP criterion A. Under criterion A, the plant is significant in the categories of Industry and Social History as part of the overall influence of electricity in the development of North Carolina communities and rural areas in the early 20th century. The Dillsboro plant was originally constructed to provide power to a local factory and commercial enterprises. By the mid-1950s, the plant supplied power to over 2,000 customers in the towns of Dillsboro, Sylva, and Webster. Electrical power supplied by the plant brought about significant social change to the western North Carolina region. The powerhouse was remodeled in 1958 with an exterior of corrugated metal steel panels. Also in 1958, the height of the dam was increased by two feet. The complex as a whole retains sufficient integrity to retain a sense of its historic time and place.

- **The Bryson Hydroelectric Project (FERC No. 2601)**

  The Bryson Hydroelectric Project consists of a powerhouse and dam. The Bryson Hydroelectric Project meets NRHP criterion A as part of the development of hydroelectric power in western North Carolina. Under criterion A, the plant is significant in the category of Social History as part of the overall influence of electricity in the region during the early 20^{th} century. Built in 1924, the plant was one of the earliest built in western North Carolina to bring electricity to a municipality. It served several hundred residents and businesses in the Bryson City area and contributed to changes in lifestyles of area resident through the introduction of electrical power. The powerhouse was designed with detailing typical of regional powerhouses of the period. It was modified in 1986 through the enclosure of the original window openings with wood and stucco panels. The existing dam was built in 1924, but in 1986 its original exterior surface was removed and a new surface of gunite was added. Despite these alterations, the plant's overall appearance as a hydroelectric facility is intact and it conveys a sense of time and place from its period of significance.

- **The Mission Hydroelectric Project (FERC No. 2619)**

  The Mission Hydroelectric Project consists of a powerhouse and dam built in 1924. The Mission Hydroelectric Project meets NRHP criteria A and C. Under criterion A, the powerhouse and dam are significant in the category of Social History as part of the overall influence of electricity in the military forces during the Cold War and the Korean Conflict. The four dams are of rock and earth fill, and their associated pipelines and tunnels are of designs and materials typical of the period. The three powerhouses are of concrete and steel.

Although evaluations of NRHP eligibility were applied only to these seven hydroelectric facilities, it is anticipated that the discussion of historic context, property types, and registration requirements, will contribute to future assessments of other hydroelectric facilities across the state.

development of North Carolina communities and rural areas in the early 20th century. The plant provided power to the Town of Andrews and by the late 1940s served over a thousand customers. The Mission Powerhouse is also significant under criterion C for its architectural design. The powerhouse is representative of the municipal and corporate designs for this type of industrial building in the region. The dam has been altered through the addition of gunite; however, the facility retains a strong degree of its historic appearance and character.

- **The Franklin Hydroelectric Project (FERC No. 2603)**

The Franklin Hydroelectric Project consists of a powerhouse and dam built in 1925. In 1994, the Franklin Powerhouse was deemed to be potentially eligible for the NRHP under criterion A and C. This assessment was made as part of a countywide survey of Macon County when it was placed on a Study List. The Consultant concurs in this assessment. The Franklin Powerhouse is significant under criterion A in the category of Social History. The plant contributed to changes in the lifestyles of area residents through the introduction of electrical power. One of the earliest hydroelectric plants in western North Carolina, the Franklin facility served several hundred customers soon after it began operation in 1925. The Franklin Powerhouse is also eligible under criterion C for its architectural design. The building has not been significantly altered and retains sufficient integrity to meet registration requirements for this property type.

The Franklin Dam was altered with the addition of a gunite surface ca. 1985. Despite this modification, the dam retains a sense of its historic sense of time and place. As an integral part of the Franklin Hydroelectric Project, the Franklin Dam contributed to its role in brining electrical power to the region and is eligible for the NRHP under criterion A.

- **The West Fork Hydroelectric Project (FERC No. 2686)**

The West Fork Hydroelectric Project consists of the Thorpe Powerhouse, Dam, and associated buildings and structures completed in 1942, and the Tuckasegee Dam and Powerhouse built in 1950. In 1994, the Thorpe Powerhouse and the adjacent worker's housing were deemed potentially eligible for the NRHP, and placed on the Study List following a survey of Macon County. These properties were considered eligible under criterion A and C for their historical and architectural significance. In addition, the Thorpe Dam Complex Historic District was determined eligible for the NRHP in 1999. This complex includes the dam and associated gatehouses. In the opinion of the Consultant, the Thorpe development has significance under criterion A in the category of Military, and under C in the category of Engineering and for the architectural significance of the powerhouse and adjacent worker's housing. The Thorpe development provided the necessary electricity to help power the Alcoa facility in Tennessee which made aluminum for aircraft.

The Thorpe Dam is significant in the category of Engineering for its overall design. This earth and rock dam was the first in the nation to utilize safety fuse plugs at its spillway entrance. The Thorpe Powerhouse is significant under criterion C as a notable example of an electrical powerhouse of its period. Designed with the influence of the Gothic Revival style, the building is similar to other powerhouses in the region. The water pipelines and tunnels connecting the powerhouse and dam also meet registration requirements for the NRHP. These structures are integral to the operation of the complex, and their construction enabled the plant to have such a high head and large electrical generating capacity. The steel pipeline and tunnels appear much as they did when they were built, and retain integrity of their historic design.

The Tuckasegee development meets the NRHP criterion A. Under criterion A, the Tuckasegee development is significant under the categories of Industry and Military. Built in 1950, the Tuckasegee facility contributed to the power supply of the Alcoa plant in Blount County, Tennessee. During the post World War II years, Alcoa was a major manufacturer in the region and a leader in the aluminum industry. The company played a major role in the growth and development of East Tennessee and contributed to US military efforts in the Korean Conflict and the Cold War through supplying a stockpile of aluminum for military aircraft manufacture.

- **The Nantahala Hydroelectric Project (FERC No. 2692)**

The Nantahala Hydroelectric Project consists of a powerhouse, dam, and associated buildings and structures built in 1942. Also part of the Project are three auxiliary dams. In 1994, the Nantahala Powerhouse and the adjacent worker's housing, located on property adjacent to the powerhouse property, were deemed potentially eligible for the NRHP, and placed on the Study List following a survey of Macon County. These properties were considered eligible under criterion A and C for their historical and architectural significance. The Nantahala Hydroelectric Project has significance under criterion A in the category of Military, and under criterion C for the architectural design of the powerhouse and adjacent worker's housing. This eligibility includes the Nantahala Dam and its associated buildings. The Nantahala Plant provided electricity to help power the Alcoa facility in Tennessee which made aluminum for aircraft. Under criterion A, the Nantahala Hydroelectric Project including the powerhouse, dam, tunnels, and pipelines would be eligible for the NRHP. The worker's housing, and ancillary buildings and structures associated with the facility would also be eligible for the NRHP.

The Nantahala Powerhouse and worker's housing is also eligible under criterion C. The powerhouse's design is illustrative of "streamlined" or "simplified" classicism which was widely used in the 1930s and 1940s for governmental and industrial buildings. The Nantahala worker's housing also retains sufficient integrity to meet registration requirements as an historic district for this property type.

The three auxiliary dams, White Oak Creek, Dicks Creek, and Diamond Valley, and their associated pipelines and tunnels, are also eligible for the NRHP under criterion A. These small dams were built in 1949, and were designed to provide additional power for the Alcoa plant in the years following World War II. Alcoa was the region's principal industry and played a major role in the growth and development of East Tennessee. The company also contributed to US military efforts in the Korean Conflict and the Cold War through supplying a stockpile of aluminum for military aircraft manufacture.

- **The East Fork Hydroelectric Project (FERC No. 2698)**

The East Fork Hydroelectric Project consists of four components: the Cedar Cliff Development completed in 1952; the Bear Creek Development built in 1953; the Wolf Creek Development completed in 1955, and; the Tennessee Creek Development also completed in 1955. The East Fork Hydroelectric Project is eligible for the NRHP under criterion A. Under criterion A, the East Fork Hydroelectric Project is significant under the category of Industry. The project was constructed to supplement the Thorpe Hydroelectric system and thereby provide additional power to the Alcoa plant in Blount County, Tennessee. During the post World War II years, Alcoa was a major manufacturer in the region and a leader in the aluminum industry. The company was also important for its contribution to the US supply of aluminum needed for military forces during the Cold War and the Korean Conflict. The four dams are of rock and earth fill, and their associated pipelines and tunnels are of designs and materials typical of the period. The three powerhouses are of concrete and steel.

Although evaluations of NRHP eligibility were applied only to these seven hydroelectric facilities, it is anticipated that the discussion of historic context, property types, and registration requirements, will contribute to future assessments of other hydroelectric facilities across the state.

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